# The impact of World War II on nutrition and children's health in Italy

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**Abstract**

The impact of World War II on the nutrition and health of Italian children is examined. During the war, both per capita GDP and consumption collapsed in Italy. Infant mortality increased. The anthropometric measurements of a sample of schoolchildren show a loss in weight and height in comparison with the pre-war years. Measurements of conscripts born during the conflict show an interruption to the secular increase in height; the average height of conscripts born in 1945 diminished. The adverse impact of the war on height particularly regarded the Northern regions, and appears to be related to the 'geography of conflict' in Italy.

**Keywords**. Italy, World War II, Food rationing, Anthropometry-

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## 1. Introduction

War may have devastating and pervasive consequences for the living standards and health conditions of a population, particularly among children. Food rationing, hunger, population displacement, the loss of parents and breakdowns in medical, educational and public services, together with the direct effects of the conflict, including injuries and illnesses, may produce long-lasting effects on individuals' lives and propagate across generations (Goldson, 1996; Hunt, 2008; Devakumar et al. 2014). These effects have been documented for conflicts involving diverse countries – such as Cambodia, Cote d'Ivoire, Rwanda, Zimbabwe and Vietnam – and with different durations (Alderman et al. 2006; Akresh et al. 2011; Merrouche, 2011; Minoiu and Shemyakina, 2014; Palmer et al. 2016).

The anthropometric measurements of children and conscripts, together with health indicators, have been used in studies aimed at assessing the impact of conflicts, such as World War I and the autarchic policies and embargoes in Germany and Spain, on the biological wellbeing of individuals (Blum, 2011, 2013; Baten and Wagner, 2003; Cox 2015; Puche, 2010; Puche et al., 2016; Pak et al., 2011). Research, conducted in 13 European countries on a large sample of adults (>50 years old), showed how the experience of World War II (WWII) during childhood increased the probability of suffering from diabetes and depression, and was associated with less education and life satisfaction in adulthood (Kesternich et al. 2014). Studies conducted on cohorts of Dutch men, born during the German blockade of food supplies to the Netherlands (the 'Hunger Winter', 1944-45), found that prenatal exposure to severe malnutrition deficiencies, particularly in the first gestation period, was associated with a higher risk of personality disorders, coronary heart disease and metabolic disorders in later life (Neugebauer et al. 1999; Roseboom et al. 2001) and with persistent epigenetic changes (Heijmans et al. 2008). Prenatal exposure to the Dutch 'Hunger Winter' famine was, furthermore, negatively related to individuals' employment outcomes in adulthood (Scholte et al. 2015). Transient effects of food restrictions due to WWII on schoolchildren's anthropometric measurements were found in studies on Norway and the other Nordic Countries (Brundtland et al. 1980; Angell-Andersen et al. 2004).

The effects of war-related shocks in childhood on adult health and wellbeing were recently estimated by Havari and Peracchi (2016), using macro and micro-level data for 14 European countries referring to the period between the two world wars. Their findings confirm how exposure to war events and the experience of hunger in childhood and adolescence are related to worse mental and physical health, education, and subjective wellbeing in adulthood. The detrimental impact of war also regards education. German

children, who during WWII were school-aged, received from 0.3 to 1.2 fewer years of schooling on average, and were about one centimetre shorter in adulthood (Akbulut-Yuksel 2014). For Austrian and German individuals, who during WWII were 10 years old, the educational loss was associated with sizeable inferior earnings some 40 years later (Ichino and Winter-Ebmer 2004).

During WWII, Italy suffered notable costs in human and economic terms. The national production system and transport infrastructures were seriously damaged; GDP per capita and household consumption collapsed, returning to pre-war levels around 1950. The scarcity of foodstuffs, due to the fall in production, was made worse by the ineffective rationing system and the very high inflation rate (Ronchi et al., 1948; Daneo, 1975; Zamagni, 1998).

Social and biological wellbeing in Italy has been examined in a historical perspective by a growing strand of research (Arcaleni, 2006, 2012; Peracchi, 2008; Vecchi, 2011, 2017). Research shows how in Italy, as in other countries, a secular trend in average height occurred. Over the period 1861-1981 the average height of conscripts increased by 11.6 cm; between 1901 and 1951, the gain was 5.2 cm (A'Hearn and Vecchi, 2011, p. 56). Notwithstanding the huge historiography on WWII in Italy (Collotti, 1973; Candeloro, 1984; Labanca, 2015), the impact of the conflict on the biological wellbeing of the population has hardly been investigated. The present paper's aim is to fill this gap, at least in part, by offering an examination of the effects of WWII on the nutritional health of the Italian population. By using children's anthropometric measurements and data on the height of conscripts born in wartime, the analysis focuses, in particular, on the consequences of the conflict on children's health both at national and regional levels.

The paper is organized as follows. The next section presents the trend of the main economic indicators and data on average consumption levels and living standards during WWI. Section three focuses on childrens' health: anthropometric measurements of schoolchildren and the height of conscripts born during WWII are used, coupled with other socioeconomic indicators, to analyse the effect of war on biological standards of living. Some conclusive remarks follow.

## 2. The impact of WWII

### *2.1. Production and consumption*

Italy entered WWII in June 1940. In July 1943, an expedition corps of 160,000 servicemen of the Allied forces landed on Sicily. The Allies quickly occupied the Southern

regions, and only two months later, in September 1943, the King of Italy accepted an armistice. The Central-Northern regions remained under the control of the Nazis and Fascists and was administered by the Italian Social Republic (RSI) led by Mussolini[1]. In the summer of 1944, Allied forces liberated much of central Italy, while in the North - above the so-called "Gothic line"– the conflict continued throughout 1944 and the first months of the subsequent year. In April 1945, the Partisan brigades and the Allies liberated the Northern regions, so ending the war (Morgan, 2007, p. 127; Labanca, 2015).

In human and economic terms, the costs of WWII for Italy were immense. Deaths among servicemen and civilians amounted to 309,453 while another 135,070 were declared missing, for a total of 444,523 persons (Istat, 1957, p. 3). The loss of life was, however, notably lower than in other countries such as Germany, Poland or Yugoslavia (Lowe, 2012). Aerial bombing on Italy started in May 1940, after the declaration of war against France and Great Britain, was intensified in 1943, when the country became one the main theatres of the war, and ended in April 1945, during the Nazis' retreat (Patricelli, 2007; Baldoli, 2010; De Bernardi and Ganapini, 2010, p. 60). It has been estimated that during the war bombardments caused, in total, over 70,000 victims (Gioannini and Massobrio, 2007).

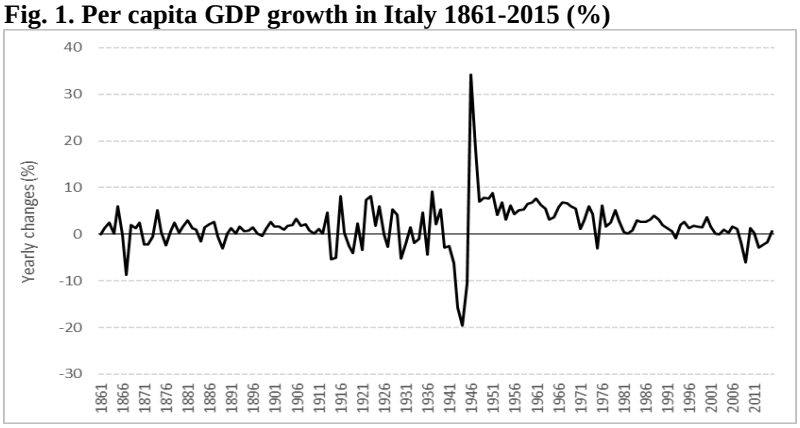
Industrial capital stock was partially damaged. Due to the systematic bombing, some estimates give the proportion of industrial capacity lost as 12.5% in the North, 38.5% in the Centre, 35% in the South and 12% in the Islands, with a weighted average of 19.4% (Jacoboni, 1949, pp. 50-51; Zamagni, 1998). Transport infrastructures suffered substantial damage, thus hampering the provision of raw materials and industrial products (Daneo, 1975). Private housing suffered aerial bombardments: 1.9 million rooms were destroyed and about 5,000 seriously damaged, out of a total of 33.6 million rooms existing in 1941 (Zamagni, 1998). Agricultural production fell in all regions, thus reducing the availability of basic foodstuffs for the entire population. Between 1940 and 1945, livestock production diminished by 55% and that of grains halved (Istat, 1968)[2]. Per capita GDP dropped cumulatively by 57%. It was the largest output fall in Italian history (Fig. 1). Per capita GDP reached a

[1] The Italian Social Republic (Repubblica Sociale Italiana) was established by Mussolini on September 1943 and lasted until April 1945. Its territory included part of Central Italy not occupied by the Anglo-American army, and the North, with the exception of Friuli Venezia Giulia (*Adriatisches Künstenland*), Trentino Alto Adige and the province of Belluno (*Alpenvorland*), which were directly controlled by the Third Reich (De Bernardi and Ganapini, 2010, p. 283).

[2] For example, between 1939 and 1945, the production of wheat dropped by 47% in the Northern regions, by 38% in the Centre and by 55% in the South and Islands. In Piedmont and Lombardy, production felt by 52%, in Friuli by 80%. In Sicily and Apulia, two of the main grain producing regions, production in 1945 was about 40% of that of 1939 (Istat, 1948, pp. 164-165).

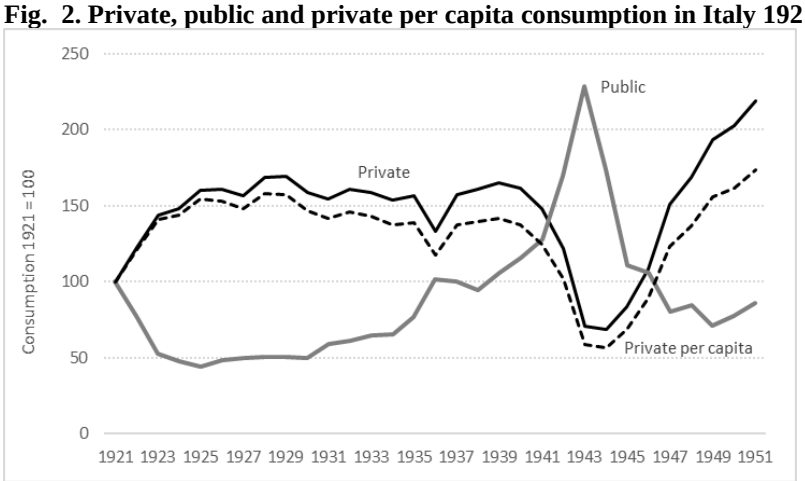
minimum in 1945, and returned to the pre-war level only in 1949-50. Household consumption followed a similar trend. While public consumption boomed due to the war effort, private per capita consumption fell: in 1944-45, its level was about half that of 1920 (Fig. 2).

**Fig. 1. Per capita GDP growth in Italy 1861-2015 (%)**




Note: chain-linked volumes (base year 2010). Source: Data from Baffigi (2015).

**Fig. 2. Private, public and private per capita consumption in Italy 1921-51 (1921=100)**

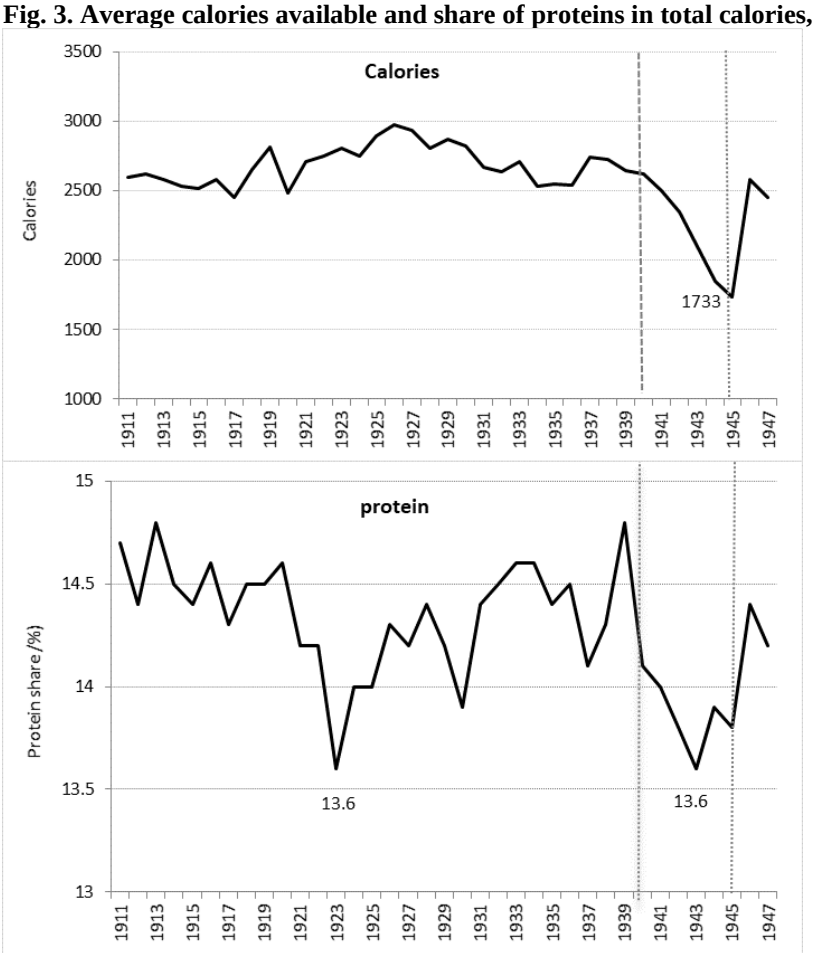



Note: consumption in constant prices (1938 Italian liras). Source: Data from Baffigi (2015)

During the war years 1940 and 1941, food production in Italy was maintained at about the pre-war levels. Food shortages become evident in 1942. In the subsequent year, due to military operations, and a severe drought in the southern regions, nutritional standards deteriorated, and the average calorie intake fell to about 2,000 calories per day. During 1944-45, almost the entire population was subject to relocation, and food consumption fell to an average of 1,900 calories per day (U.S. Department of Agriculture, 1946, p. 83). The trends of

average calories available, and the share of calories from proteins during the period 1911-47 are illustrated in Fig. 3. According to these estimates, derived from national economic accounts, in wartime, the availability of per capita calories per day dropped with respect to the previous average, reaching a minimum of 1,733 c./d. in 1945, and the share of calories deriving from protein followed a similar trend.

**Fig. 3. Average calories available and share of proteins in total calories, Italy 1911-1947**




Note: data from national economic accounts. Source: Barberi (1961) and Istat (1968).

Data show how, during WWII, the availability of foodstuffs and, hence, average consumption levels, dropped. In 1945 the consumption of meat and fish was about half, and that of dry legumes three quarters, that of 5 years earlier (Tab. 1). Consumption of most foodstuffs returned to pre-war levels only in 1951.

**Tab. 1. Per capita consumption of some foodstuffs (kg per year) 1931-1951**

| | Meat | Fish | Potatoes | Legumes | Grains | Sugar |
|---|---|---|---|---|---|---|
| **1931** | 21.1 | 3.5 | 26.6 | 12.2 | 216.7 | 7.8 |
| **1940** | 21.2 | 4.1 | 44.6 | 10.1 | 208.2 | 7.8 |
| **1945** | 10.6 | 2.2 | 17.7 | 3.1 | 138.6 | 2.8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **1948** | 13.4 | 3.3 | 41.9 | 5.8 | 186.1 | 9.7 |
| **1951** | 15.4 | 4.0 | 38.1 | 5.4 | 199.6 | 12.6 |

Source: Istat (1968).

Aggregate data from national economic accounts provide a useful, but partial, representation of the real consumption levels of individuals during WWII. The availability of calories does not completely coincide, in fact, with individuals' effective calorie intake. Discrepancies derive, for example, from waste during the production process or final consumption. In addition, data on food consumption from official statistics do not include food self-produced by households, a factor that was particularly relevant in rural areas, or foodstuffs purchased on the black market. However, in wartime, the dramatic fall in agricultural and agro-industrial production, coupled with the rationing of foodstuffs, impacted notably on the nutritional standards of households, especially in the urban centres (Morgan, 2007, pp. 61-65). An inquiry conducted in 1942 on a sample of 334 households in 15 Italian provinces, concluded that 39-42% of non-rural households suffered from starvation, while the nutrition of peasant households was, quantitively, not significantly dissimilar to that of the pre-war years (Luzzatto-Fegiz, 1948, p. 13). For the greater part of population, the situation was made more dramatic by the very high inflation rate. In 1943, the consumer price index increased by 67.7% with respect to the previous year, and in 1944 by 344.4% (Tab. 2).

In 1944, one kilogram of bread cost 48 times more than in 1940, one kilogram of pasta 95 times more and one kilogram of beef about 30 times the pre-war price. During the war, scarce foodstuffs were distributed through a rationing system implemented by national and local institutions[3]. Due to flaws in organisation and distribution, and for the scarce supply of foodstuffs from agriculture to compulsory pooling (*ammassi*), the rationing system in Italy was far from effective (Ronchi et al., 1948; Morgan, 2007, p. 66-68). The other flaw regarded the rations in themselves. It has been estimated, in fact, that the food rations distributed to individuals covered barely 60% of normal daily needs (Ronchi et al., 1948).

**Tab. 2. Annual changes in the consumer price index and to the prices of principal foodstuffs in Italy 1940-49 (%)**

| | Price Index | Bread | Pasta | Rice | Potatoes | Meat beef | Milk |
|---|---|---|---|---|---|---|---|
| 1940 | 16.7 | 8.6 | 6.5 | 9.7 | 41.7 | 23.2 | 10.8 |
| 1941 | 15.7 | -1.4 | 15.6 | 4.4 | 19.6 | 19.0 | 25.0 |
| 1942 | 15.6 | 1.5 | -1.9 | 0.6 | 36.1 | 4.5 | 26.7 |

[3] The rationing system was established by the Law no. 577 of the 6th May 1940, followed by the Ministerial Decree of the 12th September 1940 and subsequent regulations. Essentially, the system was based on the compulsory pooling of agricultural products (*ammassi*), that had been established in Italy since the 1930s, administered prices and individual rationing cards (see Ronchi et al. 1948).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1943 | 67.7 | 7.9 | 2.0 | 8.4 | 33.7 | 25.1 | 27.2 |
| 1944 | 344.4 | 413.3 | 614.4 | 1,301.1 | 809.0 | 691.9 | 351.0 |
| 1945 | 97.0 | 96.2 | 81.9 | 123.2 | 68.9 | 84.4 | 113.1 |
| 1946 | 18.0 | 53.8 | 58.6 | 54.1 | 18.2 | 29.7 | 48.2 |
| 1947 | 62.1 | 95.6 | 81.9 | 93.5 | 28.2 | 100.5 | 55.0 |
| 1948 | 5.9 | 27.3 | 9.9 | -34.5 | -32.0 | 2.6 | 21.0 |
| 1949 | 1.5 | 6.3 | 3.0 | -19.7 | -5.9 | -1.3 | 1.3 |

Note: for foods, price changes refer to kg units (litres for milk). For the years 1943 onwards, free market prices for foodstuffs were considered, while for the years prior to the war legal prices were taken into account. The prices for bread and pasta from 1944 to 1949 represent the average between legal prices and free market prices, weighted by the quantities sold in the two markets. Source: Istat (2012), Serie storiche, http://seriestoriche.istat.it.

The total calories per day provided by the rations in Italy and other countries are reported in Tab. 3. Data refer to "normal consumers", an administrative concept that comprised the overwhelming majorities of the populations. Certain groups of people, such as children, had smaller rations than "normal consumers"; others, like heavy workers, larger rations (League of Nations, 1946, p. 11). In Italy, the total calories provided by the rationing of these foodstuffs was lower than in the other nations, even though the difference derived mainly from the very low rations of potatoes, that were rationed locally, according to their availability.

**Tab. 3. Total average rations for normal consumers in some countries 1940-44 (calories per head per day)**

| | 1940 | 1941 | 1942 | 1943 | 1944 |
|---|---|---|---|---|---|
| Germany | 2,125 | 2,020 | 1,940 | 1,990 | 2,000 |
| Czechoslovakia, Prot. | 2,045 | 1,950 | 1,875 | 1,800 | 1,760 |
| Netherlands* | - | 1,800 | 1,785 | 1,845 | 1,765 |
| Finland | 1,790 | 1,650 | 1,375 | 1,640 | 1,775 |
| Belgium | - | 1,375 | 1,325 | 1,365 | 1,555 |
| Norway | - | 1,580 | 1,445 | 1,445 | 1,445 |
| France | - | 1,230 | 1,110 | 1,605 | 1,135 |
| Poland | - | 1,290 | 1,235 | 1,135 | 1,160 |
| Italy | - | 1,160 | 1,020 | 930 | 990 |

Note: *in the winter of 1944-45, the area of the Netherlands occupied by Nazis troops suffered a period of famine (Hart, 1993).
Source: League of Nations (1946, pp. 18-19).

In 1940-44, in Germany, the total calorie level of rations for a normal consumer was remarkably close to 2,000 per day; in the Netherlands, rations provided around 1,800 calories; in the Baltic States, Belgium, Finland and Slovakia, the level varied between 1,300 and 1,700 calories a day; in France and Poland about 1,150 calories. Italy, with barely 1,000 calories a day, was at the bottom of the list (League of Nations, 1946, p. 21). Among countries with a total rationing system, only in Spain and Greece was the amount of daily calories provided by rations lower than in Italy (League of Nations, 1944). In Spain, in 1942, the rations of bread and cereals provided 400 calories per head/day (League of Nations, 1942, p. 30); in the

Balkans, the nutritional conditions were even more critical, particularly in Greece, where in 1941-2 a severe famine occurred, and more 100,000 people starved to death (Lowe, 2012).

Physiological requirements change in the different periods of individual growth, and are also related to subjective conditions (e.g. pregnancy or nursing). Food rations were, however, differentiated for diverse categories of individuals. Table 4 contains data for adult males, nursing and expectant mothers, and for children at different ages and in diverse countries; it also contains the number of calories provided by each ration, the caloric needs (in brackets), and the ratio between the caloric requirements and real rations.

**Tab. 4. Rations in calories per day compared with normal requirements for different consumer categories in selected European countries, 1943**

| Consumer category | | Italy | Belgium | Czechoslovakia | France | Finland | Germany | Netherlands |
|---|---|---|---|---|---|---|---|---|
| Adult male | *a* | 1065 | 1555 | 1740 | 1115 | 1780 | 1930 | 1580 |
| *(2400)* | *b* | *44* | *65* | *73* | *46* | *74* | *80* | *66* |
| Nursing & Exp. Mothers | *a* | 1065 | 2045 | 2045 | 1440 | 1975 | 2195 | 1835 |
| *(2400-3000)* | *b* | *44-36* | *85-68* | *85-68* | *60-48* | *82-66* | *91-73* | *76-61* |
| Children 0-1 | *a* | 1355 | 2045 | 1605 | 1310 | 2020 | 1900 | 1455 |
| *(720)* | *b* | *188* | *284* | *223* | *156* | *281* | *264* | *202* |
| Children 1-2 | *a* | 1355 | 2045 | 1605 | 1310 | 1685 | 1900 | 1455 |
| *(840)* | *b* | *161* | *243* | *161* | *131* | *201* | *190* | *173* |
| Children 2-3 | *a* | 1355 | 2405 | 1605 | 1460 | 1685 | 1805 | 1455 |
| *(1000)* | *b* | *136* | *205* | *142* | *129* | *169* | *160* | *146* |
| Children 3-4 | *a* | 1065 | 1880 | 1605 | 1460 | 1685 | 1805 | 1455 |
| *(1128)* | *b* | *94* | *167* | *129* | *117* | *149* | *145* | *129* |
| Children 4-5 | *a* | 1065 | 1880 | 1605 | 1460 | 1855 | 1805 | 1870 |
| *(1248)* | *b* | *85* | *151* | *117* | *107* | *149* | *132* | *150* |
| Children 5-6 | *a* | 1065 | 1880 | 1805 | 1280 | 1855 | 2000 | 1870 |
| *(1368)* | *b* | *78* | *137* | *119* | *85* | *136* | *132* | *137* |
| Chidren 6-7 | *a* | 1065 | 1720 | 1805 | 1280 | 1855 | 2000 | 1870 |
| *(1512)* | *b* | *70* | *114* | *111* | *78* | *123* | *123* | *124* |
| Children 7-8 | *a* | 1065 | 1720 | 1805 | 1280 | 1855 | 2000 | 1870 |
| *(1632)* | *b* | *65* | *105* | *103* | *73* | *114* | *114* | *115* |
| Children 8-9 | *a* | 1065 | 1720 | 1805 | 1280 | 1855 | 2000 | 1870 |
| *(1752)* | *b* | *61* | *98* | *96* | *64* | *106* | *114* | *107* |
| Children 9-10 | *a* | 1255 | 1720 | 1805 | 1280 | 1855 | 2000 | 1870 |
| *(1872)* | *b* | *67* | *92* | *93* | *59* | *99* | *107* | *99* |
| Persons 14-20 | *a* | 1255 | 1650 | 1890 | 1465 | 2355 | 2135 | 1965 |
| *(2400-3000)* | *b* | *52-42* | *69-55* | *79-63* | *61-49* | *98-79* | *89-71* | *82-66* |

Note: *a* = rations in calories; *b* = rations as a percentage of requirements; in brackets the caloric requirements are reported, according to the data source; Czechoslovakia Protectorate. Source: League of Nations (1944, p. 29).

It is easy to see how the ratio between requirements and rations is high throughout for the youngest age groups: for example, for children <1 age, ratios provided 264% of the needs in Germany, 284% in Belgium, 156% in France and 188% in Italy. This is explained by the fact that, since it was difficult to change the rations of a child at frequent intervals, children and adolescents were subdivided into 3 or 4 groups. Hence, since physiological needs change at different ages, the ratio between requirements and rations diminished with the increasing

age of individuals (League of Nations, 1944). National variations are also explained by the differences in grouping and of rations provided. From Table 4 it is apparent how ineffective the rationing system in Italy was: for all the categories (adults, expectant mothers, and children aged 3+), the Italian population received the lowest ratios between requirements and rations among the countries considered.

The overall shortage of foodstuffs and possible resultant under-nutrition for a large part of the Italian population is indicated by other data. Tab. 5 reports the number of calories derived from the rations of the main foods yielding animal proteins, such as milk, eggs and meat, in Italy and other countries in 1942-43. Even if the data could be subject to a certain margin of error (League of Nations, 1944, p. 48), they do however describe the main trends in food consumption with respect to the pre-war period.

**Tab. 5. Calories derived from milk*, cream, eggs, cheese and meat rations per day**

| Countries | Pre-war | 1942 | 1943 |
|---|---|---|---|
| Italy | 205 | 140 | 145 |
| Belgium | 705 | 430 | 400 |
| Czechoslovakia, Prot. | 630 | 530 | 355 |
| Germany | 710 | 475 | 495 |
| Finland | 905 | 355 | 540 |
| France | - | - | 455 |
| Netherlands | 665 | 585 | 495 |
| Norway | 830 | 620 | 425 |
| Poland | 530 | 75 | 55 |

Note: * skimmed and whole. Data for 1944 and 1945 are not available. Source: League of Nations (1944, p. 49).

Rural populations suffered less from the effects of rationing than the urban ones (Morgan, 2007, p. 61-62), while the role of the black market was, most likely, greater in those countries, such as Italy, where the level of calories provided by the rations was lower (League of Nations, 1946, p. 21). Indeed, the Italian population could not survive with a calorie intake as low as that guaranteed by legal rations. As a result, the black market became so widespread that the Fascist authorities could not suppress it, and even came to tolerate it (Klinkhammer 1993, p. 248; Morgan, 2007, p. 71). In 1942-43, in the urban centres, the households that did not occasionally resort to the black market represented an exception (Luzzatto-Fegiz, 1948, p. 15). The USA Department of Labor estimated that, in 1945, about one-twelfth of the budget of a family of five, providing 2,200 calories daily per consuming unit, could be obtained through the ration card; the rest come from the black market (U. S. Department of Labor, 1945, p. 27).

The increases in food prices in the free and on the black markets caused severe hardship to waged employees, who were about half the active population (Zamagni, 1998, p. 191). The progressive deterioration in the living standards of low-income families – many of

them waged employees - is evident, considering that in 1942 individuals with an income of 400 Italian Liras consumed a mean of 62% of their caloric requirements, while individuals with an income of 1300-1600 Liras, who were able to buy foods on the black market, consumed 90% of their caloric requirement (Luzzatto-Fegiz, 1948, p. 165).

In the Southern regions, the food situation remained very critical until the first months of 1944 (Williams, 2013). In May 1944, the Office of strategic studies reported how the lower and middle classes of Naples were "not far from starvation" while, of that city's population, only the wealthy had a satisfactory diet (Coles and Weinberg, 1986, p. 318). During that year, thanks to the aid provided by the USA, the situation improved. It was estimated that, in the spring of 1944, about 84% of the population of liberated Italy received half of the food they ate from imports brought in by the Allies (Coles and Weinberg, 1986, p. 318). According to a survey conducted in the Centre-Southern regions in September 1944, notwithstanding some improvement, 37% of children aged 6-9 years old still had not consumed animal protein foods in the two days before the survey (Tab. 6).

**Tab. 6. Percentage of children 6-9 years old who in the two days before the survey consumed animal protein foods – September 1944**

| Regions | No times | Once or twice | 3 or more times | Number |
|---|---|---|---|---|
| Umbria | 36.8 | 32.8 | 30.4 | 201 |
| Latium | 31.0 | 37.7 | 31.3 | 310 |
| Abruzzi | 44.4 | 34.3 | 21.3 | 531 |
| Campania | 39.0 | 31.9 | 29.1 | 764 |
| Apulia | 46.0 | 29.9 | 24.1 | 659 |
| Basilicata | 51.5 | 31.7 | 16.8 | 167 |
| Calabria | 39.0 | 34.2 | 26.8 | 477 |
| Sicily | 34.7 | 37.2 | 28.1 | 810 |
| Sardinia | 10.0 | 30.2 | 59.8 | 401 |
| Total | 37.0 | 33.4 | 29.6 | 4,320 |

Source: Commissione alleata et al. (1945, p. 149).

In 1944, in the Centre-North, where the war against Nazi-fascists continued, the provision of foodstuffs remained problematic for a large part of population. The diminution of agricultural production was made worse by the requisition of foodstuffs, particularly beef, and by the forced recruitment of a workforce to be employed in Germany, carried out by the *Wehrmacht* (Legnani, 1965, p. 32; Cuzzi, 2015, p. 75). In the last winter of the war (1944-45), the scarcity of food and heating fuel, the lack of raw materials for industries and the notable increase in jobs lost, severely strained the population (Legnani, 1965; De Bernardi and Ganapini, 2010, p. 298).

It has been estimated that during WWII about 45-65% of the Italian population was undernourished (Vecchi, 2011, p. 22). However, deprivation was even greater in the

immediate post-war years. In the second half of 1945, in Italy, the mean level of consumption of the non-farm population was about 1,500 calories per day, compared to 2,400-2,900 calories in the Northern European nations (League of Nations, 1946, pp. 84-85). The pre-war estimated mean number of calories consumed in Italy was 2,550 (League of Nations, 1946, pp. 84), a figure consistent with the 2,658 calories available per capita reported by Vecchi (2011, p. 417).

The war exacerbated the misery that was widespread throughout the entire territory, but especially in the Southern regions that were historically lagging behind. The North-South divide in per capita GDP, which progressively increased during the first half of 20th century, reached 50% in 1951 (Daniele and Malanima, 2014). A Parliamentary inquiry, carried out in the years 1951-53, showed how the Italian economy was particularly depressed (Commissione Parlamentare, 1953). The cited inquiry estimated that 1,357,000 households (11.8% of the national total) had a standard of living defined as "miserable", and another 1,345,000 households (11.6%) as "needy"; 7.5% of Italian households did not consume meat, sugar or wine at all, while another 8.9% had very scarce consumption levels. Overall, something like 45% of Italian households consumed insufficient quantities of the mentioned foodstuffs (Commissione Parlamentare, 1953; Ruffolo, 1954).

## 3. The impact on children's nutritional health

### *3.1. Infant mortality and natality*

The adverse impact of war on nutritional health and biological wellbeing is particularly relevant for children. Nutritional shortages, lack of sanitary provision, the absence or death of a father and the overall effects of war, produce physical and mental stress that may have lasting consequences (Goldson, 1996; Shields and Bryan, 2002; Devakumar et al. 2014).

From a sample of nearly 600,000 schoolchildren aged 6-19 years old, Cox (2015) showed how the shipping embargo imposed by the Allies on Germany at the onset of the WWI, led to nutritional deprivation, causing significant loss in weight and height among German schoolchildren. In1918, boys were overall 2.57 cm shorter and 1.1 kg lighter than in 1914, while females lost 2.81 cm and 0.99 kg. A loss in physical stature has also been registered for the Comunidad Valenciana during the Spanish Civil War and the autarchy period (Puche et al. 2016).

In Italy, because of the war, 52,056 people, among servicemen and civilians with children, perished or were declared 'missing' (Tab. 7). As a result, 94,648 children lost at least one parent, almost always the father: 81,516 children were younger than 15 years old when

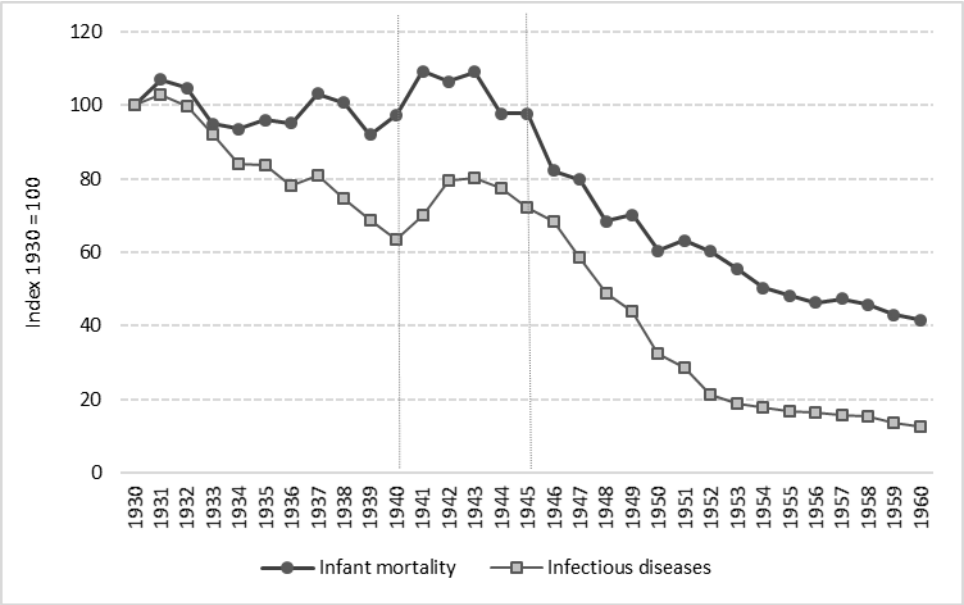
their parent died or disappeared due to the war. Children suffered the consequences of the conflict directly: 18,000 were injured and 10,000-12,000 remained maimed for life (Brosse, 1950, p. 67).

**Tab. 7. Number of deaths and missing persons with children caused by WWII and number of children of death or missing person in Italy**

| Death or missing persons with children | | Number of children | | | |
|---|---|---|---|---|---|
| Military | Civilians | of Death persons | of Missing persons | Total | <15 years |
| 46,692 | 5,364 | 52,938 | 41,710 | 94,648 | 81,516 |

Source: Istat (1957, pp. 38-40).

**Fig. 4. Infant mortality rate (<1 age) and mortality rate for infectious and parasitic disease in Italy, 1930-60 (Index 1930 = 100)**



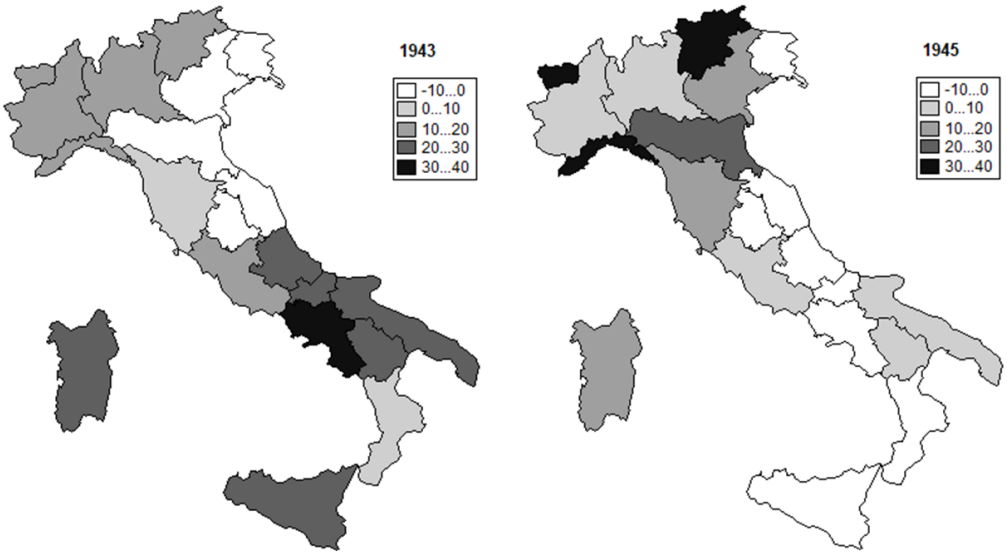

Source: Infant mortality: Istat, serie storiche, http://seriestoriche.istat.it; infectious diseases: Istat (1976).

The trend of the infant mortality rate (<1 age) in the period 1930-60 is illustrated in Fig. 4, together with the mortality rate from infectious and parasitic diseases. In Italy, the infant mortality rate had declined from the end of the 19th century. A peak was registered in 1918, however, due to the Spanish flu epidemic (Atella et al. 2011). From 1930 to 1940, the infant mortality rate diminished by about 40%. WWII interrupted the decreasing trend. Between 1940 and 1943, infant mortality rate rose from 97 to 115 per thousand live births, then diminished. The mortality rate for infectious and parasitic diseases followed a similar pattern: in 1941, the mortality rate began to increase and peaked in 1943, when the conflict entered the Italian territory. It then declined, returning to its pre-war level in 1946. The increase was mainly due to typhoid fever, the incidence of which went from 90 to 163 deaths

per one million inhabitants between 1939-43; to tuberculosis of the respiratory system, that went from 507 to 802 deaths per million inhabitants; to other forms of tuberculosis and infectious diseases, and to a recrudescence of malaria (Istat, 1950, p. 10).

In the Southern regions, infant mortality rates were historically higher than in the Northern ones (Atella et al. 2001). In 1939 for example, infant mortality rates in the Southern regions ranged between 95-147‰, while in the Northern ones between 61-97‰ (Istat, 1950, p. 4). In wartime, the regional changes in infant mortality during the conflict were different. Fig. 5 shows the differences in infant mortality rates respect to the pre-war level, in 1943 and 1945 in the twenty Italian regions. It is easy to see how, in 1943, infant mortality rates were higher than in 1939 everywhere in the country, except for five regions in the Centre-North East. In 1945, in the South and part of the Centre infant mortality rates returned to their pre-war level or were even lower; instead, in the rest of the country, the rates remained higher than in 1939.

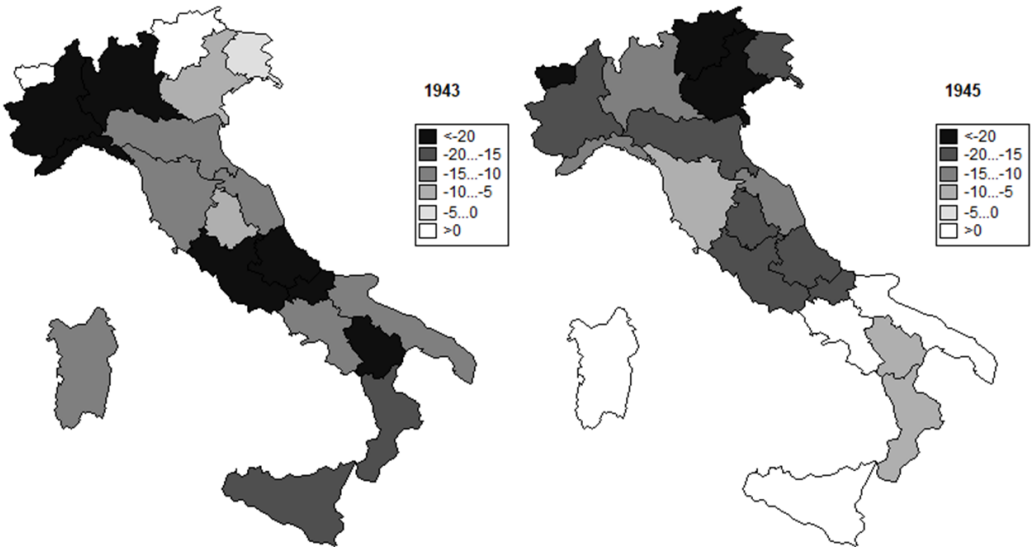
**Fig. 5. Infant mortality in 1943 and 1945 in the Italian regions (index 1939 = 100)**




Note: Differences are in percentage points. Darker colour indicates higher mortality. Source: Calculations on Istat (1950, p. 4).

During WWII, the natality rate decreased in Italy. The number of live births per 1,000 inhabitants went from 23.6 in 1939 to 18.5 in 1945; in 1946, it increased to 22.7 per 1,000 (Istat, 1940, 1952). Even though in the Southern regions, natality rates were higher than in the Centre-North, the conflict impacted negatively on all regions. Fig. 6 illustrates the regional differences in natality rates in 1943 with respect to the 1939 levels, and in 1945 with respect to the 1943 levels. The map shows how in 1943 natality diminished in all Italian regions, except in the Valle d'Aosta and in Trentino Alto Adige. During 1944-45, in the North-Centre Italy, natality rates continued to decline, while in the South and Isles it increased (Istat, 1952, p. 14). In fact, as shown in Fig. 6, natality in the Centre-North remained notably lower than the 1943 level. Overall, the trends in infant mortality and natality rates seem to reflect the 'geography of the conflict' in Italy. As noted above, in fact, in 1944 the South of Italy was controlled by the Allies, while the conflict continued in the rest of the country occupied by the Nazi-Fascists.

**Fig. 6. Natality rates in 1943 (index 1939 = 100) and in 1945 (index 1943 = 100) in the Italian regions**




Note: Differences are in percentage points. Darker colour indicates lower natality rates. Source: Calculations on Istat (1940, p. 28-29; 1952, p. 14).

### *3.2. Anthropometric data*

Anthropometric measurements are widely used indicators of the standards of living of populations (Komlos and Meermann, 2007; Silventoinen, 2003; Ayuda and Puche, 2014; Grasgruber et al. 2014). Anthropometric measurements, especially height, are the result of the

interaction between genes and environment (McEvoy and Visscher, 2009). Nutritional standards during pregnancy and in childhood, together with health conditions, are key factors affecting height, weight and, consequently, the body-mass index in adulthood (Bogin, 2001). These factors also affect the incidence of some diseases in the course of life. There is evidence to show how exposure to war in childhood, diseases and environmental conditions, can affect the height and weight of children, producing long-lasting effects on physical and psychological health. These effects have been documented, for example, for Germany during WWI (Blum, 2011, 2013; Cox 2015). In Spain too, the Civil War and the autarchic policies pursued during Franco's dictatorship had a permanent, detrimental effect on children's and conscript's height (Martínez-Carrión et al. 2012; Puche et al. 2016). A transient reduction in temporal trends of children's weight and height, related to food restriction, was instead observed for Norway and Finland during WWII (Angell-Andersen et al. 2004).

ln the case of Italy, there is little evidence concerning children's anthropometric measurements for the war period. In most cases, available anthropometric data refer to samples that changed over time, regarded diverse Italian regions, or referred to years very distant from each other: this somewhat limits analysis. There are, however, some studies regarding school-age children that make some comparisons possible. Three studies refer to Rome and two to Naples. A study of a sample of 2.832 children, aged 6-11 years old, of which 52% (1,480) were boys, was carried out in 1945 in the schools of Rome, with the aim of verifying the impact of WWII on children's nutritional health (Galeotti, 1948).

In Tables 8 and 9, height and weight measurements are reported for boys and girls respectively, together with similar measurements regarding 1939-41 and 1949. The 1939-41 data were collected by the Office of Public Health of the Municipality of Rome from a sample of 1,800 schoolchildren, and reported in the 1945 study by Galeotti (1948) for comparison purposes. The measurements for Roman and Neapolitan schoolchildren in 1949 were collected during research that involved 13,619 schoolchildren in all the Italian regions and, in the same research, were separately reported and compared with previous data regarding the two cities (Bacchetta 1951, p. 48, 93)[4].

[4] This study does not report the number of observations for the Rome and Naples samples but it is reported for the respective regions, that is 1,403 schoolchildren (703 boys) for Latium and 976 (569 boys) for Campania (Bacchetta, 1951, p. 91).

**Tab. 8. Rome, height of 6-11 year-old boys and girls, 1939-41, 1945, 1949, and differences between measurements (cm)**

| | | | Boys | | | | | Girls | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| **Ages** | 1939-41 | 1945 | 1949 | (3) - (2) | (4) – (3) | 1939-41 | 1945 | 1949 | (8) - (7) | (9) – (8) |
| **6** | 114.1 | 112.6 | 118.3 | -1.5 | 5.7 | 114.7 | 114.1 | 115.3 | -0.6 | 1.2 |
| **7** | 119.0 | 117.3 | 121.6 | -1.7 | 4.3 | 118.4 | 117.5 | 120 | -0.9 | 2.5 |
| **8** | 125.6 | 123.2 | 126.7 | -2.4 | 3.5 | 123.9 | 123.5 | 126.3 | -0.4 | 2.8 |
| **9** | 130.5 | 128 | 130.9 | -2.5 | 2.9 | 128.4 | 128.2 | 130.4 | -0.2 | 2.2 |
| **10** | 134.7 | 131.9 | 136.1 | -2.8 | 4.2 | 133.3 | 133.1 | 133.9 | -0.2 | 0.8 |
| **11** | 136.6 | 136.2 | 138.4 | -0.4 | 2.2 | 138.2 | 136.6 | 141.3 | -1.6 | 4.7 |

Source: for 1939-41 and 1945, Galeotti (1948); for 1949, Bacchetta (1951, p. 93).

**Tab. 9. Rome, weight of 6-11 year-old boys and girls, 1939-41, 1945, 1949, and differences between measurements (kg)**

| | | | Boys | | | | | Girls | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| **Ages** | 1939-41 | 1945 | 1949 | (3) – (2) | (4) – (3) | 1939-41 | 1945 | 1949 | (8) - (7) | (9) – (8) |
| **6** | 20.3 | 20.2 | 25.5 | -0.1 | 5.3 | 21 | 20.4 | 23.1 | -0.6 | 2.7 |
| **7** | 22.4 | 22.3 | 26.6 | -0.1 | 4.3 | 22.7 | 21.7 | 25.2 | -1 | 3.5 |
| **8** | 25.7 | 24.8 | 28.3 | -0.9 | 3.5 | 24.7 | 24.2 | 27.9 | -0.5 | 3.7 |
| **9** | 28.2 | 27.2 | 30.3 | -1 | 3.1 | 27 | 26.5 | 30.5 | -0.5 | 4 |
| **10** | 30.7 | 29.3 | 33.8 | -1.4 | 4.5 | 29.8 | 29.4 | 32.6 | -0.4 | 3.2 |
| **11** | 32.4 | 31.4 | 34 | -1 | 2.6 | 32.5 | 31.6 | 36.5 | -0.9 | 4.9 |

Source: see tab. 8.

The comparisons clearly show how WWII impacted negatively on the anthropometric measurements of schoolchildren in Rome. In 1945, at the age of 6 years old, boys were shorter by 1.5 cm than in 1939-41, while girls were 0.6 cm shorter (Tab. 8, col. 5). At the age of 11, the difference for boys was -0.4 cm and for girls -1.6 cm. In addition, the weight of both boys and girls in 1945 was less than in 1939-41 (Tab. 9, col. 5). For boys, the difference in weight between the samples from 1939-41 and 1945 was very small at the age of 6-7 years and about 1 kg for those aged 8-11 years; instead for girls, the larger differences were registered for the ages of 7 and 11 years old, and were 1 and 0.9 kg respectively. In the post war period, there was a significant gain in height and weight. Between 1945-49 the height of 11 year-old boys increased by 2.2 cm, and their weight by 2.6 kg, on average (Tables 8 and 9, col. 6).

Even though these gains may appear large, given the relatively short time-span, it is noteworthy that for all the considered ages there were systematic and significant differences in anthropometric measurements between the three inquiries. Significant increases in weight and height were also registered for schoolchildren in Naples between 1944 and 1949 (Tab. 10 and 11). It goes almost unnoticed that the reported anthropometric data concern samples of

children living in two large cities and, thus, cannot be considered as representative of the entire Italian national population[5].

**Tab. 10. Naples, height of 6-11 year-old boys and girls in 1944 and 1949, and differences between 1944 and 1949 (cm)**

| | Boys | | | Girls | | |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Age | 1944 | 1949 | (3) – (2) | 1944 | 1949 | (6) – (5) |
| 6 | 108.8 | 112.4 | 3.60 | 107.4 | 110.6 | 3.20 |
| 7 | 113.5 | 117.1 | 3.60 | 111.5 | 117.3 | 5.80 |
| 8 | 117.2 | 122.4 | 5.20 | 118.4 | 121.7 | 3.30 |
| 9 | 122.4 | 124.7 | 2.30 | 123.6 | 127.8 | 4.20 |
| 10 | 127.8 | 130.4 | 2.60 | 128.1 | 131.0 | 2.90 |
| 11 | 130.3 | 136.8 | 6.50 | 132.6 | 133.2 | 0.60 |

Source: Bacchetta (1951, p. 93).

**Tab.11. Naples, weight of 6-11 year-old boys and girls in 1944 and 1949, and differences between 1944 and 1949 (kg)**

| | Boys | | | Girls | | |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Age | 1944 | 1949 | (3) – (2) | 1944 | 1949 | (6) – (5) |
| 6 | 18.0 | 19.89 | 1.89 | 17.7 | 18.85 | 1.15 |
| 7 | 20.3 | 22.11 | 1.81 | 19.9 | 21 | 1.10 |
| 8 | 22.3 | 23.77 | 1.47 | 21.7 | 24.16 | 2.46 |
| 9 | 24.5 | 25.13 | 0.63 | 24 | 25.06 | 1.06 |
| 10 | 26.7 | 27.23 | 0.53 | 26 | 27.47 | 1.47 |
| 11 | 28.1 | 30.32 | 2.22 | 27.2 | 29.61 | 2.41 |

Source: see tab. 10.

Even considering the possible limitations deriving from different samples or measurement methods used, the differences in the somatic development of schoolchildren between 1945 and pre-war and post-war years, can be attributed to the precarious and insufficient nutritional conditions during the conflict (Galeotti, 1948, p. 57; Bacchetta, 1951). The diminution in height and weight between 1939-41 and 1945 observed for Roman schoolchildren and, especially, the gains registered in 1949 in the two cities sampled, are consistent with the trends in GDP and consumption per capita. Notwithstanding the aftermath of the war, and the destruction of productive capacity and infrastructures, by 1949 the fall in aggregate production and consumption levels had, in fact, been almost completely restored, and children's height and weight reflected these general improvements.

[5] The samples of schoolchildren in Rome and Naples may, to some extent, be considered representative of the urban population; it is, however, necessary to bear in mind that WWII had different regional impacts and that, in addition, the economic and nutritional conditions of Italian regions were heterogeneous.

Were the adverse effects of war on anthropometric measurements long-lasting or, instead, transient? Research indicates that, in the human life-cycle, two growth periods are especially important for determining adult height: the first period goes from conception to 2 years of age, while the second occurs before the onset of puberty (Perkins et al. 2016, p. 150). This last is defined as an opportunity for 'catch-up growth': it is characterized by a body growth that is more rapid than normal for age, and follows a period of growth inhibition (Perkins et al. 2016). This phase of 'catch-up' is not always sufficient, however, to fully redress deficiencies in the first growth period and achieve full growth potential (Leroy et al. 2014).

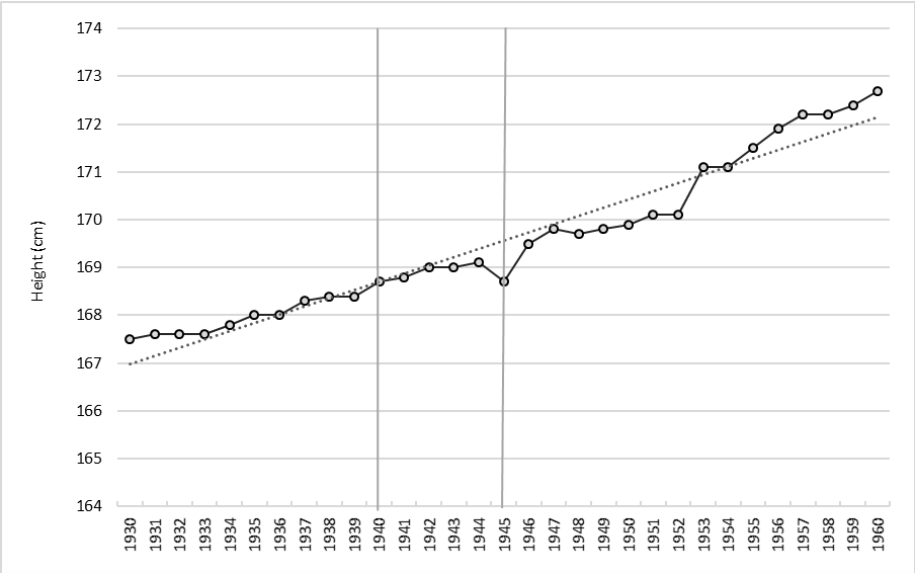
To evaluate the eventual permanent effects of food deprivation or physiological stresses on health, height in adulthood is a more appropriate indicator than children's height. Adult height, in fact, is the result of the cumulative balance between nutritional intake and loss during the life-cycle, particularly during the growth periods (Perkins et al, 2016). A child's height or body mass index reflect, instead, current nutrition, or the immediate effect of environmental factors, and may not fully represent the effects of catch-up growth.

### *3.3. The effects on height*

A strategy to evaluate possible permanent effects on health of exposure to warfare during childhood and pre-adolescence is that of using the height of conscripts. In Italy, military service was mandatory, so 18-year-old males were subject to a medical examination during which height, weight and thoracic circumference were recorded (Arcaleni, 1998, 2006)[6]. The average height of Italian conscripts born in the years 1930-60 is reported in Fig. 7. The secular increase in height that characterized Italy during the last century, like other developed countries, is evident (Sanna, 2002; Danubio and Sanna, 2008; A'Hearn and Vecchi, 2011; Arcaleni, 2012). The increasing trend was interrupted in 1943-44, while in 1945 the average height diminished with respect to the previous year. This interruption of secular trend in height during the two World wars was also found in other European countries, such as Belgium and Greece (Malina, 1990; Hatton and Bray, 2010).

[6] Compulsory military service was established in 1863. Initially, the medical examination for military recruitment was usually performed at the age of 20, but occasionally at a younger age. Starting from the cohort born in 1941, the medical examination was performed at the age of 18 (Istat, 2012, p. 190). For this reason, national average height is standardized at the age of 20 (Istat, 1976, 1986). The difference between the measured average height and that centred at 20 years was, however, significant until the 1930s; subsequently, the difference became negligible (Arcaleni, 1998, p. 30). For the methodology of the adjustment of height at 20 years of age see: Costanzo (1948); Arcaleni (1998, 2012); A'Hearn and Vecchi (2017, p. 81).

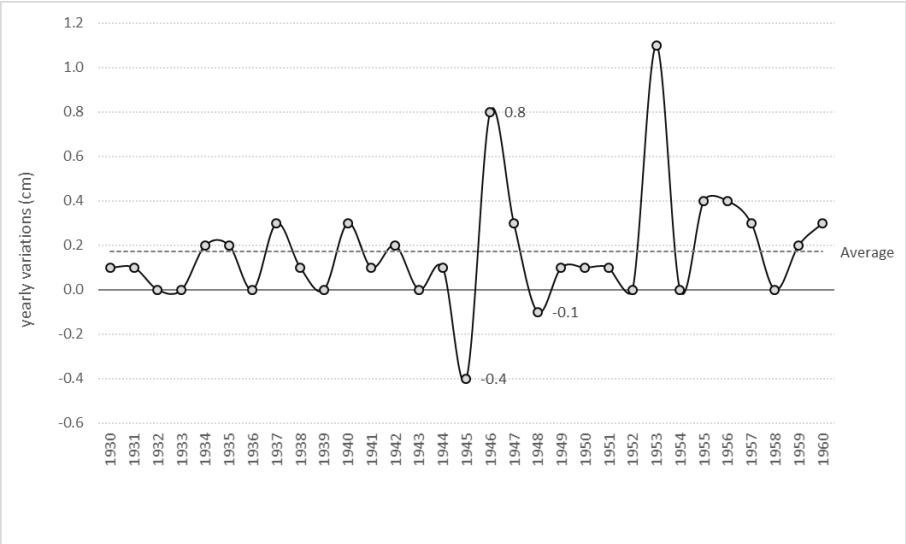
**Fig. 7. Height of the Italian conscripts born in 1930-1960**




Source: Istat (1976; 1986)

Over the considered period, negative variations in height were registered in 1945 (-0.4 cm) and in 1948 (-0.1 cm) with respect to the previous years. Conscripts born in 1945 were, therefore, 0.8 cm shorter than the 1946 cohort (Fig. 8).

**Fig. 8. Yearly variations in the heights of the conscripts born in 1930-1960 (cm)**



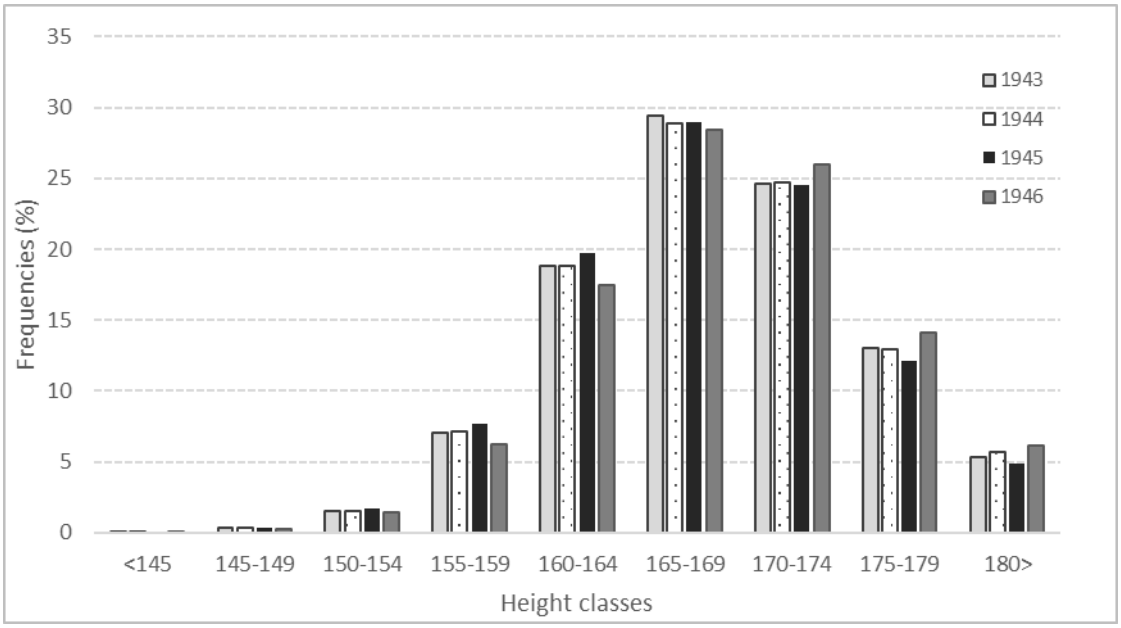

Source: see Fig. 7.

Fig. 9 reports the histogram of height in the years 1943-1946. It is evident that the distribution changed between 1943 and 1946, with a marked increase in the shares of

conscripts in the highest classes (>169 cm) of the distribution. The diminution of the average height of the conscripts born in 1945 is explained by the increase in the share of individuals in the classes <165 cm and by a corresponding decrease of those falling in the classes >169. In 1946, the distribution shows, instead, a comparatively higher frequency of subjects taller than 169 cm, while the frequency of those shorter than 165 cm is lower.

In the last century, modifications in the distribution of mean height have been documented for several countries (Hermanussen et al. 1995; Staub et al. 2015). In developed nations, the distribution of height is nearly symmetrical (Arcaleni 2006; A'Hearn et al. 2009, Staub et al. 2015). In the case of inadequate nutrition for a large proportion of a population, as in pre-modern times, or in some developing countries today, the shape of height distribution, instead, deviates from symmetry, presenting a left-tail (Deaton 2008; A'Hearn et al. 2009). For example, in Italy, in 1874, the distribution of height of Italian conscripts was negatively skewed, indicating an over-representation of individuals in the left tail of the distribution. Skewness passed to values near to zero in 1938 and, subsequently, assumed slightly positive values, indicating a small excess of subjects in the right tail of the distribution; simultaneously, kurtosis progressively decreased, assuming values typical of a normal distribution (Terrenato and Ulizzi, 1983).

**Fig. 9. Histogram of height of conscripts born in 1943-46**




Source: Calculations on Istat (2012), serie storiche, http://seriestoriche.istat.it

The changes in the distribution of height, and the negative variation registered in 1945, may suggest a permanent, although small, adverse effect of the war, due to the nutritional deprivation that the 1945 cohort was subject to, in the first year of life or *in utero*, as has been suggested by previous studies (Grassivaro Gallo, 1972; Hermanussen et al. 1995). This conclusion could be misleading, however, if we do not consider the possible effects deriving from the regional changes regarding the cohort of conscripts born in 1945. In Italy, in fact, there are significant regional differences in average height (Arcaleni, 1998, 2006; A'Hearn and Vecchi, 2011). In the Centre-North, height is historically higher than in the South-Islands: the difference between the two areas was, respectively, 4.9 cm in 1941, 3.9 cm in 1951 and 3.7 cm in 1961 (A'Hearn and Vecchi, 2011, p. 56)[7].

As previously noted, until April 1945, the Northern regions were occupied by Nazi-Fascists, while the Allied forces had already liberated the Southern part of Italy in 1943. Since, in 1944, Northern regions were still involved in the conflict, natality fell in the subsequent year. The fall in natality, modifying the regional shares of conscripts born in 1945, could explain the reduction in average height and the modification of the shape of height distribution in the national sample. In fact, in 1945, the number of male children born in the Northern regions diminished by 14.4% with respect to the previous year, while in the South it increased by 13.6% (Istat, 1952). These changes in natality modified the regional shares of conscripts at the military recruitment medical check-up. As shown in Tab. 12, the share of conscripts born in 1945 in the Southern regions was higher, and that of the Northern areas lower, than in the other years considered.

**Tab. 12. Conscripts per macro-regions (%) and total numbers in Italy 1942-46**

| | 1942 | 1943 | 1944 | 1945 | 1946 |
|---|---|---|---|---|---|
| North | 43.6 | 43.0 | 43.8 | 40.1 | 42.5 |
| Centre | 17.8 | 18.4 | 17.7 | 18.4 | 18.5 |
| South | 38.7 | 38.6 | 38.5 | 41.6 | 39.0 |
| Num. conscripts | 356,126 | 355,899 | 349,578 | 337,422 | 398,280 |

Source: Istat (1969, 1970)

These data suggest that the negative variation registered for the average height of Italian conscripts born in 1945 may be due to two reasons: a 'nutritional effect' that impacted on height, and a 'natality effect' that modified the regional shares of conscripts born in that year. In order to disentangle these two effects on total variation in height observed in Italy, we computed the average height in 1945 by applying the 1944 regional distribution of the

[7] It is worth noting how in Italy regional differences in height are in part due to genetic factors (Cacciari et al., 2002; A'Hearn and Vecchi, 2017, p. 71-72).

conscripts. Thus, we obtained a measure of average height that cancelled out the effect due to changes in natality rates in the regional distribution of height. The difference between this measurement and the height recorded in 1945 gives the variation due to nutritional aspects, which accounts for about 55% of the total variation in height registered for Italian conscripts between 1944-45, and it is estimated at -0.22 cm.

The different impacts and the length of the conflict in the diverse areas of Italy, however, leaves us room to hypothesise that the impact on height may have been territorially differentiated. To verify this hypothesis, we considered the changes in height in each of the twenty Italian regions (Tab. 13). Slight decreases in height for the 1943 cohort of conscripts were registered in four regions, three of which were in the Centre-South: Latium (-0.8 cm), Molise (-0.3 cm) and Campania (-0.2 cm). Data for Latium and Campania are consistent with the anthropometric measurements of the schoolchildren of Rome and Naples previously presented that, in both cases, show significant differences in average height between 1944 and 1949, for children at different ages. In the years 1944 and 1945, height diminished in the Northern regions and in Latium and Abruzzo. In 1944-45, the height of conscripts decreased cumulatively by 1.3 cm in Valle D'Aosta, by 0.9 in Piedmont, Lombardy and in Trentino Alto Adige, and by 0.7 cm in Liguria.

**Tab 13. Yearly variations in average height of conscripts in the Italian regions 1940-1945 (cm)**

| Regions | 1940 | 1941 | 1942 | 1943 | 1944 | 1945 | 1944-45 |
|---|---|---|---|---|---|---|---|
| **North** | | | | | | | |
| Piedmont | 0.3 | 0.1 | 0.1 | -0.3 | 0.0 | -0.8 | -0.9 |
| Valle D'Aosta | -0.4 | 0.9 | 0.0 | 0.3 | -0.6 | -0.7 | -1.3 |
| Lombardy | 0.2 | 0.0 | 0.0 | 0.4 | 0.0 | -0.9 | -0.9 |
| Liguria | 0.1 | 0.2 | -0.1 | 0.1 | -0.5 | -0.2 | -0.7 |
| Trentino A. A | 0.4 | 0.0 | 0.8 | 0.3 | -0.9 | 0.0 | -0.9 |
| Veneto | 0.1 | 0.2 | 0.3 | 0.0 | -0.1 | 0.0 | 0.0 |
| Friuli V.G. | 0.6 | 0.1 | 0.0 | 0.2 | -0.1 | -0.1 | -0.1 |
| Emilia R. | 0.3 | 0.1 | 0.2 | 0.0 | 0.0 | -0.1 | -0.1 |
| **Centre** | | | | | | | |
| Toscana | 0.3 | -0.1 | 0.2 | 0.0 | 0.2 | 0.0 | 0.3 |
| Umbria | 0.5 | -0.3 | 0.9 | 0.0 | -0.3 | 0.4 | 0.1 |
| Marche | 0.4 | 0.2 | 0.4 | 0.3 | 0.1 | 0.0 | 0.1 |
| Latium | 0.3 | 0.5 | 0.9 | -0.8 | -0.2 | -0.3 | -0.5 |
| **South and Isles** | | | | | | | |
| Abruzzo | 0.0 | 0.1 | 0.5 | 0.2 | -0.1 | -0.5 | -0.6 |
| Molise | 0.1 | 0.2 | 0.2 | -0.3 | -0.1 | 1.4 | 1.3 |
| Campania | 0.0 | 0.3 | 0.3 | -0.2 | 0.9 | -0.2 | 0.8 |
| Apulia | 0.2 | 0.0 | 0.0 | 0.1 | -0.1 | 0.1 | 0.0 |
| Basilicata | 0.6 | -0.3 | 0.5 | 0.0 | 0.2 | -0.1 | 0.1 |
| Calabria | -0.1 | 0.3 | 0.2 | 0.2 | 0.0 | 0.1 | 0.1 |
| Sicily | 0.1 | 0.1 | 0.2 | 0.0 | 0.0 | 0.3 | 0.3 |
| Sardinia | 0.4 | 0.5 | -0.2 | 0.2 | 0.0 | 0.3 | 0.3 |
| **Italy** | **0.3** | **0.2** | **0.2** | **0.0** | **0.1** | **-0.4** | **-0.3** |

Note: For 1944-45 cumulated yearly variations. Source: calculation on Istat (2012), serie storiche, http://seriestoriche.istat.it.

The variations in height for Italy and its twenty regions for the 5-year period between 1930 and 1950 are reported in Tab. 14. In the considered time span, the average height continuously increased in all regions, except for Campania in 1935-40. Between 1940-45, height decreased in the four Northern Western regions and in Latium where, however, the diminution was close to zero. In Piedmont, height decreased by 0.9 cm, in Lombardy and Liguria by 0.5 cm. In the case of Piedmont, a negative impact of WWII on height and physical development was observed by Masali and Venturini (1964), who considered anthropometric measurements of samples of females and males born between 1940-49, and which they attributed to nutritional deficiencies.

**Table 14. Variations in height in the Italian regions in the period 1930-1950 (cm)**

| | 1930-35 | 1935-40 | 1940-45 | 1945-50 |
|---|---|---|---|---|
| **North** | | | | |
| Piedmont | 0.4 | 0.7 | -0.9 | 1.2 |
| Valle D'Aosta | 1.0 | 0.4 | -0.1 | 1.3 |
| Lombardy | 0.4 | 0.5 | -0.5 | 1.3 |
| Liguria | 0.6 | 0.7 | -0.5 | 0.6 |
| Trentino A. A. | 0.4 | 1.2 | 0.3 | 1.3 |
| Veneto | 0.3 | 0.5 | 0.4 | 1.4 |
| Friuli V. G. | 0.7 | 0.9 | 0.1 | 1.3 |
| Emilia Romagna | 0.4 | 0.5 | 0.2 | 1.2 |
| **Centre** | | | | |
| Tuscany | 0.7 | 0.3 | 0.4 | 0.7 |
| Umbria | 0.5 | 0.6 | 0.8 | 2.7 |
| Marche | 0.5 | 1.0 | 0.9 | 0.9 |
| Latium | 0.7 | 1.0 | 0.0 | 0.2 |
| **South and Isles** | | | | |
| Abruzzo | 0.6 | 0.6 | 0.2 | 3.0 |
| Molise | 0.5 | 0.8 | 1.4 | 1.7 |
| Campania | 0.6 | -0.1 | 1.1 | 1.3 |
| Apulia | 0.4 | 0.9 | 0.2 | 2.1 |
| Basilicata | 0.3 | 1.0 | 0.3 | 1.9 |
| Calabria | 0.6 | 0.3 | 0.8 | 1.4 |
| Sicily | 0.2 | 0.5 | 0.7 | 1.3 |
| Sardinia | 1.0 | 0.6 | 0.8 | 0.7 |
| **Italy** | **0.5** | **0.7** | **0.0** | **1.1** |

Note: Absolute variations in the selected periods. Source: calculation on Istat (2012), serie storiche, http://seriestoriche.istat.it.

It is worth noting how the regional picture that emerges from the changes in average height coincides with the course of the conflict in Italy: it was in the regions to the North of the Gothic Line, where height diminished, that the war lasted until April 1945. Latium - and Rome particularly - suffered from the devastating consequences of the repeated air raids. In the Southern regions, the rapid advance of the Allied troops in 1943, allowed the population to suffer for a less time the effects of the war.

## 4. Conclusions

This paper has examined the effect of WWII on the nutritional health of the Italian population and, particularly, of children. Recent reconstructions of national accounts show that, during the war, per capita GDP and private per capita consumption collapsed by about 50% with respect to pre-war levels. The drop in agricultural production, the difficulties in the distribution of raw materials and the necessities imposed by the economy of the war, including the provisioning of the troops, caused a shortage of foodstuffs for the Italian civilian population (Morgan, 2007, p. 65). The shortage was made worse by the inefficiency of the rationing system. In Italy, the number of calories provided by rations in 1942-43 was, in fact, notably lower than in other Western Countries, such as France, Germany or Belgium (League of Nations, 1944, 1946).

Children in particular suffered the consequences of the conflict. About 94,600 children, 86% of which were younger than 15 years of age, lost at least one parent because of the war. Between 1939-43, infant mortality increased, given the recrudescence of infectious and parasitic diseases. During the war, the natality rate fell. At the regional level, the trends in infant mortality and natality were different, and appear to be related to the 'geography of the war' in Italy. After 1943, in the Southern regions occupied by the Allies, infant mortality decreased, while natality rates increased; in the Centre-North, where the conflict lasted until April 1945, infant mortality rates remained higher than the pre-war level, while the natality rate continued to diminish.

The anthropometric measurements of some samples of children in Rome and Naples in 1945 provide evidence of the negative impact of the war on health. In a sample of Roman schoolchildren of 1945, at 6 years of age, boys were 1.6 cm shorter and girls 0.6 cm shorter than in 1939-41. At the age of 11 years, the difference in height was of -2.8 cm for boys and -0.2 cm for girls. Between 1945 and 1949, both height and weight increased markedly for all age-groups.

To verify a possible long-lasting effect of war on nutritional health, we considered the heights of conscripts. During the last century, average height significantly increased in Italy (Peracchi, 2008; Arcaleni, 2006, 2012; A'Hearn and Vecchi, 2011). As in other countries (Hatton and Brey, 2010), the trend of increase was interrupted by WWII. A diminution of height of about 0.4 cm for the cohort of conscripts born in 1945, with respect to the previous year, is apparent from the national data. This regress in height was accompanied by a reduction of the number of conscripts from the Northern regions falling in the highest groups of height distribution. We propose that these changes are in part explained by the change in

the shares of conscripts coming from the diverse Italian regions. In 1944-45, in fact, because of the war, natality in the Northern regions, where the average height was comparatively higher, fell. This impacted both on the average national height and the distribution of the same. However, regional data on the stature of conscripts indicate that WWII probably also had an adverse and long-lasting effect on general health. For the cohort of conscripts born in 1943, slight decreases in height were registered in four Italian regions, three of which were in the Centre-South. In 1944-45 stature decreased in some Northern Italian regions, where the war of liberation from the Nazi-Fascists lasted longer.

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