War, Blockades, and Hunger: Nutritional Deprivation of German Children 1914 - 1924

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At the beginning of the First World War, the British imposed a blockade against Germany intending to prevent all imports from entering the country. Germans began to call the British naval action the *Hungerblockade*, claiming that it seriously damaged the well-being of women and children through lack of adequate nutrition. These German claims that Britain used hunger as a weapon of war against civilians have sometimes been dismissed as propaganda. However, newly discovered anthropometric measurements made of German school children during the war gives credence to German contentions that the blockade inflicted severe deprivation on children and other non-combatants. Further, these data show that the blockade exacerbated existing nutritional inequalities between children of different social classes; working class children suffered the most profound effects of nutritional deprivation during the war. Once the blockade ended however, working class children were the quickest to recover, regaining their pre-War standards in weight by 1921. They surpassed their own pre-War height standards by 1923, and approximated the weight of middle class children by 1924. This recovery of working class children is likely due to the outpouring of international aid targeted at poor German children. These data also indicate significant gender inequalities starting at age fourteen in nutritional status, with male adolescents suffering far greater deprivation from 1914-1924.

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At the advent of World War I, England quickly imposed a naval blockade against Germany. Before the War, Germany had imported 25% of all foodstuffs, in addition to needed chemical fertilizers for German crops. One of the greatest challenges Germany faced was a lack of food. When the imports stopped, hunger soon followed. Germans began to refer to the British naval action as the *Hungerblockade.* After the war, some German government officials claimed that the British blockade caused the direct starvation of hundreds of thousands of civilians.

> The *Blockade* imposed upon us the avowed purpose not only of cutting off supplies for the army, but of inflicting bodily and vital harm on Germany's civilian population, women, children, old people and all those unfit for military service…It is today possible to give our enemies a receipt for the grand total. 763,000 persons belonging to the civilian population has in Germany succumbed to the effects of the hunger-blockade.[2]

In the 1940s, the plight of German children during the *Hungerblockade* was seized upon by the National Socialists for propaganda purposes to justify their military assault on their old enemies. German military excesses could be excused, they claimed, since the British had already demonstrated their inhumanity by using hunger as a weapon against German women and children.[3]

British apologists responded that the reports of starvation inflicted by the World War I blockade were exaggerated[4]. More recently some revisionists have claimed that the physical well-being of Germans was not greatly impacted by the blockade during the

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[2] Taken from the "Frankfurter Zeitung" January 19th, 1919. As quoted in Rubmann's *Hunger!* p. 50.
[3] Schaeffer, *Krieg Gegen Frauen und Kinder*.
[4] For an early example see Menn, *Armistice and Germany's Food Supply Study;* for a more recent criticism see Offer, *The First World War.*

First World War. "Was Germany starved into defeat? The idea is one of the most tenacious in modern European historiography. Yet, it is almost certainly wrong."[5]

These debates about the effects of the blockade on German civilians have intermittently continued for nearly a century. At its core, the debate revolves around metrics. Statistics published by Germans after the war were deemed suspect. Critics claimed they were exaggerated. There has not even been agreement on civilian death tolls during the blockade.[6]

Qualitative data are equivocal. Personal diaries and newspaper articles chronicling war-time hunger can be dismissed as merely anecdotal and unrepresentative of the common German experience. At the advent of hostilities, diaries were typically kept by the elites of society, and not by normal citizens.[7] While such ethnographic evidence should not be rejected out of hand, the inherent subjectivity of these accounts is difficult to overcome. The jury remains out on this vitally important question: did the British blockade of Germany result in nutritional deprivation of German children?

One way of approaching the question of the adequacy of diet is to examine human growth. Fortunately, a newly discovered data source that includes approximately 600,000 anthropometric observations of school children across Germany between 1914-1924 has recently come to light. Analysis of the weight and height of German children shows that significant nutritional deprivation occurred during and after the British blockade. Furthermore, the data demonstrate that nutritional deprivation varied significantly by

[5] Ferguson, *The Pity of War*. p. 276.
[6] Menn, *Armistice and Germany's Food Supply*.
[7] The most widely published diary written in Germany during the First World War is by Princess Blücher, *An English Wife in Berlin.* Her account, while extraordinary, was written while living in the grand Esplanade Hotel, and should not be seen as typical.

year, by social class, by age, and by gender. Combined with other studies of smaller anthropometric data sets[8] these new data provide evidence that the blockade had a profoundly negative impact upon the physical wellbeing of children throughout Germany. Yet, these data also document a recovery in heights and weights for children belonging to the lowest socioeconomic classes once the blockade was lifted. This suggests that humanitarian international responses to relieve poor hungry German children by British and American citizens after the First World War—representing perhaps the first major international civilian aid programs—were in fact successful.

Figure 1. Photograph of Kindergärten children in Munich, taken in 1918.[9]

NUTRITIONAL STATUS OF GERMAN CHILDREN BEFORE WORLD WAR I

German children at the turn of the twentieth century were shorter than children are today. (See Figure 2.) Biologists note that in general, human populations have increased in stature over time. This "secular trend" as it is called, has not been constant.

[8] See Wall, "English and German Families in the First World War"; Blum, "Government decisions before and during the First World War".
[9] Collected from the Landeshauptstadt München Stadtarchiv.

Human height has vacillated over time as living standards have changed.[10] Although over the panorama of human evolution there may have been selection, particularly in males, for increased height, within the last hundred years genetic influences have been eclipsed by environmental determinants, particularly nutritional status and living standards. Differences in height between modern children and German children prior to the advent of World War I can be shown graphically:

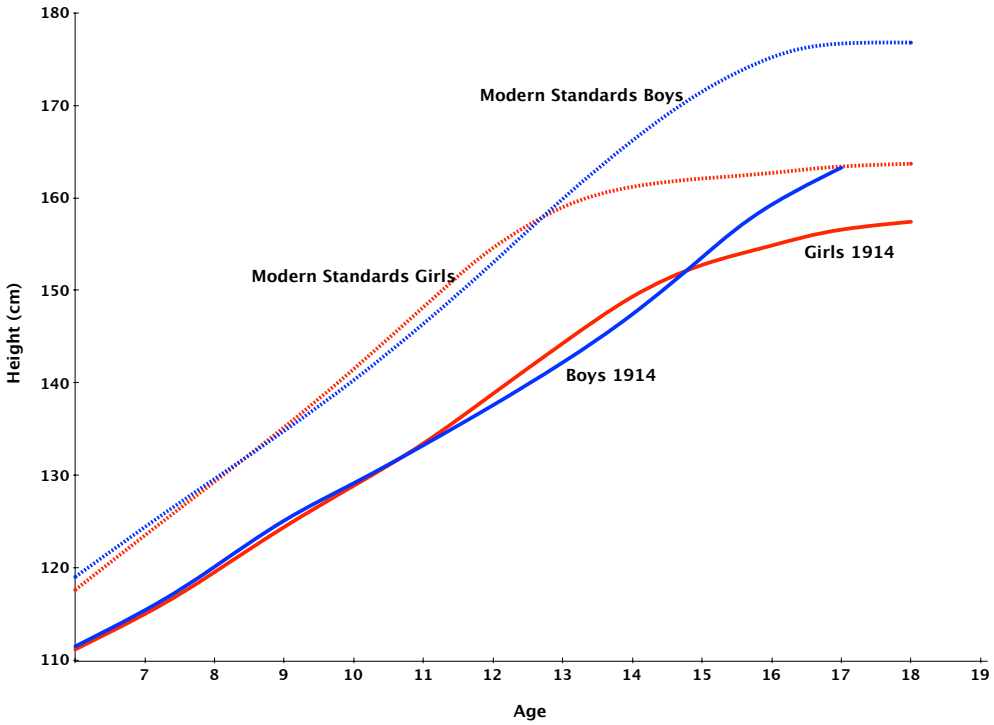

Figure 2. Heights of Boys and Girls from 1914 Compared to Modern Standards[11]

Therefore, merely showing that differences exist in height or weight between modern populations of children and German children during the war is insufficient to demonstrate nutritional deprivation induced by the blockade. Instead, what is needed is a

[10] Sweden, Britain, and Hungary, for example, all experienced decades of decreased heights in the 19th century. See *The Cambridge Encyclopedia of Human Growth and Development*. p. 393.

[11] German standards for 1914 collected by author. Modern standards taken from Steckel, "Percentiles of Modern Height Standards".

study to show what happened to children during the war relative to their pre-War standards.

REDISCOVERING A GERMAN DATA SOURCE BASED ON ANTHROPOMETRIC MEASUREMENTS

Germany became a unified country on 9 November 1871, and in 1872, less than a year later, the *Kaiserliches Statistisches Amt*, or Imperial Statistical Office, was established. Soon, annual and monthly national statistics were compiled in large tomes.[12] By the turn of the century many statistics were routinely gathered in Germany, including anthropometric measurements.

> Anthropology constituted a type of national cultural anatomy. University professors of anatomy offered courses in anthropology as a free-lance activity. The public was gripped by a fever of measuring, mapping and digging in the cause of science and national identity. Anthropology was a public and participatory field of study.[13]

Anthropometric measurements of children were initiated during this general enthusiasm for statistics. Usually local doctors, who were often assigned to more than one school, took and recorded the anthropometric measurements. A British educator sent to study German elementary level schools commented in 1906 on the skill and professionalism of German doctors visiting schools to administer vaccinations and take measurements.[14] If a doctor was not available then the main teacher could take anthropometric measurements after having been trained.

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[12] See Tooze, *Statistics and the German State.*
[13] Weindling, *Health, race and German politics*, p. 54.
[14] Mackenzie, *Health of the School Child*.

Though anthropometric measurements of German children were common, the results were not analysed or published in the national statistics volumes and have thus been an untapped source in the debate about the *Hungerblockade*. Indeed the anthropometric data used in the current study remained unknown and unanalysed for nearly a century. Since the data source was first compiled, it has not been used as a means of measuring children's wellbeing in Germany during and immediately after the War. Furthermore, though the original compilers seem to have noticed patterns and been aware of some of the changes that occurred in the heights of German children during the war, econometric and statistical tools developed since that time allow for a far more robust analysis than would have been possible when the data were originally assembled.

These German height and weight data are taken from a rediscovered source that I found during my search of German archives and libraries. Measurements of individuals were made by doctors, or teachers, between 1914 and 1924 (1915 missing), with weights and heights collected on a yearly basis for boys and girls aged six to twenty in different types of school. The book records the summary statistics in detail. Every row of data in the study includes the average height and weight for children of a specified gender, age, school type, and location. It also includes the class size. Some records even include standard deviations. There are 2,426 of these averaged rows, and in all, the sample sizes for each row of observations correspond to 590,088 observations of individual children during the war. Most major German states are reflected in the data set.

At the time these measurements were taken, German society was strictly hierarchal. This social stratification impacted the lives of children in multiple ways, including the type of school they attended. Affluent parents could afford to send their

children to *Höheren Schulen* or "higher" schools, while working class parents would instead send their children to *Volksschulen* or "peoples' schools" and then later, if the child showed sufficient interest, to a trade school or *Fachhochschule*. Terms such as *Höheren Schulen* and *Volksschulen* are still in use in German schooling today, but their meanings have shifted over the last century. *Volksschulen* in early twentieth century Germany could include children up to age 18. Today, *Volksschulen* only include elementary aged school children. Likewise, *Höheren Schulen* in early twentieth century Germany included children from ages 8 – 20, rather than from age 15-19 like they do today. To simplify, and better represent the classes as a whole, my analysis uses contemporary sources to divide the original ten types of schools represented in the data into just three classes: upper, middle, and working class. [15]

In the data set 350,695 observations represent the working class, 142,625 the upper class, and 82,134 the middle class. The remaining 14,634 observations represent data based on more than one school and were not used in my analysis to determine socioeconomic class. By far most of the data are for children of working class parents.

As various school doctors or teachers in different parts of Germany collected statistics, some measurements vary in terms of their detail. For example, the majority of children's ages in the data were presented by year. However, some school doctors from different cities chose to give more precision to children's ages, in some instances recording age by half and even quarter years with a single cohort consisting of all 6 year-olds being designated as 6.5 or 6.25 years old. Another unusual feature of these data is

[15] School definitions were taken from *Brockhaus' Konversations-lexikon* and *Der Große Brockhaus Handbuch des Wissen*.

that children's ages were sometimes represented as a range rather than as a single chronological age, such as 6 – 7, 7 – 8, etc. For analysis, I represented all such age ranges as a cohort based on the lower integer.

The data were carefully collected and precise. Most students were measured to the closest millimeter, but some were measured to the half-centimeter. Weight measurements were similar, with most, but not all, results given to the nearest gram.

ANTHROPOMETRIC ANALYSIS EVIDENCES NUTRITIONAL DEPRIVATION OF GERMAN CHILDREN

I regressed measures of child health, such as height, on indicators for sex, year of measurement, age, social class, interactions of social class with sex, and interactions of social class with year. I clustered standard errors by school type.

$$y_i = \alpha_m male_i + \sum_{s=1}^{9} \beta_s \, (state_i = s) + \sum_{y=1916}^{1924} \gamma_y \, (year_i = y) + \sum_{a=6}^{19} \delta_a \, (age_i = a) + \sum_{c=1}^{2} \theta_c \, (socialclass_i = c) + \sum_{a=6}^{19} \zeta_a \, (age_i = a) \times male_i + \sum_{c=1}^{2} \sum_{y=1916}^{1924} \eta_{c,y} \, (socialclass_i = c) \times (year_i = y) + \epsilon_i$$

y_i is a measure of child health such as height (cm),weight (kg), height-for-age z-sores (HAZ) and weight-for-age z-scores (WAZ). Results are shown in the appendix in Tables 1-4.

Figure 1 shows the partial regression coefficients for boys controlling for social class, age, and location. Heights of German children were significantly reduced during the First World War. Compared with 1914, before any impacts of the war or blockade

could have occurred, children were significantly shorter from 1917 through 1922. See Table 1. This pattern of reduced height continued each year through 1922, well after the war had ended. The mean stature of children was most diminished in 1918, with overall stature being 1.8 cm less than it had been in 1914. These results in height for children correspond to a time lag of at least a year between acute nutritional deprivation and stunted height. Further, height diminishment is cumulative: children stunted one year will begin the next year shorter. Thus the 1920 mean height, for example, reflects not only the inadequate nutritional resources for the previous year, but also reflects accumulated nutritional deprivation. When the body receives few calories, it allocates those calories to maintain bodily organs rather than to accelerate growth in stature. This is clearly the case in children in Germany during the years 1917, 1918, 1919, 1920, 1921, and 1922. Surprisingly, children were significantly taller in 1923 and 1924 than they had been in 1914. By 1923 and 1924 there was rapid and significant growth (Figure 3).

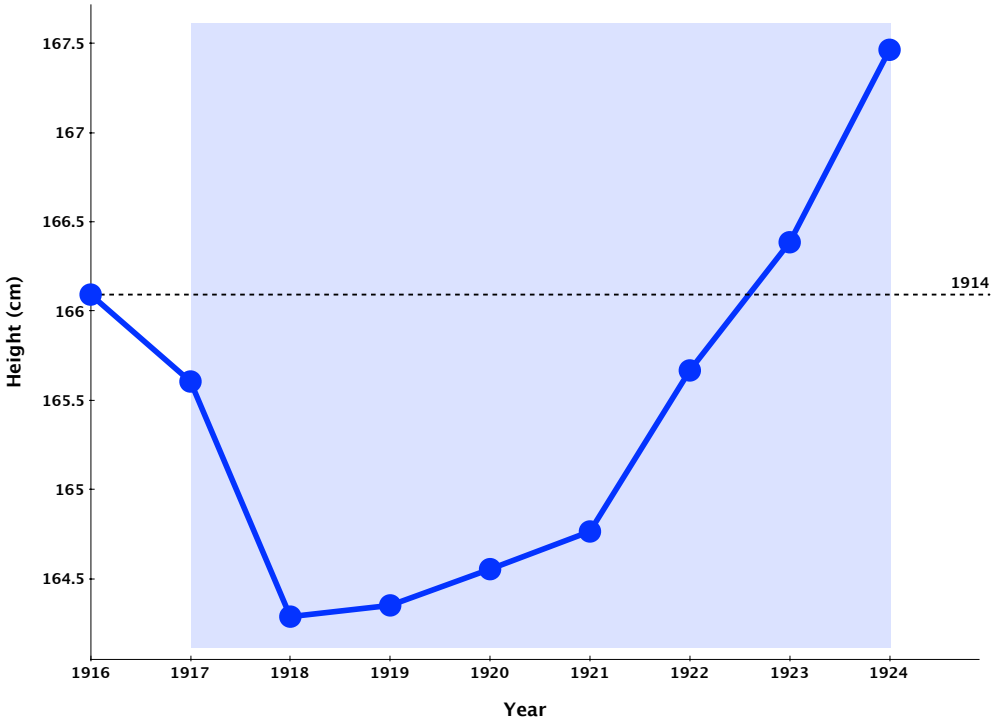

Figure 3. Change in male heights (partial regression coefficients). Years of statistical significance are shaded in blue.

At its lowest point in 1918, overall height loss for German boys from 1914 was 1.804 cm. And at its highest point in 1924, height gain relative to 1914 was equal to 1.37 cm. These differences are even greater when differences such as social class or gender are taken into account.

Weights of children reveal a similar pattern. Table 2 shows OLS estimates of child weight, which is a more immediate measure of nutritional status than height. In the absence of adequate nutrition, a child first slows in weight gain, and finally, if deprivation is intense enough, stature is also affected. German children suffered the greatest amount of weight loss in 1919; children weighed .570 kilograms less in 1919 than they did in 1914.

POST WAR NUTRITIONAL STATUS OF CHILDREN: A TIME OF PLENTY?

In the years 1922, 1923 and 1924 German children exhibited significant weight *gain*, with .017 kg in 1922, .654 kg for 1923 and 2.898 kg for 1924. The regression of weight on years of measurement, controlling for sex, age, location, social class, and interactions of social class with year, shows 1922 as statistically significant with a small positive value. With the regression of height, children's average weight change for 1922 was small and negative. Weight should anticipate height. Weight is more elastic, and more closely reflects recent nutritional exposures than height does. A child cannot diminish in height from one year to the next, but they can lose weight. When the blockade was lifted in 1919 and foreign imports resumed, calories became available allowing stunted children to increase in weight before they increased in stature. Still, for

children to surpass their pre-War weights and heights so significantly and so quickly in a time of major changes in the government and German economy implies that living conditions for children immediately following World War I were better than they had been before the war. Foreign aid targeted at children that was sent to Germany after the War may explain this, a hypothesis that will be explored in more depth later.

SOCIOECONOMIC INEQUALITY BEFORE, DURING, AND AFTER THE WAR

My analysis shows that heights differed in German children relative to their socioeconomic background before the First World War. At the start of the War, wealthier children were taller than middle and working class children. For example, heights of ten to ten and a half years old children from Stuttgart show significant differences between social classes. Children who attended upper class schools were initially taller than children from working class backgrounds, who in turn were taller than children who attended working class schools. The initial height differences between children of different socioeconomic backgrounds in 1914 are not surprising. However, as Figure 4 and Figure 5 show, children who attended working-class schools in Stuttgart not only started out much shorter than their higher class peers in other schools, they also exhibited the greatest decreases in stature between 1918-1919, a trend symptomatic of significant nutritional deprivation.

It is interesting to note that the red lines, representing children who attended middle class schools, follow a different trajectory than the lines for either upper or working class children. In Figure 4, female stature for the middle class children improved

from 1916 through 1917, while it remained constant for both upper and working class children at the same time. Figure 5 shows that middle class boys on average lost a cm in height between 1916-1917, however both upper and working class children lost an average of two cm that same year.

Figure 4 shows that after the initial decrease in height for ten to ten and a half year-old girls of all socioeconomic backgrounds that occurred between 1914-1916, working class girls continue to decrease in heights while middle and upper class girls saw no change. Heights of working class girls also recovered first, one year ahead of either the middle or upper classes. Observe that while middle class girls from Stuttgart on average eventually reached their initial pre-War heights by 1924, girls from the upper and middle classes both were both one cm shorter than they were in the pre-War period.

In Figure 5 for males of the same age there was an initial improvement in heights for all social classes between 1914-1916. From 1916 to 1917, average heights for both upper and middle class children dropped back down to what they were before the First World War. The mean heights of working class boys from 1916-1917 dropped down 1 cm lower than their average before the War. From 1917-1918 heights of working class boys continued to decrease, while middle and upper class boys maintained consistent height until 1919. Similar to working class girls, working class boys were the first to show a steady recovery starting from 1920. In 1922 ten to ten and a half year-old boys had the same average height as boys of the same class and age did before the War. And by 1923 they surpassed their pre-War heights. Middle class boys in 1922 also had the same height as middle class boys in 1914. They too had an average height improvement of 1 cm compared to their pre-War 1914 standards. Like the working and middle class

boys, upper class boys in Stuttgart were the same height as those measured pre-War by 1922. However, unlike the working and middle class boys, they were not any taller then they were pre-War by 1923 or 1924. The extremely large sample size rules out the possibility of a bias.[16]

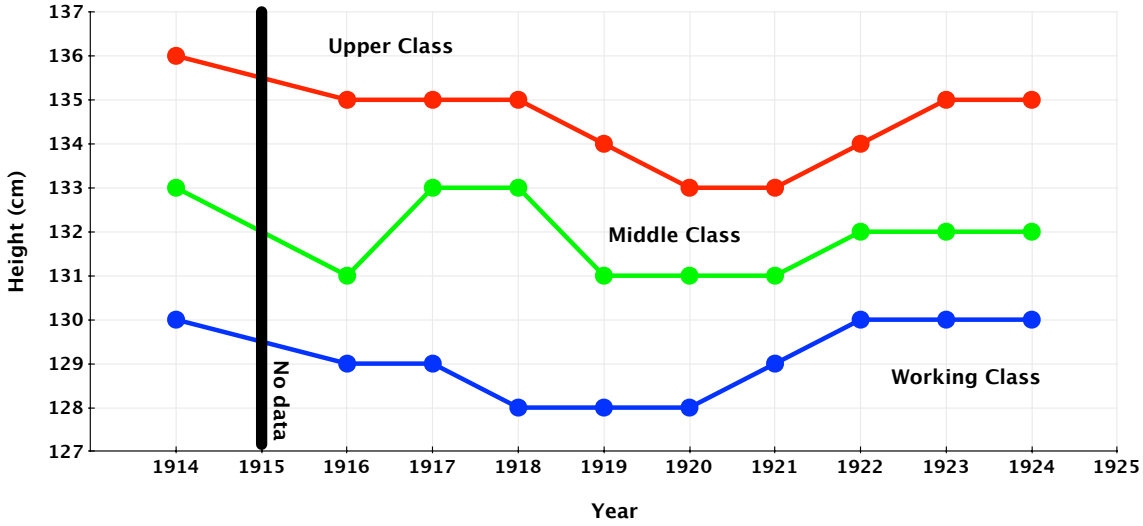

Figure 4. Heights of 10 – 10.5 year-old girls from Stuttgart, 1914 – 1924. Raw data.

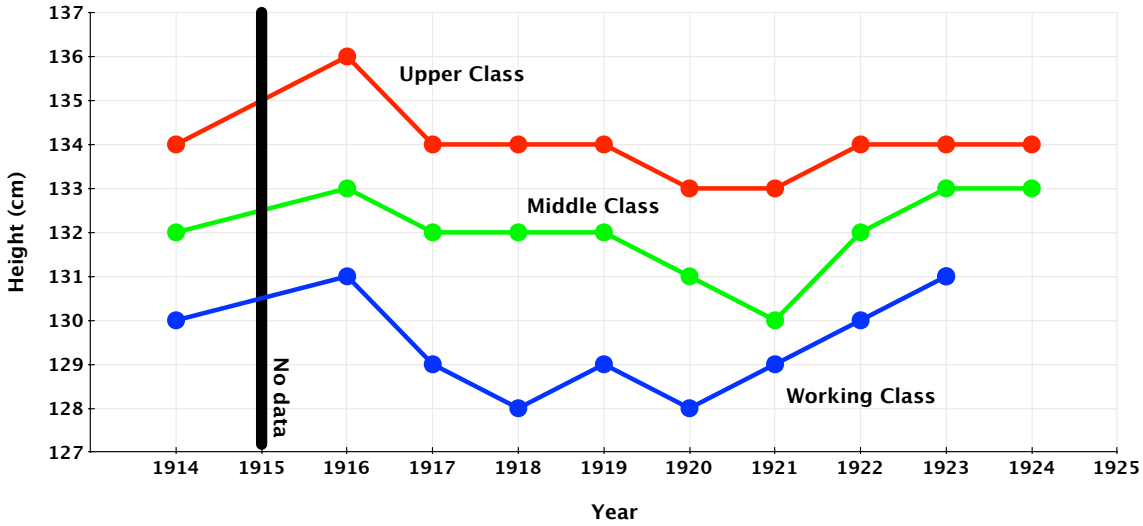

Figure 5. Heights of 10 – 10.5 year-old boys from Stuttgart, 1914 – 1924. Raw data.

[16] Working class girls in Figure 4 had a sample size range between 574-858 for each year. Middle class girls had a sample size range of 245-357. The sample size of upper class girls from the period ranged from 211–386. Sample sizes for working class boys in Figure 5 ranged from 459-703 for each year of observation. Middle class boys ranged from 204-339 in sample size. Upper class boys ranged from 183–462 in sample size.

I also regressed child height on social class. Middle class children were on average 2.63 cm taller than working class children and 1.325 kg heavier. Upper class children were 5.089 cm taller and 3.02 kg heavier than working class children. Please refer to Figure 6, which is drawn from regression results taken in Table 1.

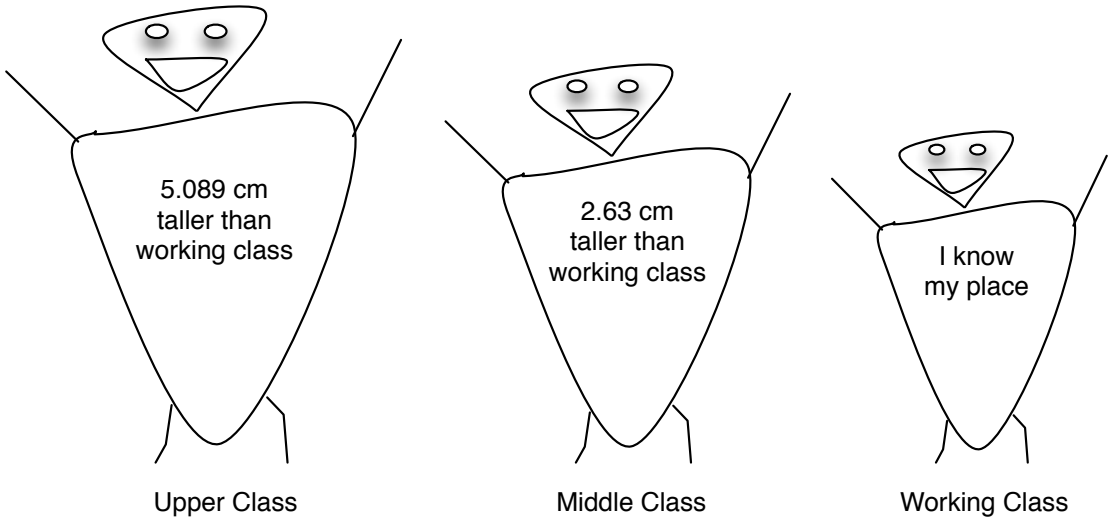

Figure 6. Level of deprivation varied significantly by class.

In order to better understand the different effects of the blockade on children of both sexes and at different ages, these data have also been normalized since humans do not grow at a constant rate from birth till maturity. Growth patterns of boys and girls are slightly different with girls tending to reach their pubescent growth spurt several years earlier than boys. Further, in general, boys overall attain greater height than girls. Thus, the raw comparison of strict heights and weights in cm and kg without consideration of the contributions of age and sex to the results can be misleading. Instead, development economists and policy-makers looking at child and infant inequalities use Height-for-Age z-scores (HAZ) and Weight-for-Age z-scores (WAZ) as part of their analysis. By

measuring the average distance from the median height or median weight of a reference population, children of different ages and different sexes can be fairly compared.[17]

The standard equation for calculating a z-score is:

$$z - score\ \left(\frac{H}{A}\right) = (h_i - \ h_{mp})/\sigma$$

h_i = height of individual,
h_{mp} = median height of child from reference population with same age and gender as h_i
σ = the standard deviation of the reference population.

Data on German children from 1914-1924 are school class data. Therefore, when HAZ and WAZ scores are computed, h_i no longer represents an individual of specified age and sex, but rather the mean of a group of individuals that share the same age, sex, school type, and location. This change matters more than might be immediately apparent because the range is affected and variance is reduced. Children who were particularly small or large were averaged-in with the other children from their school. Instead of getting the true deviation of individual heights and weights, it is possible only to compute the deviation of entire classes from the population mean. If we knew the distribution for each row of data this problem could be addressed, however those distributions are not available and cannot be inferred from the pooled data.

The resultant compression of range and variance presents two challenges. The first is that data from pooled classrooms, not individuals, results in an underestimation of the true percentage of children who experienced deprivation. The second is that because

[17] O'Donnell, "Analyzing Health Equity."

nutritional deprivation of individual children is underestimated, accurate classification for such things as total percentage of children stunted or wasted becomes difficult. Typical assessments of nutritional deprivation focus on the percentage of children who are two standard deviations away from the reference median. A child whose HAZ score is less than -2 is considered stunted. A child with a WAZ score of less than -2 is considered to be wasting. In terms of populations, these metrics are useful in the comparison of different populations to estimate the percentage of children who are wasted or stunted.

Because of the nature of my data I cannot classify children into such groups. Getting from the z-score at mean weight and height to the proportion of children in the study who were actually wasted or stunted would require making assumptions about the distribution of weight and height within each individual school class without proper evidence. Still, despite these obvious drawbacks, HAZ and WAZ scores are beneficial in this study as they illuminate relationships that would otherwise be hidden, even if underestimated.

Table 3 shows OLS estimation of HAZ scores. Please note the interactions of social class with year. These have been charted in Figure 7. The black dotted horizontal lines show the average HAZ score for working, middle, and upper classes in 1914, before the effects of the blockade. These lines are drawn to facilitate the comparison between changing HAZ-scores over time relative to their own pre-War standards as well as other socioeconomic groups. Notice first that in 1916, two years into the War, all else being equal, upper-class children were taller than they had been before the war. Notice too that in 1916, children from middle class backgrounds were .1079 HAZ less than they had been before the War, and that working-class children were barely below what they had

been previously. Data for 1915 are not included because these data were not recorded at the time, a singular lapse in the collection of children's measurements that reflects the exigencies of the war. It is important to recall that when interpreting heights or HAZ scores over time, a time lag of roughly one year must be considered. Further, height is cumulative. Heights are less elastic than weights, and it takes some time before changes in nutrition in an individual or a population will be manifest in increased stature. Thus the HAZ scores for 1916 for the upper and working classes indicate that as late as 1915, the effect of the blockade on children's nutrition was small. As shown by the HAZ scores, the year 1916 was highly significant, being small and negative. (-.0108). By 1917, upper class children experienced their biggest drop in HAZ scores, and working class children too began to lose stature. All things equal, the drop was -.0984 overall and highly significant. Middle class children seem to be the least affected, since their HAZ scores were slightly increasing.

The turnip winter

Of particular interest to historians is the winter of 1916/1917, a period known as the "turnip winter" due to the severe food shortages across Germany. Turnips, a foodstuff that had been primarily used to feed livestock including pigs, were one of the few remaining items available for human consumption. Low HAZ scores for 1917 and 1918 could perhaps be a reflection of the turnip winter. Indeed by 1918 HAZ scores for the working class were at their lowest, at -1.207. Yet HAZ scores for the middle and upper classes improved slightly, indicative of the possibility of securing food sources beyond the highly volatile rations. After 1918 working class children experienced a slow and

steady improvement in their heights. By 1923 they surpassed their pre-war standard. The upper and middle classes did not obtain their previous 1914 heights, although the middle class got close. Both upper and middle class children began to lose stature relative to their working class peers starting in 1919; while the stature of working class children improved, upper and middle class children lost in height. It is possible that whatever outside supplements to their diets these children might have had at the beginning of war, many of the upper and middle classes were no longer capable of participating in black markets, perhaps due to lack of availability of goods, increased enforcement of prohibitions against black market activity, or the continued heavy prices foodstuffs must have commanded. Yet nutritional recovery after the war was far more rapid for working class children than it was for middle and upper class children. While HAZ and WAZ scores decreased in 1920 relative to 1919 for the upper and middle classes, they increased for the working class. From 1918 onwards, working class children showed a steady recovery.

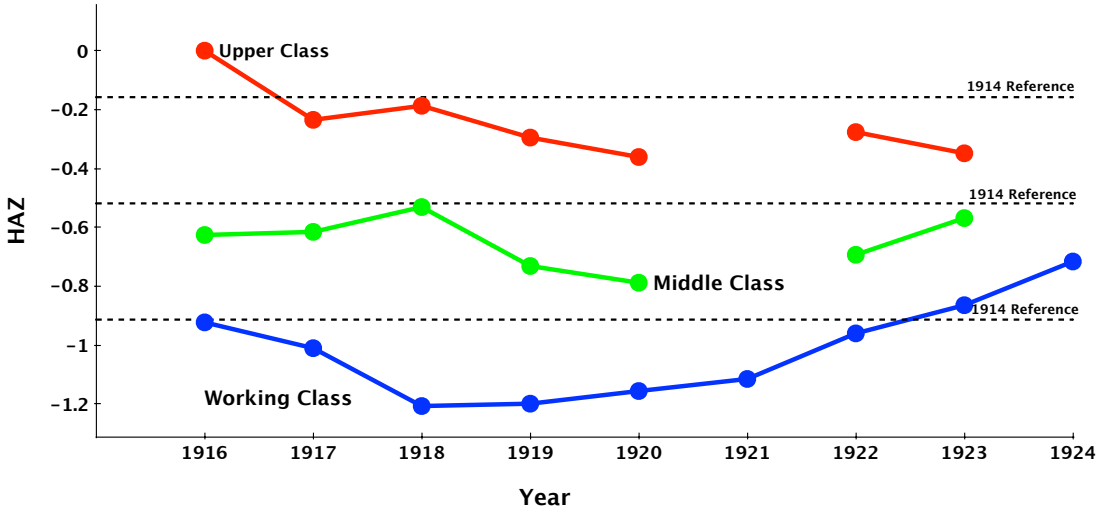

Figure 7. Changes in HAZ scores for social class by year (partial regression coefficients)

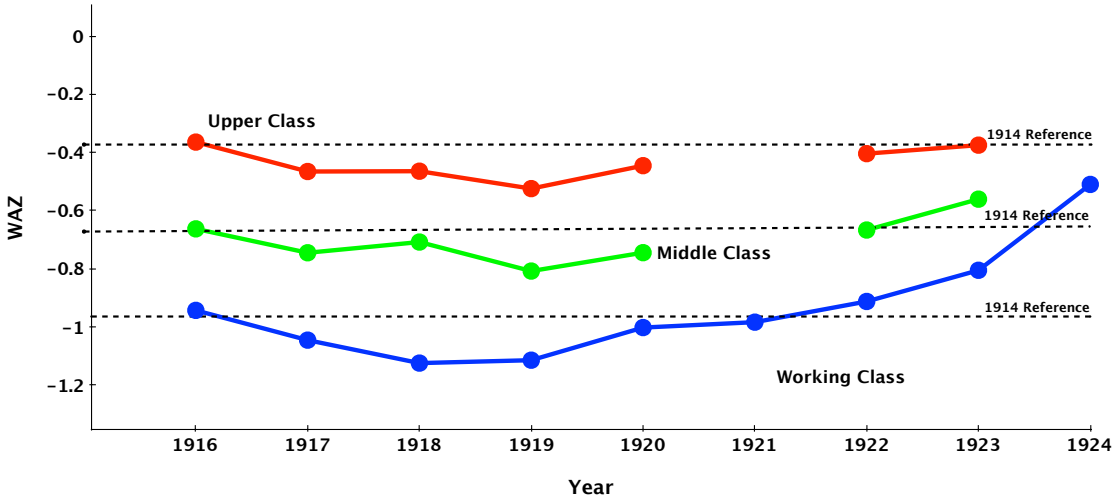

Figure 8. Changes in WAZ scores for social class by year (partial regression coefficients)

An examination of WAZ scores by social class confirms those shown by the HAZ-scores, and adds a bit more detail. Recall that weight is much more elastic than height, and changes in nutritional status will first be reflected in weight than in height.[18] Weight shows a more immediate picture of nutritional status. But weight alone is not a perfect snapshot. Weight-for-Height z-scores (WHZ) are a better indicator of immediate health conditions than Weight-for-Age z-scores. However, WHZ for older children are not included as part of the reference standards for either U.S. National Center for Health Statistics (NCHS) reference group, or the World Health Organization (WHO) reference group. For this study I have to rely on WAZ rather than WHZ scores. Though still a snapshot of more immediate body mass for age, WAZ is a composite measure of HAZ and WHZ scores.

Consider the WAZ scores in Figure 8, keeping all things equal, for 1916 compared to the HAZ score for 1916 in Figure 7. While HAZ scores for the upper class

[18] Costello, for examples, shows that stunted children gain weight at the expense of height.

in 1916 were higher than they were before the war, WAZ scores for the upper class in 1916 were about the same as they were in 1914. This means that while upper class children may have enjoyed a brief influx of food resulting in an increase in their heights relative to 1914, their weights weren't increasing by the same amount. Unfortunately, data for 1915 are lacking, but may have shown an increase in WAZ above the 1914 standard. Otherwise it would be unlikely to find a jump in HAZ scores that profound for 1916. That said, whatever boon came to the upper class soone after the war began in 1915 was dissipated by 1916 as their weights went back down to their 1914 standard. Heights however, less elastic, were slower to change and remained at their higher position.

Continuing to consider 1916 and moving down Figures 7 and 8, it seems strange that WAZ scores were roughly the same for the middle class as they were in 1914 while their HAZ scores had decreased. This indicates that their nutritional status the year previous would have been compromised, with lower weights in order to decrease heights the following year. Yet whatever loss there was in terms of weight in 1915, middle class children regained their weight in 1916.

Continuing down the line for 1916, working class children had very close to the same HAZ and WAZ scores in 1916 as they did in 1914. It was not until 1917 that working class children had large decreases in their WAZ scores. This is similar for the upper and middle classes as well. The slope of HAZ scores for working class children between 1916 and 1917 is slightly steeper than it was for the middle and upper class children. Between 1917 and 1918 WAZ scores for the working class continued to plummet, reaching their lowest point at -1.207. This was not the case for the middle and upper classes, which, while still below their 1914 standards, increased their WAZ scores

relative to the year before. From 1918-1919 the working classes made a slight improvement, with the average WAZ-score at -1.199, while the middle and upper classes both declined. Upper class WAZ scores stayed about the same between the years 1917-1918. They improved for the middle class, but decreased for working class children.

There is a limit to how much weight can be lost and how much stunting can occur in children. From 1918-1919 weights for the working classes were stable, while at the same time weights decreased for middle and upper class children. This does not necessarily indicate an improvement in nutritional status for working class children in comparison to their middle and upper class peers. If all groups had been receiving similar amounts of nutrition, then you would expect to see the weights of working class children jump to closer approximate that of middle and upper class children. This is not the case in 1918 or 1919.

Perhaps the most interesting detail to emerge from Figure 8 of WAZ-scores is the constant improvement in WAZ scores for the working class between 1918 and 1924. By 1921 they almost regained their 1914 levels, and by 1922 they surpassed it. By 1924, working class children increased their WAZ-scores, surpassing even the WAZ standards that the middle class held at the beginning of the war in 1914. These changes were significant, and quite large, especially for such a short period of time.

Improvements occurred for upper and middle class children during this period as well, however not to the same degree and not at the same rate as for the working class. By 1923 middle class children surpassed their 1914 WAZ standard before the war, and upper class children just about reached their previous 1914 levels. In terms of HAZ

scores however, middle and upper class children had not yet approximated the norms they had held pre-war in 1914.

It is important to note that there is no viable indication that German children a hundred years ago were shorter than they are today due to genetic variation. While developmental issues such as the health of the mother during pregnancy certainly have a role to play[19], with the importance of epigenetics becoming more apparent, if these children had been receiving adequate nutritional inputs and lived under reasonable standards there is no reason why they shouldn't have reached modern standards of weight and stature. These modern standards serve as benchmarks for a normal, healthy population, and are what can reasonably be expected from any population, other than Asian, under similar circumstances. If German children in the study had, all things equal, normal nutritional status, then HAZ and WAZ scores for all classes should hover around zero. They were all already lighter and shorter before the War than they would have been had they been living in a healthy country with modern nutritional standards. Except for the HAZ score of the upper class in 1916, their HAZ and WAZ scores were all well below zero. And recall too, from the initial discussion on HAZ and WAZ, that the amplitudes of these differences are dampened more than they would otherwise be if the data were for individuals rather classrooms. To show the differences in height for modern standards compared to the data on German children in 1914 (which include all classes) please see Figure 2.

[19] Roseboom, Rooij, and Painter, "Dutch famine and its long-term consequences."

Blessed Are the Poor For They Shall Receive

What might be the reasons for improved heights and weights of the working class from 1919 onwards, surpassing even what they had been before the war by 1922, compared to the middle and upper classes that did not enjoy such resiliency? Though wartime hostilities ceased in November of 1918 due to the armistice, Britain maintained the blockade until July of 1919 in the Treaty of Versailles. The German diplomats who agreed to the draconian terms of the armistice (though the record shows that they did not do so without a fight) lost their entire political careers. And although Germany had surrendered, the German people continued to suffer from the lack of food.

One gets a sense of the rigidity of the Entente in regards to the food blockade and the concomitant desperation of Germany from an examination of the armistice negotiations themselves. "The existing blockade conditions set up by the Allied and Associated Powers are to remain unchanged," Commander-in-Chief of the Allied Armies, Marshal Foch declared, even though Germany had already called for a cease-fire. "German merchant ships found at sea remain liable to capture."[20]

The German Armistice Commission disagreed with this pronouncement, since a continued blockade of Germany would continue to inflict suffering on an already hungry people. Foch responded, "The Allies are of the opinion that once the armistice has been concluded the continuation of the blockade will not hinder the provisioning of Germany as shall be found necessary." [21]

The final demands of Marshal Foch in regard to the blockade contained minor consolations from his first two suggestions and was signed by both Allied and central

[20] *The Blockade of Germany After the Armistice*, p. 3.
[21] Ibid. p. 4.

powers representatives on November 11, 1918 at 5 a.m. French time. The German delegates who signed the document, Secretary of State Matthias Erzberger, Ambassador Count Oberndorff, General Major Von Winterfeldt, and Captain Vanselow would be later be termed the "November Traitors" on their return to Germany. Secretary of State Erzberger, would later pay for it with his life when he was shot point blank in 1921 by a disgruntled citizen.[22] After considerable discussion and objection these German leaders signed their names to the following treaty:

> The existing blockade conditions set up by the Allied and Associated Powers are to remain unchanged, German merchant ships found at sea remaining liable to capture. The Allies and the United States contemplate the provisioning of Germany during the armistice as shall be found necessary. [23]

This concession, marginal at best, obligated the Allies and the United States to "contemplate the provisioning of Germany" while in reality still keeping the blockade intact. Thus the creation of a stable food supply in post-war Germany was totally dependent on the largesse of the Allies, a largesse which, given the extreme bitterness of the previous hostilities, and the massive number of Allied casualties, was not soon to materialize. Marshall Foch represented a country that, while not as destitute as the Germans, had also come out of a major war with a weakened economy and smaller food supply. The impact of sustained blockade on German children is reflected by the WAZ of the middle class for the years 1918 and 1919 on Figure 8.

Meanwhile the German economy, which had suffered during the War, continued to struggle. Germany underwent a major change of government. Kaiser Wilhelm II went in exile to the Netherlands in November 1918. Governmental political bodies were

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[22] Evans, *The Coming of the Third Reich*.
[23] *The Blockade of Germany After the Armistice,* p. 4

reorganized or destroyed though some national institutions, such as the Reichstag, were created. Hyperinflation of the Reichsbank mark hit a high in 1923 before the currency was replaced with the more stable Rentenmark.

In addition to a new government, there were other political consequences of the end of war. National boundaries changed, and Germany lost much of its former land, some of which was quite fertile and which previously had been considered centers of agriculture. Former German farmlands were instead ceded to France, Belgium, and Poland. "The peace settlement of 1919 transferred a fifth of Germany's rye lands and a smaller fraction of the wheat, barley, and oats fields to Poland, France, Belgium, or Denmark. The potash and phosphoric fertilizers of Alsace-Lorraine went to France. Germany lost about one-eighth of her rural productive capacity."[24]

This alienation of German agricultural lands and appropriation of domestic sources of German fertilizer supplies by the victors of World War I had a significant impact on the food supply for German civilians. Taken together, these events perpetuated the wartime disruption of the German food supply, resulting in inadequate nutrition for German children.

The plight of German children did not go unnoticed on the international stage. Immediately after the War, books and pamphlets depicting hungry German children were published in English,[25] German,[26] Swedish,[27] and Spanish.[28] The message was consistent: German children had suffered greatly during the War and were in need of immediate

[24] Heaton, *Economic History of Europe*. pp. 449-450.
[25] Rubmann, *Hunger! Effects of Modern War Methods*.
[26] Siegmund-Schultze, *Die Wirkungen der englischen Hungerblockade auf die deutschen Kinder*.
[27] Johansson, *Om Tysklands folknäring under kriget och för närvarande.*
[28] Guervos, *Un pueblo en la miseria.*

help. Different groups across the world began shipping food aid to Germany specifically targeted towards poor children—working class children.

Shipments came over from the Quakers in the US, as well as the US government. From the US, aid was initially sent over by individual German-Americans, eager to help their relatives. As soon as the post office was open to again send packages to Germany in 1919, anxious family members and relatives sent packages of food. From the Milwaukee post-office alone (a city with a large amount of German immigrants) 100,000 packages were sent to Germany by the end of November 1920.[29] Politics were involved with some German-Americans vocal in proclaiming "American responsibility" for the state of Germany children due to the treaty of Versailles. In an attempt to separate philanthropic consideration from this negative, almost anti-American rhetoric, Herbert Hoover joined his initial relief aid group, a semi-private organization he set up called the American Relief Administration, to the Quaker "American Friends Service Committee." Hoover had been responsible for aid to Germany immediately after the War's end in 1918, and this new endeavor he founded was his response to being released from that post starting in 1919. His linking of the American Relief Administration with the Quakers was strategic, as the Quakers were seen as quintessentially American, with long roots stretching back to the formation of the country, as well as having the requisite political leanings of peace. The idea, which was slow to take root, was that by giving the face of international aid to Germany to the Quakers rather than to the angry or dissatisfied German-Americans, the cause would reach wider appeal and receive greater amounts of charitable donations, from both government and individuals. Other religious groups in the

[29] Strickland, "American Aid to Germany".

US, particularly those that had a high percentage of German-American in them such as the Lutherans, raised $800,000 to send to Germany within two years of Armistice in addition to their personal contributions. The personal donations of individual German Americans were generous, but unfortunately some donors were publicly reviled in the early aftermath of the War. Donations and aid from the United States increased as time went on and as sympathies began to sway in favor of Germany. The American Relief Committee for German Children collected $266,000 by March of 1920, with many single donations of $1,000 to $10,000 being made by famous Americans. By securing support from well-known, non-German Americans, the hope was that more Americans, not just German-Americans or the religious, would donate. In December of 1920, Hoover, unhappy that more had not been donated to the Quaker American Friends Service Committee, quietly transferred $4,000,000 for the relief of German children.[30] Hoover would continue to fight for German children, a fight that would eventually include them as one of the targets for the European Relief Council, which had access to $33,000,000. He famously declared, "The United States is not at war with German infants."[31]

Hoover's tact in working with different political and religious groups and with wealthy Americans, as well as his personal tenacity and direct contributions in securing funds for German children is nothing short of heroic. This aid, specifically targeted towards poor German children, was undoubtedly reflected in the steady improvement of working class children from 1918 through 1924 as reflected in their HAZ and WAZ scores seen in Figures 7 and 8.

[30] Ibid, p. 264.
[31] Ibid, p. 264.

Hoover's peer in the United Kingdom, Eglantyne Jebb, started the Save the Children foundation to respond to what she viewed as the immoral treatment of German children, particularly since the British blockade continued after the War had ended. Jebb printed pamphlets with pictures of hungry-looking German children and babies as a way to wake up her country and secure sufficient donations. While being arrested at one of her demonstrations, Jebb fought on for the cause of needy children. Well connected, and from a privileged aristocratic background, Jebb used her social standing and personal tenacity to garner support and donations from British elites and manage the ever growing Save the Children Foundation. Her efforts eventually won her an audience with Pope Benedict XV, who immediately responded to her plea with a personal donation of £25,000.00, and, later, with a special worldwide letter requesting that all Catholics, regardless of their location, donate to the Save the Children Foundation so that needy German children might be fed. This was the first instance in which the Church had supported a non-denominational cause. Collections for the poor children in Germany were acquired from as far away as Samoa, a former German colony in the Pacific.[32]

It seems very likely that these international efforts at relieving poor German children of their suffering manifested themselves in the steady improvement of heights and weights of working class German children, as shown in Figures 7 and 8. As foreign aid was targeted towards working class children rather than upper class children, working class children improved their overall heights and growths in the post-war period of limited trade and an unstable currency, while upper and middle class children continued to flounder immediately after the War. Statewide control of foodstuffs and rationing

[32] Mulley, *The Woman Who Saved the Children.*

during the War were not administered equally to hungry German children, but foreign aid after the First World War ensured that working class children received food. These data evidence the success of one of the earliest instances of international philanthropic aid.

Contemporary anthropometric measurements of children's heights and weights show that when the War and blockade began, Germany children began to lose in stature and in weight. The effects of the War on childhood nutrition continued for a time after the war stopped. International aid in the form of foodstuffs targeted towards poor children began arriving in Germany just as inflation was at its worst. The negative impacts of the British blockade, ruined German economy, alienated German lands, and currency inflation, all could have been predicted to have worsened the nutritional status of German children. But what the data reveal is that despite these circumstances, nutrition of poor children's health in Germany, as shown by their HAZ and WAZ scores, improved significantly. These data now clearly show the truly massive beneficial effect additional food in Germany had on the welfare of its poor working class children.

THE GERMAN HOUSEHOLD: GENDER DIFFERENCES IN CHILDREN'S NUTRITIONAL STATUS

Nutritional deprivation also varied for males and females. This is apparent from the sex indicators of HAZ and WAZ scores, which show that females did significantly better than boys. The full results of these regressions are found in Tables 3 and 4. Figures 9 and 10 below show a clear lead in female heights and weights. They also show the importance of age in determining overall height and weight.

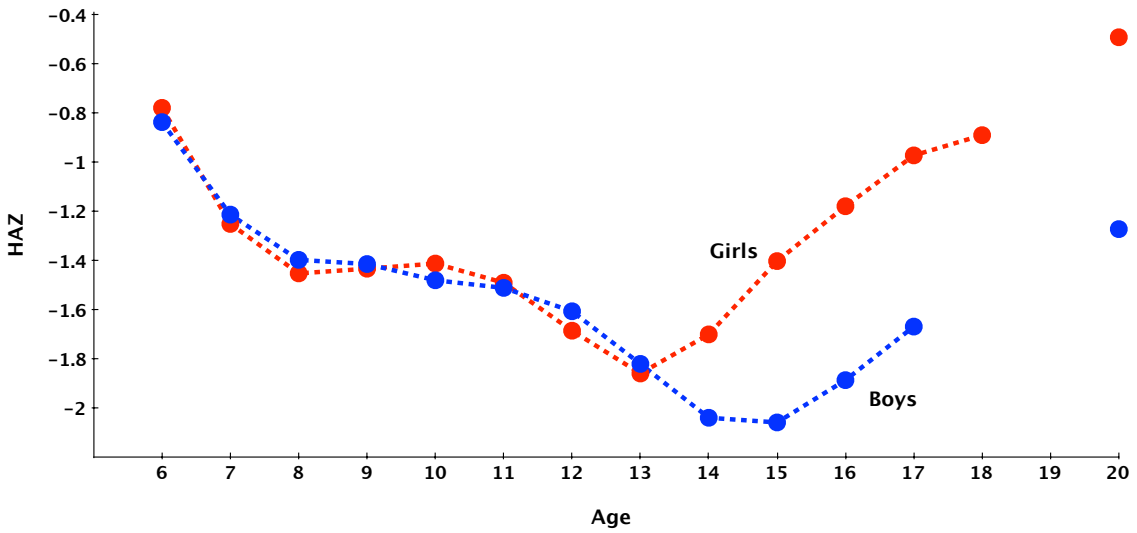

Figure 9. HAZ Scores by Gender and Age (Partial Regression Coefficients)

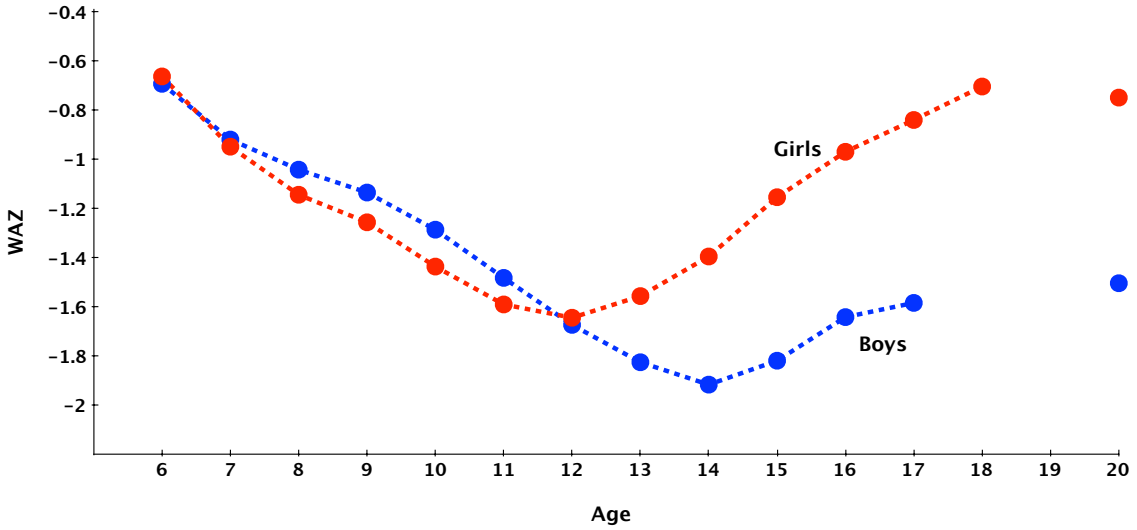

Figure 10. WAZ Scores by Gender and Age (Partial Regression Coefficients)

As Figure 9 shows, HAZ scores were higher overall for females than they were for males, but not until age fourteen. Until then, males and females shared similar HAZ scores by age. Examining the WAZ scores in Figure 10 reveals a similar pattern. Males and females shared similar WAZ scores, with males slightly heavier, until age thirteen, when they diverged and females again took the lead. From ages eight through eleven boys were slightly heavier than girls, while boys and girls shared a closer height relationship between those ages.

That girls fared significantly better than boys (accounting for age they have a .715 higher WAZ and .494 higher HAZ overall) is at first a surprising result. Household economies are notoriously difficult to analyze quantitatively, and while these data are not divided into individual households, they imply that within family structures sisters did better than their brothers.

Previous studies show that in times of need, household division of resources tended to favor that individual in a household who could bring in the highest income through their labor, thus ensuring a family's continued survival. Highest income potential was predominantly male in the 18th and 19th centuries. This was reflected by caloric allocation within households. For example, for Philadelphia in the 1880s, Haines found that male children received a higher allocation of food then female children within the same household.[33] This fits into the economic paradigm of bargaining power. The logic is that intrahousehold allocation favors those who contribute, or will contribute, more to overall household incomes. Even as women and children entered the workforce in increasing numbers thanks to specialization with inventions directly targeted for their job entrance[34], wages for women and children were much less than they were for men.[35] Household caloric allocations continued to favor the male patriarch. As men, including boys, have tended to have higher wages than women and girls, it makes the most economic sense for a family to favor them and thus secure future higher earnings. There are also physical arguments in favor of expending more household resources on men rather than women. Men in heavy industry require more physical energy to complete their

[33] Haines, "Poverty, Economic Stress, and the Family". p. 251.
[34] Humphries, *Childhood and Child Labour in the British Industrial Revolution*.
[35] Humphries, "The Lure of Aggregates and the Pitfalls of the Patriarchal Perspective".

work than a woman not engaged in such intense physical activity. Often however, even when accounting for differences in caloric need and expenditure, many men still receive higher ratios of household goods than females. This simplicity of the bargaining logic often ignores the intricacies of historical detail. Boys have not always received a large piece of the familial household pie, even when their potential earnings were much greater.[36]

In a paper examining household economies during the 18th and 19th century in England, Horrell and Oxley show a complex picture based on data taken from Eden's survey of parishes in 1795 and the Rural Queries of 1834. Matching heights with the nutrients obtained in household economies, not just total caloric inputs, they show that as women's income from outside their household increase, they tended to command a greater percentage of household goods with a concomitant increase in heights. This matches earlier theory on allocation of resources in household economies.

However, patriarchal advantage over increased female bargaining power was not universal. Horrell and Oxley show several examples of locations where older female matriarchs, beyond childbearing age, received a large percentage of household goods regardless of their direct economic contribution of wages brought in by the rest of the family.[37]

The interesting story of intrahousehold allocation, both now and in the past, is still playing out as historians and economists recognize that rational decision making involves

[36]Horrell and Oxley (1999) show that children expected to earn higher wages did not necessarily receive more household expenditure; Logan (2007) cannot fail to reject any statistical hypothesis that shows that household allocation between male and female children in the late 19th c. was equitable.

[37] Horrell and Oxley, "Bringing home the bacon?"

not only the interests of a single individual, but often, and usually, the interests of an entire family and household. As Humphries[38] has rightly asserted, it is not enough to take the average income for a family and then divide by the number of individuals in the family in order to estimate living standards of individual family members. Nor is it sufficient to calculate all dependents as being a certain percentage of a man. Details concerning onset of puberty, pregnancy or breastfeeding, are important when considering times when caloric needs increased.

What then, if anything, can this analysis—which demonstrates equitable nutritional status between male and female children until adolescence—add to our understanding of household allocation? It is important to note, again, that in terms of caloric consumption, unequal intrahousehold allocation is only an issue in times of need and deprivation. Wartime Germany from 1914-1924 was certainly one of these times, as has been shown.

The relative distribution of calories between males and females can be shown by examining height-for-age z-scores (HAZ) and weight-for-age z-scores (WAZ). Refer to Tables 3 and 4 and Figures 9 and 10. It appears at first glance that females were systematically favored over boys during the War. However, a more nuanced analysis that separates not only by gender but also by age reveals a more complex story.

On the workforce, German boys at the time earned more than their sisters which could have added to the families overall food supply. Furthermore, boys would have gone off to become soldiers. Wouldn't that be an adequate reason to give the extra food to boys? Or, to take the opposing side of the future soldier example, perhaps the pending

[38] Humphries, "The Lure of Aggregates and the Pitfalls of the Patriarchal Perspective".

departure of sons in circumstances as soldiers, where they would have been fed better than civilians at home, meant they could afford to take a little less of the family pie before they left. OR, depending on the individual's view of the War, perhaps mothers thought the fighting would end soon and took little account of their sons' future enlistment.

But, when looked at this issue in terms of physiology rather than just economics, the reasons for this gender disparity becomes clearer. Boys and girls need roughly the same amount of nutrition from birth. However, beginning a little before puberty, boys require far more calories to maintain their growth then females do. For instance, modern nutritionists assert that for healthy bodies to grow, girls on average between the ages of 14 and 18 need 2368 calories per day. Boys between the ages of 14 and 18 however need 3152 calories per day.[39] The difference in caloric need to maintain adequate health between adolescent boys and girls is significant. At puberty, boys require 33% more calories. These ages serve only as an indicator, however, because they reflect chronological age, and not biological age. Further, this rough estimate of caloric needs does not take into consideration any of the essential vitamins, minerals, or proteins that are necessary for growth.

In addition to a greater need for calories for boys than for girls at puberty, physiological differences that are more apparent during and after puberty also affect the ways in which different genders handle food shortages. In additional to the development of sexual organs in puberty, girls begin to store fat deposits. At the same time that girls

[39] Stang and Story, eds. "Nutrition Needs of Adolescents". p.22.

increase their overall fat composition boys begin increasing in lean muscle mass.[40] When the body is under stress due to insufficient nourishment, females lose their fat deposits before they lose muscle. Males in adolescence on the other hand have less fat reserves and their bodies are more susceptible to large decreases in caloric intake.

Further to physiological differences in terms of caloric need and response to adverse conditions, there is also another historical example which show boys to be more impacted nutritionally than girls during times of nutritional disaster. Tanner, for example, points out in reference to the famine in Brussels in 1816 and 1817, that "in such circumstances [puberty] boys are almost always worse affected than girls…"[41]

Perhaps then, the counterintuitive impacts of food shortages on gender in World War I Germany aren't as surprising when human physiology is into account. There are additional possibilities for the gender-based disparities found in this study.

The first is the recognition that World War I was not a time of normal family economy. Rather, German families were operating under severe disruption to their food supplies. The normal patriarchy system had been disrupted, with large numbers of working men away from their families and fighting at the front. There would have still been old or disabled men at home, plus normal aged men that were retained to work in the factories, mines, and on farms. But the overall number of males shrank dramatically. This changed fundamentally who controlled the bulk of familial expenditures. Women, particularly mothers, had a much higher discretion than before as to how they divided household goods and foodstuffs. Furthermore, the historical record details the long hours working women spent in lines in order to redeem their food rations and pick up basic

[40] Roche and Sun, *Human Growth Assessment and Interpretation*.
[41] Tanner, *A History of the Study of Human Growth*. p. 132.

necessities. This was primarily a female activity, and not one that men at home entered into. Women's ability to wait in line and to negotiate needed social outcomes may have thus contributed more to the caloric content of the family diet than the traditionally male-dominated spheres of farming and manufacture. Women were much more involved and closer to their family's food supply than they had been previously. With no husband at home to then dictate how those goods should be allocated, women took the lead.

Is it fair then to assume that mothers favored their female children more than they did their male children, once they entered their teenage years? Perhaps not. As has been previously mentioned, different physiological requirements for overall food intake begins to increase at puberty, just when we see HAZ and WAZ scores for German children in the study diverge. It could be that equal access by gender to scarce food supplies continued in absolute terms—families could have continued to give children the exact same amount of food—but that this "even divide" was not actually fair. To fulfill basic caloric requirements, boys at adolescence needed to consume at least a third more than girls at puberty did. This may not have seemed very fair to those mothers who tried to divide their insufficient food supplies equally. Perhaps boys did get more than girls did, but because no one received enough, the physical constraints on adolescent boys with their lean muscle was greater than it was on adolescent females who could rely on some fat deposits.

It could also be the case that food was divided equally at home, but that teenage boys began to work after school, expending more calories than girls did. Thus even if boys had received a third more of the calories at puberty than their sisters did this wouldn't have been sufficient. Ute for example, writes about teenage boys being

employed after school and contributing to the family income.[42] How much of an overall effect this had, and the percentage of employed male teenagers overall, is still uncertain however. Thus, mothers may not have been complicit in assuring that their daughters had a higher nutritional status than their sons did.

Recall that human growth rates speed up during puberty for both boys and girls, giving rise to the pubescent growth spurt. During and preceding the pubescent growth spurt, more calories are required for the body to sustain growth. Knowing this, and seeing that girls still take a very large lead, before and during puberty, makes this a very interesting case. Girls would have needed more calories early.

More research is necessary to test these hypotheses. What is not in question, however, is that teenage girls were less deprived in World War I Germany than boys.

CONCLUSION

The specter of nutritional deprivation for children existed in Germany before the War began, largely determined by a child's socioeconomic class. Analysis of contemporary anthropometric data on German children refutes claims that the effects of the British blockade and War on Germany did not result in significant nutritional deprivation for German children during the First World War. Indeed, the data show that children across Germany suffered significant losses in their heights and weights during the war. These data also show that deprivation varied significantly for different groups across society, based on class and gender. The lowest class fared the worst during the war, yet their recovery was the quickest and most robust. Widespread international relief

[42] Ute, *The War From Within.*

targeted at poor German children helps explain the recovery of the working class from 1919-1924. Finally, analysis of children's nutrition during the war shows that girls were less nutritionally deprived than boys of the same age starting at puberty. At adolescence German girls from 1914-1924 were on average taller and heavier compared to modern standards than boys were. These results gives new insights into how wartime family economies, or economies without traditional patriarchy, allocate nutritional resources during times of stress.

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APPENDIX

TABLE 1
OLS REGRESSION: CHILD STATURE, GERMANY 1914-1924
Dependent variable: Height, cm

Independent Variables		
LOCATION DUMMIES		YES
DATE		
Year: 1916	-0.000139	(-0.0139)
Year: 1917	-0.487***	(-0.0139)
Year: 1918	-1.804***	(-0.0191)
Year: 1919	-1.741***	(-0.0138)
Year: 1920	-1.538***	(-0.0119)
Year: 1921	-1.327***	(-0.0102)
Year: 1922	-0.425***	(-0.0122)
Year: 1923	0.293***	(-0.0104)
Year: 1924	1.371***	(-0.0717)
AGE DUMMIES		YES
INFLUENCE OF MALES BY AGE INTERACTIONS		YES
SOCIAL CLASS		
Upper Class	5.089***	(-0.0121)
Middle Class	2.63***	(-0.0136)
DATE AND SOCIAL CLASS INTERATIONS		YES
OTHER		
Sex: Male	9.092***	(-0.084)
Constant	157***	(-0.402)
Observations	587018	
R-squared	0.986	

* = Significant at the 90 percent level, ** = Significant at the 95 percent level., *** = Significant at the 99 percent level.
Notes: Robust standard errors are in parentheses. Standard Errors were clustered by school type. Observations for which social class could not be determined were dropped. Reference categories: Date, Year = 1914, Location, State = Baden, Sex = Female, Age = 19, Social Class = working class, 18 year-old x female, 1914 x working class. 1915 not included in sample as data are not available.

TABLE 2
OLS REGRESSION: CHILD WEIGHT, GERMANY 1914-1924
Dependent Variable: Weight, kg

Independent Variables		
LOCATION DUMMIES		YES
DATE		
Year: 1916	0.107***	(0.0096360)
Year: 1917	-0.292***	(0.0096754)
Year: 1918	-0.558***	(0.0132686)
Year: 1919	-0.570***	(0.0095923)
Year: 1920	-0.127***	(0.0082363)
Year: 1921	-0.119***	(0.0070697)
Year: 1922	0.017**	(0.0084438)
Year: 1923	0.654***	(0.0072374)
Year: 1924	2.898***	(0.0498409)
AGE DUMMIES		YES
INFLUENCE OF MALES BY AGE INTERACTIONS		YES
SOCIAL CLASS		
Upper Class	3.020***	(0.0083843)
Middle Class	1.325***	(0.0094376)
DATE AND SOCIAL CLASS INTERACTIONS		YES
OTHER		
Sex: Male	4.126***	(0.0583732)
Constant	51.417***	(0.2793246)
Observations	587,018	
R-squared	0.9826	

* = Significant at the 90 percent level, ** = Significant at the 95 percent level, *** = Significant at the 99 percent level.
Notes: Robust standard errors are in parentheses. Standard Errors were clustered by school type. Observations for which social class could not be determined were dropped. Reference categories: Date, Year = 1914, Location, State = Baden, Sex = Female, Age = 19, Social Class = working class, 18 year-old x female, 1914 x working class. 1915 not included in sample as data are not available.

TABLE 3
OLS REGRESSION: Height for Age z-scores (HAZ) GERMANY 1914-1924
Dependent Variable: Height for Age z-scores (HAZ)

Independent Variables		
LOCATION DUMMIES		YES
YEAR DUMMIES		YES
AGE DUMMIES		YES
INFLUENCE OF MALES BY AGE INTERACTIONS		
Age 6 x Male	0.436***	(0.0136)
Age 7 x Male	0.532***	(0.0128)
Age 8 x Male	0.549***	(0.0128)
Age 9 x Male	0.513***	(0.0128)
Age 10 x Male	0.426***	(0.0128)
Age 11 x Male	0.473***	(0.0128)
Age 12 x Male	0.573***	(0.0128)
Age 13 x Male	0.533***	(0.0128)
Age 14 x Male	0.155***	(0.0128)
Age 15 x Male	-0.162***	(0.0130)
Age 16 x Male	-0.213***	(0.0132)
Age 17 x Male	-0.202***	(0.0140)
Age 19 x Male	0.25***	(0.0656)
Age 20 x Male	-0.286***	(0.0918)
SOCIAL CLASS		YES
DATE AND SOCIAL CLASS INTERACTIONS		
Year: 1916 x Middle Class	-0.0971***	(0.00377)
Year: 1917 x Middle Class	0.00102	(0.00372)
Year: 1918 x Middle Class	0.282***	(0.00552)
Year: 1919 x Middle Class	0.0737***	(0.00362)
Year: 1920 x Middle Class	-0.0261***	(0.00340)
Year: 1922 x Middle Class	-0.127***	(0.00348)
Year: 1923 x Middle Class	-0.0981***	(0.00289)
Year: 1916 x Upper Class	0.17***	(0.00338)
Year: 1917 x Upper Class	0.0226***	(0.00335)
Year: 1918 x Upper Class	0.267***	(0.00513)
Year: 1919 x Upper Class	0.151***	(0.00332)
Year: 1920 x Upper Class	0.042***	(0.00286)
Year: 1922 x Upper Class	-0.0692***	(0.00275)
Year: 1923 x Upper Class	-0.237***	(0.00231)
OTHER		
Sex: Male	-0.494***	(0.0127)
Constant	-0.912***	(0.0606)
Observations	587,018	
R-squared	0.716	

* = Significant at the 90 percent level, ** = Significant at the 95 percent level., *** = Significant at the 99 percent level.
Notes: Robust standard errors are in parentheses. Standard Errors were clustered by school type. Observations for which social class could not be determined were dropped. Reference categories: Date, Year = 1914, Location, State = Baden, Sex = Female, Age = 19, Social Class = working class, 18 year-old x female, 1914 x working class.1915 not included as data are not available.

TABLE 4
OLS REGRESSION: Weight for Age z-scores (WAZ), GERMANY 1914-1924
Dependent Variable: WAZ

Independent Variables		
LOCATION DUMMIES		YES
YEAR DUMMIES		YES
AGE DUMMIES		YES
INFLUENCE OF MALES BY AGE INTERACTIONS		
Age 6 x Male	0.685***	(0.0116)
Age 7 x Male	0.744***	(0.0110)
Age 8 x Male	0.817***	(0.0109)
Age 9 x Male	0.836***	(0.0109)
Age 10 x Male	0.865***	(0.0109)
Age 11 x Male	0.823***	(0.0109)
Age 12 x Male	0.686***	(0.0109)
Age 13 x Male	0.446***	(0.0109)
Age 14 x Male	0.194***	(0.0109)
Age 15 x Male	0.0503***	(0.0111)
Age 16 x Male	0.0429***	(0.0113)
Age 17 x Male	-0.0287**	(0.0119)
Age 19 x Male	0.283***	(0.0560)
Age 20 x Male	-0.0397	(0.0783)
SOCIAL CLASS		YES
DATE AND SOCIAL CLASS INTERACTIONS		
Year: 1916 x Middle Class	-0.0109***	(0.00322)
Year: 1917 x Middle Class	0.00928***	(0.00317)
Year: 1918 x Middle Class	0.125***	(0.00471)
Year: 1919 x Middle Class	0.0153***	(0.00309)
Year: 1920 x Middle Class	-0.00433	(0.00290)
Year: 1922 x Middle Class	-0.0455***	(0.00297)
Year: 1923 x Middle Class	-0.0466***	(0.00246)
Year: 1916 x Upper Class	-0.0117***	(0.00288)
Year: 1917 x Upper Class	-0.0105***	(0.00286)
Year: 1918 x Upper Class	0.0695***	(0.00438)
Year: 1919 x Upper Class	-0.000354	(0.00284)
Year: 1920 x Upper Class	-0.0336***	(0.00244)
Year: 1922 x Upper Class	-0.082***	(0.00235)
Year: 1923 x Upper Class	-0.16***	(0.00198)
OTHER		
Sex: Male	-0.715***	0.0108
Constant	-0.963***	0.0517
Observations	587,018	
R-squared	0.759	

* = Significant at the 90 percent level, ** = Significant at the 95 percent level., *** = Significant at the 99 percent level.
Notes: Robust standard errors are in parentheses. Standard Errors were clustered by school type. Observations for which social class could not be determined were dropped. Reference categories: Date, Year = 1914, Location, State = Baden, Sex = Female, Age = 19, Social Class = working class, 18 year-old x female, 1914 x working class.1915 not included as data are not available.