Women's health, size at birth and socio-economic change in Bologna, Italy, 1880-1940*

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1. Introduction. Over the past two decades, anthropometric descriptions of past populations have become widely-accepted measures of human welfare in earlier times. Height-for-age and, much less often, newborn weight have been employed as indices of human well-being, and long-term fluctuations in mean height and birth weight are now regarded as indications of changes in living standards. The first historical anthropometric studies focused upon a small group of European and American populations from the late 18th century onward. But the range of societies and the time periods investigated have widened dramatically, as have the evidentiary base and the nature of the investigative techniques employed. While much work remains to be done, we can now begin to consider the possibility of mapping a global anthropometric history of our species over several millennia.

Yet anthropometric data and the means used to explore them remain rather basic analytic tools. At both an individual and an aggregate level, height-for-age and newborn weight are products of many factors, some unique to an individual, some broadly environmental, many still not fully understood. Anthropometric historians have been almost entirely preoccupied with environmental factors; apart from height and weight, locating information about the growth experiences of individuals has proved extremely difficult. In addition, investigators have faced serious problems in specifying with any precision the range of environmental factors that might affect growth outcomes. Most noticeably, they have not been able to distinguish economic from disease factors when exploring the determinants of growth and well-being. The relevance of both to growth outcomes is universally acknowledged. But the lack of information about disease conditions in study populations has usually forced investigators to treat mean height and birth weight as net products of interactions between economic and disease factors. The identification of height as a consequence of 'net nutrition' – gross nutritional intake minus the ener-

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gy claims of everyday life and disease – is now well-established in the literature (Fogel 1993; Steckel 1995). The most important limitation of this argument should be apparent at once. In any analysis of change over time it is not possible to specify whether change is due either wholly or in part to one group of factors or to the other. To what extent are year-over-year variations in mean stature or newborn size due to changes in the socio-economic, as opposed to the disease, environment? Thus far we've lacked evidence to explore this question. A set of case records from a maternity clinic in Bologna, provides an opportunity.

While birth size in earlier populations has been far less extensively explored than has stature, it provides unique opportunities to examine the independent role of health in past anthropometric outcomes. Clinical childbirth provided far greater opportunities for medical observation and record-keeping than did most historic settings in which heights were recorded. Although a small number of maternity hospitals predated the nineteenth century, most institutional obstetric services in the western world emerged after 1800, largely during the middle and later decades of the century, and almost invariably in association with a university medical faculty. The growing emphasis of 19th century medical teaching, research, and practice on careful observation and systematic record-keeping resulted in the accumulation of case records that noted social and medical information about mothers, as well as descriptions of the birth process and the size and health of the newborn child. The patient records of the maternity unit at the Ospedale Sant'Orsola in Bologna are particularly rich sources of information about maternal health, providing an opportunity to examine its relationship to fetal growth and size at birth. In turn, these data contribute to an understanding of the health and welfare of the northern Italian population during the industrial transition from the late 19th century to the Second World War.

As an index of human welfare, weight at birth has two dimensions. On one hand it is influenced by, and therefore reflects, maternal socio-biological circumstances. On the other it influences the short term life chances of newborns and, according to a growing body of evidence, health over the long term as well (Barker 1992; Barker 1997; Richards 2001; Shenkin 2001). While the study of fetal growth has a long history, most investigations have been conducted in the relatively recent past and in the industrialized world. Opportunities to examine the relationship between long term socio-economic change and newborn size and health have therefore been limited. This project employs an historical approach that allows such relationships to be examined more closely.

2. Sources and methods. The study is based on the maternity case records of the Ospedale Sant'Orsola in Bologna between 1880 and 1940[1]. Samples of approximately 200 cases per year were selected for analysis. In years when fewer that 200 cases were available, all were recorded. The resulting database consists of 12,417 cases. It includes women admitted to the clinic for other health reasons, primarily gynecological. 89% (10,426 cases) of those included in the sample, however, were obstetric patients, 70% (8,230 cases) delivered live born children and 19% (2,196 cases) experienced abortions or stillbirths.

The Ospedale Sant'Orsola was one of two general hospitals in the city with close ties to the medical faculty of the University of Bologna. The other, the Ospedale Maggiore, did not admit obstetric patients. The roots of the Sant'Orsola lay deep in the charitable traditions of late medieval monasticism and, before reforms introduced during the second half of the 19th century, it accommodated only poor and incurable patients. In 1860, however, on the decree of the reforming head of the regional government of Emilia, the hospital established an obstetric and gynecological clinic, one of a series of innovations during the early Italian national era that laid the foundations for the development of modern hospitals in the region (Moretti 1960; Tarozzi 1990; Bernabeo 1992). A second civic maternity, l'Ospizio Esposti e l'Asilo di Maternità, had similar ancient charitable origins as a hospice for abandoned or orphaned children. The same administrative decree that led the Sant'Orsola to introduce an obstetric clinic required the Ospizio e Asilo to do the same. Thus, from the early 1860s onward Bologna possessed two institutional maternity services (Rubbi 1960)[2].

The two clinics differed in important respects. The Ospizio e Asilo was intended exclusively for unmarried women and illegitimate children. As the decree establishing the clinic stated, «le nubili trovassero in un luogo appartato adeguata assistenza con ogni garanzia di riservatezza e conforto, per poter allattare nei primi mesi i loro nati senza preoccupazioni». Those admitted were working women, mostly servants, agricultural labourers or workers in the needle trades (Bruers 1885; Bordè 1904). With a median age in the lower 20s, they tended to be younger than the Sant'Orsola patients. They were more likely to be primiparous as well. Pregnant outside marriage, with few resources to draw upon, they were amongst the most vulnerable women in the community. While the Sant'Orsola maternity service also admitted unmarried patients, married women formed the great majority. 86% of patients in the primary sample were married, 13% single and 1% widowed. The patients' mean age was just under 30 and only one in four delivered a first child. About 40% were housewives and an equal number servants, while another 13% were unskilled labourers. Although women of higher socio-economic status do not appear in the sample, the hospital accommodated patients from across the lower and middle social ranks of the community. Their backgrounds and circumstances set them apart from – and from the standpoint of human welfare well above – those who delivered in the Ospizio e Asilo.

In Bologna, as elsewhere in the western world, childbirth was gradually relocated from the home to the hospital in the years after the turn of the 20th century. Once the site of parturition for the poor and the unwed, in time the hospital became the location most women preferred for delivery. In 1880 about one birth in ten in the city occurred in one of these two institutions, the proportion almost doubling by the turn of the century. By 1920 almost half of civic births occurred in hospital and by 1940 the number may have exceeded 80% (*Bologna in Cifre* 1942)[3]. Consequently, the study sample grew progressively more representative of the entire maternal and newborn populations over time.

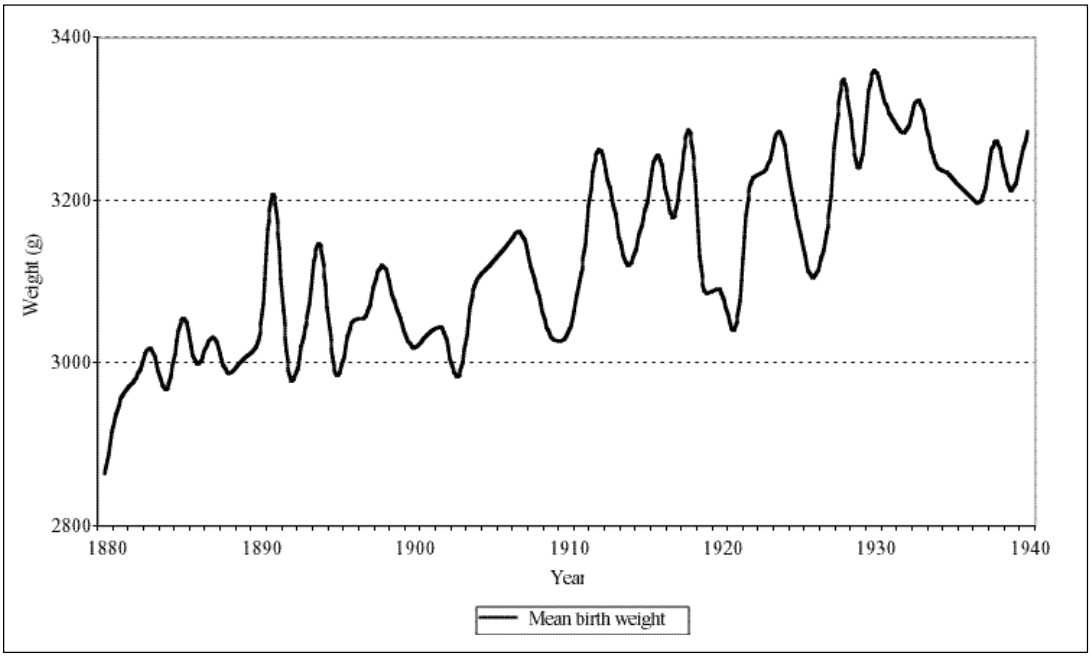
The clinical records also provide information concerning other social character-

istics of the patients. The great majority of them (92%) were born in Bologna and the surrounding region while most of the rest came from the neighbouring provinces of northern Italy. Less than 2% were born south of the Apennines. Not surprisingly, virtually all patients resided in Bologna city or province, with only a handful admitted from more distant locations. In this respect, however, the sample composition changed somewhat over time as the proportion of patients from the province of Bologna rose after 1910 while that from the city declined. The marital status of patients changed over time as well. While 64% of the women were married in the 1880s, the proportion increased to well over 80% in the later years of the 19th century and by the 1930s it had risen to 97%[4]. At the same time the national illegitimacy rate in Italy declined from 7.5% to 4.6% of all births. This tendency was directly linked to the changing occupational structure of the sample. During the first half of the study period almost three patients in four were domestic servants or labourers. During the second half 60% were housewives. Although there was no clear trend in the mean age of patients, the number of women bearing their 5th or subsequent child declined from 21% to 11% while the number bearing their first child rose from 23% to 36%. These trends reflected the broad decline in fertility in Italy during the period.

3. Results. The two most commonly reported measures of newborn weight are the mean and the proportion of low birth weight infants (i.e. neonates weighing less than 2,500 grams). Over the past half-century these have become basic measures of newborn welfare in the developed as well as the developing world. Low birth weight has long been regarded as a risk factor in newborn and infant life, the lower the weight, the greater the risk. Some factors influencing neonatal weight are reflected in the sample clinical data while others are not. Broadly speaking they can be grouped in four categories: the genetic constitution of the mother and child, the maternal history of an individual pregnancy, a woman's health before and during her pregnancy, and a range of social and economic factors (Ward 1993, 12-20). Thus the mean weight of newborns in a community, as well as the proportion of low birth weight infants, reflect the genetic, health, and socio-economic circumstances of their mothers – and most likely women of childbearing age in that community more generally.

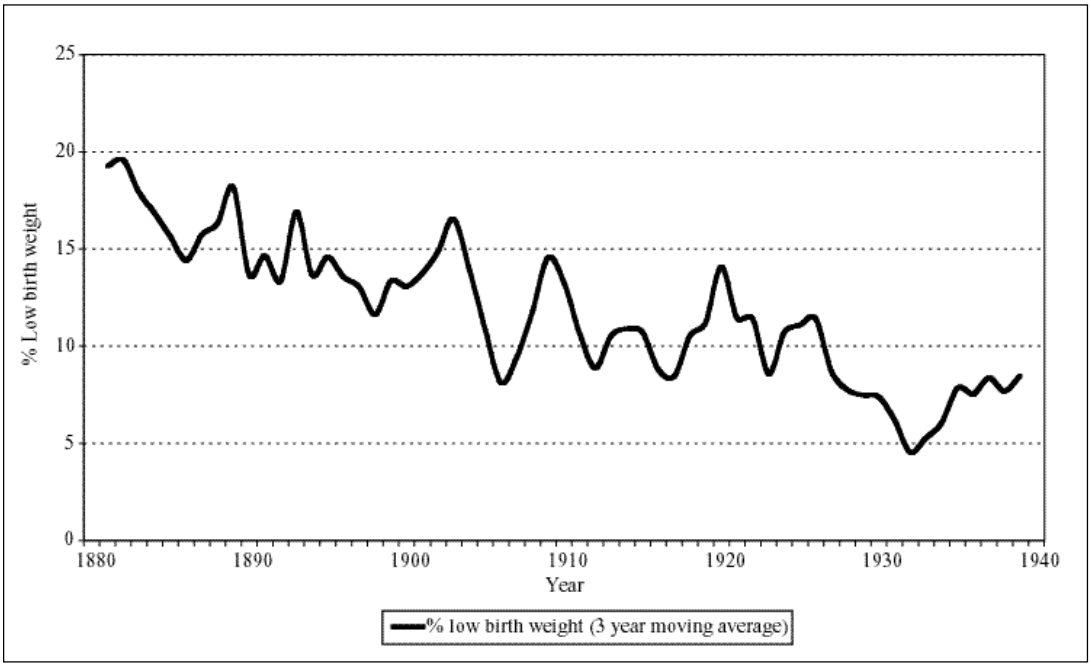
Figures 1 and 2 chart the trends in mean birth weight and the proportion of low birth weight newborns in the hospital population over the 60 years of the study. The average weight of newborns rose by more than 300 grams during this period, from below 2900g to well over 3300g, peaking in 1930. While the mean fluctuated somewhat from year to year the secular trend was upward. Similarly, the incidence of low birth weight fell steadily, from just under 20% at the beginning of the period to 8% by the conclusion. In at least some instances, the variation around these trends may be significant. Birth weight means fell during the economic crisis following the First World War and again during the depression years of the mid and late 1930s, at the same time as low birth weight rates rose significantly. But in each case the reversal represented only a small fraction of previous gains.

Fig. 1. *Bologna: Mean birth weight 1880-1940*



Source: data base.

Fig. 2. *Bologna: Low birth weight 1880-1940*



Source: data base.

Factors related to newborn weight. Linear regression analysis allows the identification of many factors related to birth weight variation. Two versions of the primary sample were analyzed, one defined on the basis of gestational age, the other on birth

weight. Because the precise date of conception is often unknown, gestational age is calculated from the beginning of the last menstrual period before delivery. Children born between 38 and 42 weeks from that date are considered full-term, while those born earlier are by definition premature. Studies of fetal growth to maturity normally include only newborns of advanced gestational age, usually 28 weeks or more. Contemporary investigators generally doubt the reliability of recollected data on last menstrual period, historically the most common basis for estimating gestational age. Consequently, the robustness of the gestational age data in these records may be questioned. Despite this limitation, all live born infants delivered at gestational ages of 28 to 42 weeks were analyzed in one set of regressions. In a substantial number of cases the date of last menses was missing. The resulting sample includes 5205 cases.

In the past, the remaining ways of estimating neonatal maturity relied upon physical indicators of fetal development. Nineteenth century medical practitioners often based their estimates on a cluster of newborn physiological features, including weight, length, and developmental signs such as head circumference or the condition of the newborn's cartilage, fingernails, and genitalia (Frank 1895). Gradually, however, birth weight came to be recognized as the primary index of fetal growth. For much of the 19th century and the early part of the 20th 2500 grams was widely accepted as the division between premature and mature infants. In the present study 1100 grams was established as the lower limit of fetal weight at 28 weeks of gestational age, this estimate based on recent fetal growth curves. All live newborns weighing 1100 grams or more were analyzed in a second series of regressions. The sample size in this instance was 8177[5].

The results of regression analysis on birth weight have been grouped into four categories of variables: biological, maternal health during pregnancy, maternal prepregnancy health history, and socio-economic (See Appendix A). Included are the regression coefficients for each variable (the number of grams that the variable adds to or subtracts from birth weight), the *t* statistic (the higher the *t* statistic, the greater the finding's significance) and the probability value *p* (the likelihood that the result could be produced by chance, eg. when $p < .001$ the likelihood is 1 in 1000). Results are reported for both samples.

Among the biological variables, males weighed over 100 grams more than females, while multiple birth deducted about 800 grams in both regression models. First-born children were somewhat lighter than those in the comparison group (parities 2 to 4) and those born 5th or later in the family constellation enjoyed a small weight advantage. Children identified as premature weighted 650 grams less than those of normal gestational age. The series results are consistent with most findings on birth weight variation, past and present.

Many illnesses and disorders were linked with lower newborn weight, conditions described with varying degrees of exactness in the original clinical records. The vagaries of diagnostic terminology derived from two principle sources. In many instances the case records simply noted the patients' own general descriptions of their health in the prose of everyday life. 'Poor health' was an imprecise diagnosis

but it was the kind of general symptom that many patients could easily identify. In addition, the language of medical diagnosis itself was evolving during these years. Conditions once described only in broad terms came to be specified much more precisely and, as a result, the clinical records recorded illnesses with greater exactness over time.

A series of general health problems were associated with weight at birth. Seriously malnourished women delivered smaller newborns: over 200 grams less than the normally nourished in both regressions. Similarly, both regressions revealed that women described generally as weak, sickly, or in poor health also bore smaller babies. Among the more specifically described medical conditions, placental disorders were linked to smaller newborn size in both regressions. The infectious disease environment was also related to birth weight variation. Venereal diseases, pulmonary and non-pulmonary tuberculosis, and other pulmonary infections were linked with significant birth weight reductions in one or both populations. Likewise, disorders of the circulatory, blood and renal systems, as well as serious haemorrhages, were associated with lower birth weight. Women with anaemia or a cardiovascular complaint delivered smaller infants, while those with rickets also bore lighter children. Women with glandular and liver disorders delivered smaller infants, too. Conversely, patients suffering from oedema bore slightly heavier newborns.

A woman's health prior to pregnancy was also associated with newborn weight. Women with a history of malnourishment or poor health bore lighter children, as did those with a history of premature delivery, stillbirth, or a venereal disease. In addition, maternal physical deformity was associated with lower levels of birth weight.

Finally, a cluster of social and economic factors accounted some of the variance in newborn weight. Domestic servants bore slightly heavier children than those in the reference group (unskilled labourers). In this instance one likely contributing factor was nutritional because servants enjoyed privileged access to food in their employers' homes. The children of unmarried mothers were disadvantaged when compared with those of married women, reflecting their mothers' more precarious socio-economic position. Women hospitalized for one to three weeks before delivery bore slightly heavier children than those in the control group (less than 1 week); those hospitalized for four weeks or more delivered heavier infants still. The most likely explanation for this finding is the superior rest, care, and nutrition that patients received while in hospital.

The regression also detected two temporal effects, one seasonal, one longitudinal. Birth in autumn conferred a slight weight advantage compared with birth in spring while birth in winter imposed a small disadvantage. In this case it seems probable that the greater abundance and lower cost of food in autumn and the converse during winter influenced newborn weight. Similar seasonal variations have been identified in other European populations during the second half of the nineteenth century and the early part of the twentieth (Ward 1993, 116-117).

A significant upward trend in birth weight was detected over the long term, as

well. Compared with the years 1880-1895, mean weight was higher from the beginning of World War I onward in both samples. The regression thus confirms the statistical significance of the pattern revealed in Figure 1. Much of the importance of this finding, however, lies in the fact that the time intervals entered into the regression model were based on cycles of the northern Italian economy during this 60 year interval: 1880-1895 a period of gradual increase in per capita GDP, 1896-1913 one of rapid growth, the wartime years and post-war disruptions of 1914-1922, an interval of economic recovery between 1923 and 1930 that coincided with the early years of fascist government, and the international depression of the 1930s. While the secular trend in newborn weight rose throughout this period, the cycles themselves were not associated with cyclical patterns in newborn weight. Nevertheless, birth weight appears to have been linked with some shorter term economic fluctuations, with substantial increases during the late prewar years and the early wartime expansion, a sharp decline during the post-war crisis of readjustment, a resumption of pre-war levels during the mid and late 1920s and an end to further increases in the 1930s.

Gestational age. Premature birth – i.e. before the 38th week of gestation – is a primary cause of low birth weight. The rate of fetal weight gain during pregnancy is highest during the second trimester but, although it slows somewhat thereafter, it remains high for the first half of the third trimester as well. During the final weeks before delivery weight gain slows but continues at a lower rate until the end of the normal gestational period. Even small differences in gestational age may be associated with medical and other environmental factors. Therefore analysis of variance was employed to examine the association of health variables with gestational age. Those health variables affecting birth weight identified in the regression analysis of the sample defined by gestational age were tested for significant relationships between medical conditions and gestational age. The results are summarized in Appendix 2.

Associations were identified between mean gestational age and a wide range of health disorders, during pregnancy as well as the pre-pregnancy period. The average gestational age of infants born to healthy mothers was 39.0 weeks. Malnourished women and those suffering from generally poor health delivered 1.5 weeks earlier than the norm, while those suffering from placental disorders delivered 3 weeks earlier. More generally, a series of common infectious diseases, as well as circulatory, blood and renal disorders all were significantly associated with early birth, with most means in the premature range, i.e. less than 38 weeks.

Fewer associations were identified between maternal health conditions before pregnancy but here, too, a history of malnutrition, poor health and venereal disease were associated with slightly shorter gestational age. A history of premature delivery was also related to premature birth.

Intrauterine growth retardation and body proportions. Fetal growth can also be analyzed by means of Rohrer's ponderal index, a body mass index used to assess the growth history of newborns. In particular, it can help explain the causes of small birth size, also known as intrauterine growth retardation (IUGR). IUGR is a leading

health problem in both developed and underdeveloped countries today. Small infants are at greater risk of morbidity and mortality than those of normal size and, as a result, the incidence of IUGR exerts a determining influence on population health. The index is calculated in the following manner:

$$PI = 100 \times \text{weight in grams} / \text{length}^3 \text{ in centimetres.}$$

Newborn length has generally been considered less reliable than birth weight because accurate measurement of length is more difficult than weight. Thus, the recorded data likely underestimate newborn length. The bias, however, would appear to be slight. The range of error is not great enough to preclude using newborn length in anthropometric analysis.

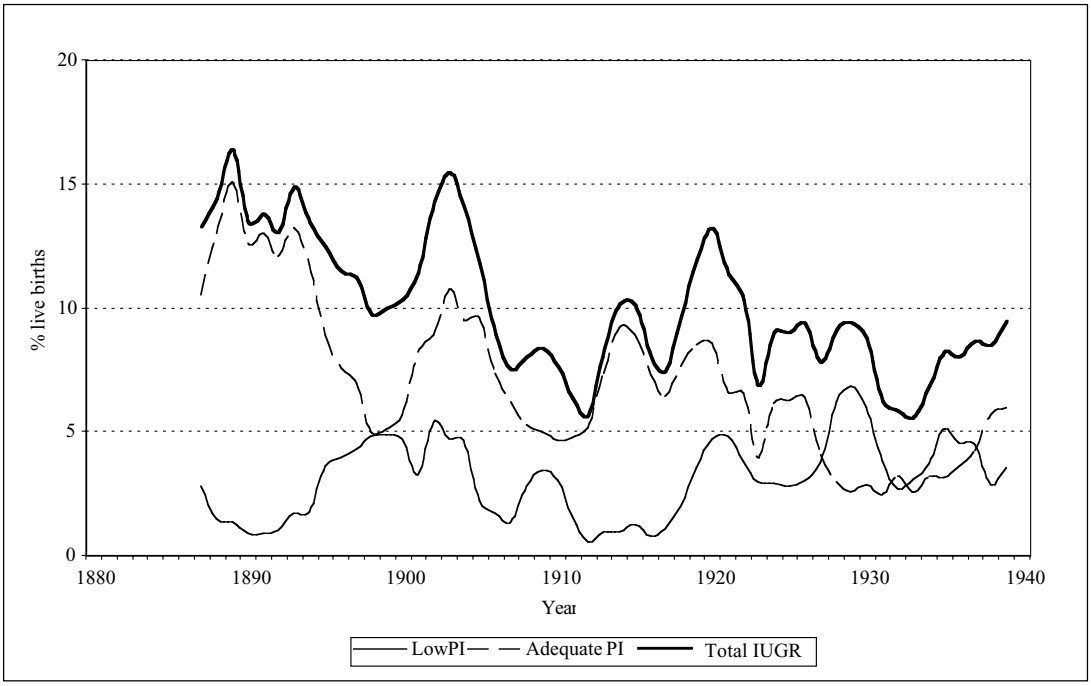
IUGR newborns are identified as those weighing less than the 10th percentile of a birth weight distribution, adjusted for gestational age, based on the population of a developed country (Villar 1986). In the present study the reference group used was the Italian population of 1995 and the estimated 10th percentile 2550 grams (United Nations 1999, table 11). The study population used for this analysis was that for which gestational ages could be calculated. All newborns of gestational ages 28 through 42 weeks and weighing 2550 grams or less were identified as IUGR. Of the 723 births in this category, 357 were premature, born between 28 and 38 weeks of gestation, while 366 were full term.

A ponderal index was calculated for each IUGR infant and they were then classified into two groups. Those with low index values (LPI, at or below the 10th percentile) are commonly referred to as disproportionately growth-retarded. Often referred to in the literature as 'wasted' or 'asymmetric', their condition is the result of acute or sub-acute fetal malnutrition. Those with adequate indices – above the 10th percentile (API) – are proportionately growth-retarded and are commonly described as 'stunted' or 'symmetric'. This condition is the result of chronic fetal malnutrition (Villar 1986). In assigning the IUGR births to one of these two categories, the percentile distributions standardized by gestational age as identified by Lubchenco *et al.* (1966) were used. Of the 723 IUGR births, 220 were LPI and 503 API. Table 1 summarizes their anthropometric characteristics and compares them with the remainder of the study population with birth weights above the 10th percentile.

Tab. 1. *Characteristics of IUGR and normal newborns*

	Growth retarded. LPI		Growth retarded. API		Normal growth pattern	
	Mean	St. Dvn.	Mean	St. Dvn.	Mean	St. Dvn.
Gestational age	37.7	3.2	36.0	3.6	39.4	2.0
Birth weight (gm)	2,154	355	2,169	362	3,297	408
Birth length (cm)	47.8	2.3	44.2	3.0	50	2.0
Ponderal index	1.97	0.21	2.52	0.33	2.65	0.29
	n = 220		n = 503		n = 4,762	

Fig. 3. *Intrauterine growth retardation (3 year moving average)*



Source: data base.

Figure 3 charts the incidence of IUGR in the sample population between 1885 and 1940, including both its symmetric and asymmetric forms. Most importantly, despite considerable variation, the overall incidence of IUGR declined by close to half during this period, from 15% to well under 10% of all live births. Although some variation cannot be explained and may be related to small sample size, two intervals seem particularly noteworthy, a peak during the late years of the Great War and the early 1920s, and a prolonged increase during the depression of the 1930s, both of them periods of serious economic stress. The trends of the two forms of IUGR, however, moved in opposite directions. API or symmetric growth retardation declined by as much as 2/3 during these years. Meanwhile LPI or asymmetric retardation increased slightly over the same period. At the beginning of the interval, the great majority of IUGR cases were symmetric while by the end of the period the proportions of both types were approximately equal. These findings suggest that chronic, low level fetal malnutrition in Bologna declined substantially while the more severe forms persisted, and may even have increased, over the interval.

4. Discussion. At the outset of the period Bologna was a mid-sized European city with an economy based on commerce and administration as well as a range of small handcraft manufacturing industries and a few large factories. Over the next half-century and more the city experienced steady population growth and economic change. By the eve of World War I its population had almost doubled while its industrial employment had grown 6 fold, the metalworking trades the leading sector (Zamagni 1986). At the same time the agricultural sector of the surrounding

countryside passed through a prolonged process of stagnation and transformation that reduced rural incomes and displaced a significant part of the rural population, directing them toward the wage labour force or emigration. These structural changes, the short-term shocks of World War I and the post war adjustment, and the international economic crisis of the 1930s, form the broad socio-economic context of the analysis of long-term change in newborn weight.

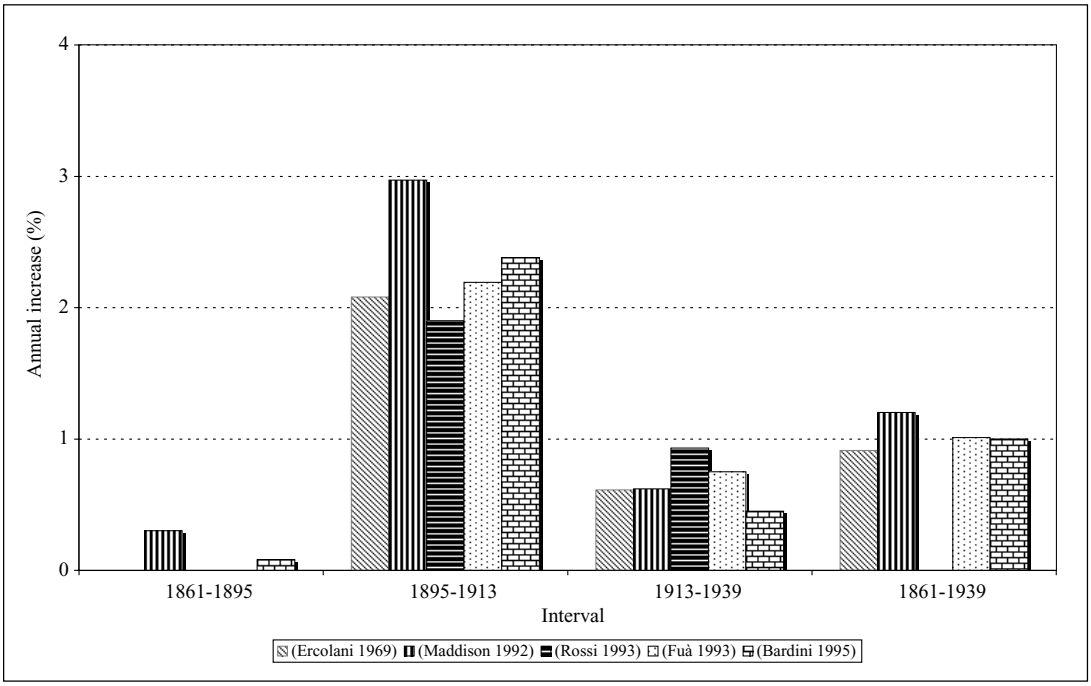
There is no evidence to indicate that the secular trend in the birth weight mean was influenced greatly by alterations in the sample's composition, i.e. in the social characteristics of the patients who sought hospital care in childbirth. Despite the socio-economic and demographic changes noted above, the patients in the sample shared much the same social background throughout the period of the study. While some of the variables linked to these changes were associated with birth weight variations, the effects of compositional change tended to offset one another. The growing proportion of housewives, for example, was balanced by the decline in domestic servants, both groups bearing children with similar birth weight advantages. The most socially vulnerable maternity cases were admitted to the Ospizio e Asilo, while upper class women continued to give birth under medical care in private clinics or in their own homes.

The regression models indicate that no higher status occupations had significant associations with birth weight, a sign that the changing occupational structure of the sample did not yield measurable social differences within the patient population. Unmarried women bore somewhat lighter children but, although their proportion in the sample population declined sharply from 1890 onward, this change could not have accounted for more than a small part of the rise. Furthermore, any increase would have been offset by the decline in the numbers of patients admitted a week or more before delivery, whose newborns weighed more than those who were delivered soon after admission. As the maternity shed its older welfare functions and tightened its admissions procedures, the proportion of these patients shrank from 29% to 9%, reducing the 'hospitalization effect' on the patients' well being. Thus, any influence of changing sample composition on the birth weight trend would have been slight at best.

One test of the reliability of any human welfare index is its congruence with indices describing other, related social characteristics through the analysis of different sources of information. In this instance, the Bologna birth weight trend may be compared with estimates of the Italian Gross Domestic Product, the trend in adult male stature in Italy, and with estimates of the nutritional value of average Italian diets. The Bologna birth weight mean can also be compared with similar data drawn from other European cities of the time, thus situating it within a wider continental context.

Of the variables associated with differences in newborn weight, those related to long term economic change are most pertinent here. They suggest a statistically significant upward trend independent of shorter-term economic cycles. Several estimates of the Italian GDP have been calculated for the second half of the nineteenth century and the first half of the twentieth. While they differ somewhat in degree

Fig. 4. *Italy: Per capita GDP estimates, 1861-1939*



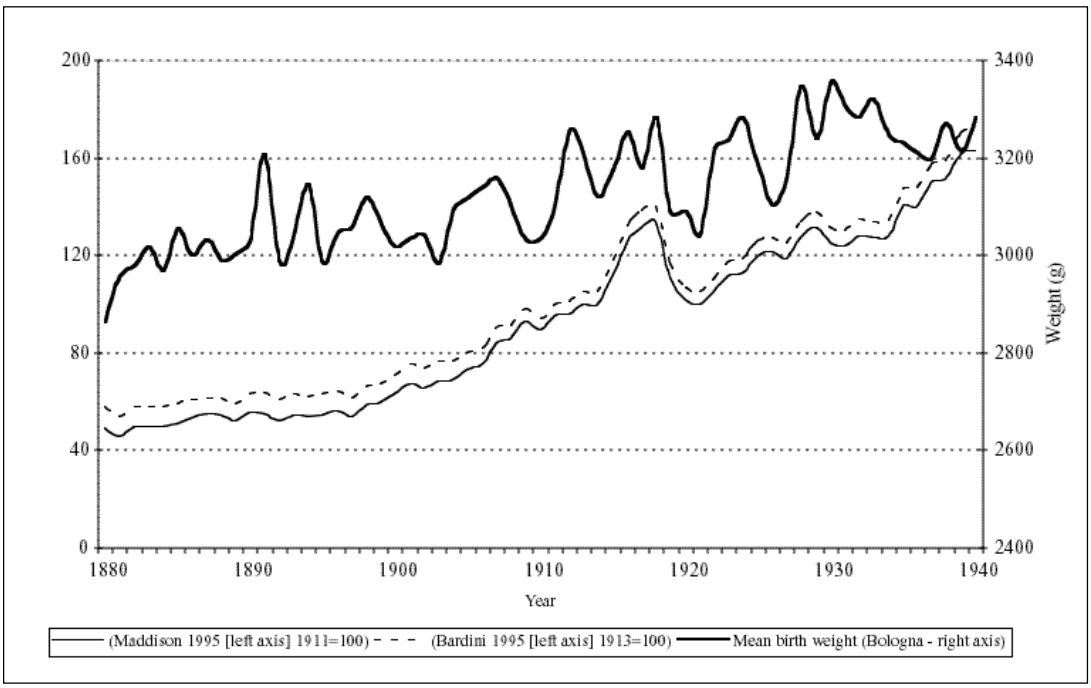
Source: Cohen 2001, 10.

they all agree in kind, and although they may be open to question (Cohen 2001, 8-11), they offer a starting point for comparison with the birth weight trend. Italian productivity grew slowly during the last quarter of the nineteenth century. Thereafter the growth rate increased sharply, reaching a peak during the latter years of World War I. Following a sharp contraction during the late 'teens' and early 'twenties,' growth in production resumed, continuing until the outbreak of the Second World War, with a period of little or no expansion during the early 1930s. Figure 4 indicates the range of average per capita GDP estimates for three broad time intervals during the period of this study and confirms the high growth rate of the years 1895-1913. The consensus is that the Italian economy experienced sustained expansion between 1880 and 1940, interrupted by one brief period of contraction, though growth rates varied considerably over time.

The Bolognese birth weight trend is broadly consistent with this pattern. Although some short-term variation is evident, the secular trend is upward throughout the entire period, with a noticeable decline from 1919 to 1921 and a shallower one during the early and mid 1930s. Figure 5 plots the annual birth weight mean against two recent GDP estimates (Bardini *et al.* 1995, 145-146; Maddison 1995, 148-149). While no statistically significant link has been established between annual fluctuations in measures of GDP and mean birth weight, the general direction of both trends infers such a relationship.

Data are also available on adult stature in Italy throughout the period, in this instance the height of male military recruits at age 20 (ISTAT 1976, 17)[6]. The relationship between stature and living standards, and the measurement of historic con-

Fig. 5. *GDP (Italy) and mean birth weight (Bologna)*



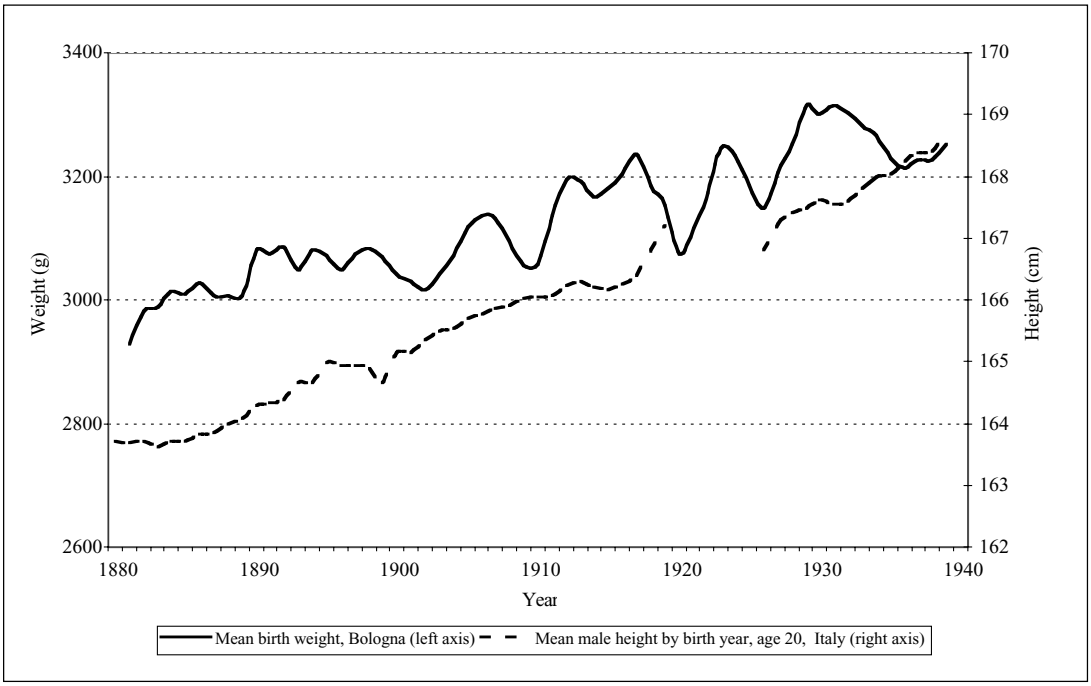
Sources: data base; Bardini *et al.* 1995, 145-146; Maddison 1995, 148-149.

ditions of health and welfare through analysis of data on stature, are now well-established. Here, too, the data are national and mask an unknown amount of regional variation. In the absence of information on the height of recruits from Emilia Romagna, however, they offer at least a general impression of the trend in Italian stature over this period. Figure 6 charts the secular trend in mean male height at age 20 against the birth weight mean. Between 1880 and 1940, mean height rose by 3% and mean birth weight by 15%. Given the differences in sample size and composition, as well as the types of growth being measured, the difference between the two growth rates and the evident lack of correlation between their short-term variations, are much less significant than the fact that they share a rising trend.

Two estimates of daily caloric consumption in Italy have been published for the later 19th and early 20th centuries. While neither provides direct measures of what was consumed, they offer additional points of comparison with the birth weight trend (ISTAT 1976, 161; Federico 2003, 303-304)[7]. In this instance, again, the data are national and therefore offer no insights into regional variations. There can be no doubt that substantial variation existed, however; the literature on the history of nutrition in Italy indicates substantial differences in food consumption patterns by social class and region (Somogyi 1973; Quirino 1991; Del Panta, 1994).

The course of nutrition in Italy during the later 19th century is disputed. The conventional – and pessimistic – view is that the nutritional status of the Italian population was poor during the half century following unification: calorie intake was low, diets were monotonous, and food consumption patterns changed little. According to this view the caloric value of Italian diets fell by over 20% during the

Fig. 6. *Adult male height (Italy) and mean birth weight (Bologna)*



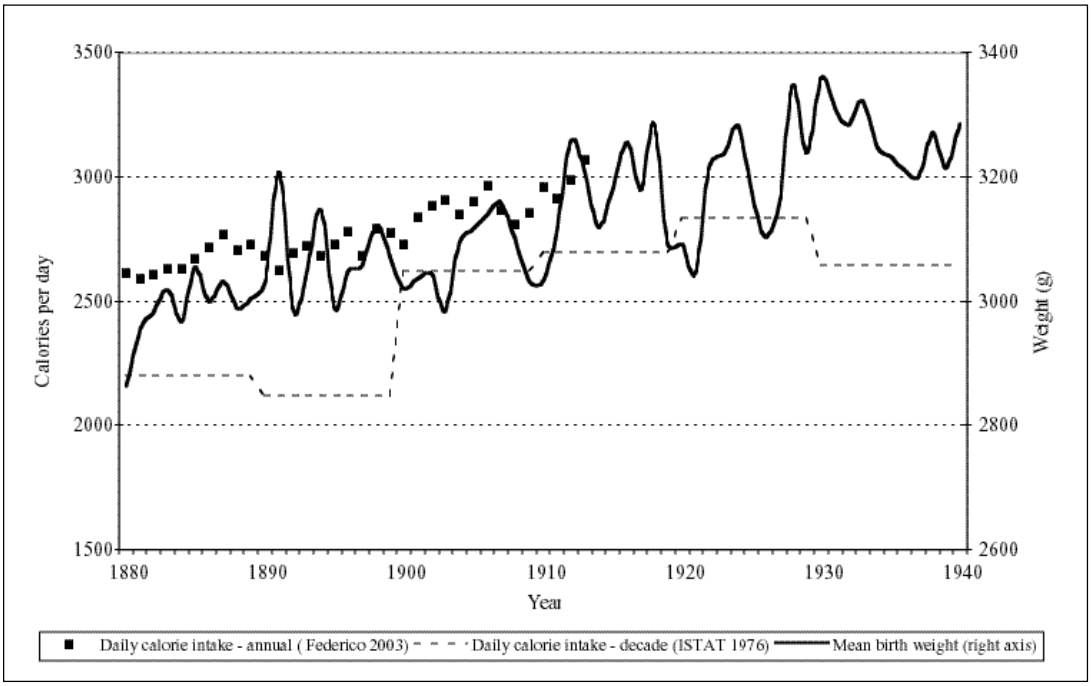
Sources: data base; ISTAT 1976, 17.

1880s and early 1890s before recovering their former level during the first decade of the 20th century (ISTAT 1976, 161). Over the next 30 years they increased by a further 8%, losing this gain during the depression years (fig. 7).

Other qualitative sources support the pessimistic view. There is substantial evidence of growing malnutrition in much of northern Italy over the early and middle years of the nineteenth century, particularly amongst the rural poor. The decline in caloric intake just noted has been linked with the spread of maize-based diets and a broad-based deterioration of nutrition during the 1860s and 1870s. An epidemic of pellagra affecting much of northern Italy reached its peak by about 1880 and, while rates declined rapidly over the next two decades, the disease persisted well into the twentieth century (De Bernardi 1983; Livi-Bacci 1986). Although other parts of northern Italy were more seriously afflicted, pellagra was widespread in Emilia Romagna as well. Largely a rural phenomenon, the disease likely had only a limited influence on the nutritional welfare of the women in the sample population. But rural-urban migration, undetectable in this study, may well have brought numbers of poorly-nourished women to Bologna as the city's population grew during these years. The cost of food as a proportion of family expenditures was almost certainly related to nutritional levels, as well. Food absorbed about 2/3 of Italian family budgets from the 1880s to the 1920s, and more than half thereafter (Fuà 1978, 310). Thus, those Italians who relied on food purchases for the bulk of their dietary consumption, including the vast majority of urban residents, were vulnerable to price fluctuations, and many lived near the edge of deprivation.

Recently, however, more optimistic views have challenged the pessimistic con-

Fig. 7. *Calorie consumption (Italy) and mean birth weight (Bologna)*



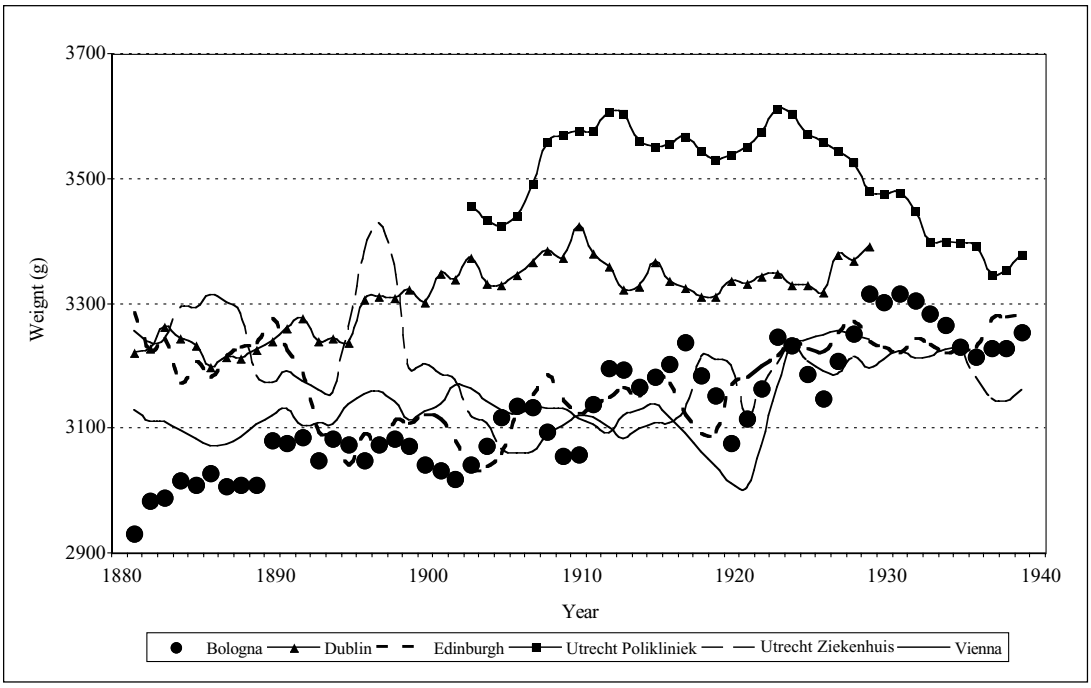
Sources: data base; Federico 2003, 303-304; ISTAT 1976, 161.

sensus. They paint a picture of broadly rising Italian living standards from the 1860s onward and suggest that diets were improving, not deteriorating, at this time. Fenoaltea has provided evidence of rising wages and consumption during the 1880s, the decade on which much of the ambiguity has centred (Fenoaltea 2002). Federico's estimates of daily caloric consumption indicate a steady rise over the period from 1880 to the eve of the Great War of at least 18% (Federico 2003) (fig. 7). More recently still, Vecchi and Coppola have provided estimates supporting those of Federico, arguing that the average Italian was adequately nourished from the beginnings of the national period and that substantial nutritional improvement occurred during the final two decades of the century (Vecchi 2003; Vecchi 2006). They indicate that the incidence of undernutrition declined by 15% or more during this period and suggest that the early phase of industrialization benefited most of the Italian population, including the very poor.

At first glance the rising trend in newborn weight would seem to support the optimistic view that Italian nutritional welfare improved substantially during the half century following unification. It matters little to this argument whether the primary driver was higher calorie intake or improved maternal health, or if more complex interactions between the two produced heavier infants. To the extent that net nutrition was reflected in newborn weight, the fact of bigger babies strongly suggests better nourished mothers.

During the years before World War I, however, the weights of Bologna's newborns were at the lower range of European birth weights of the period (fig. 8). They fluctuated well below those recorded in northern European cities, including the

Fig. 8. *Bologna compared: Mean birth weight (3 year moving averages)*



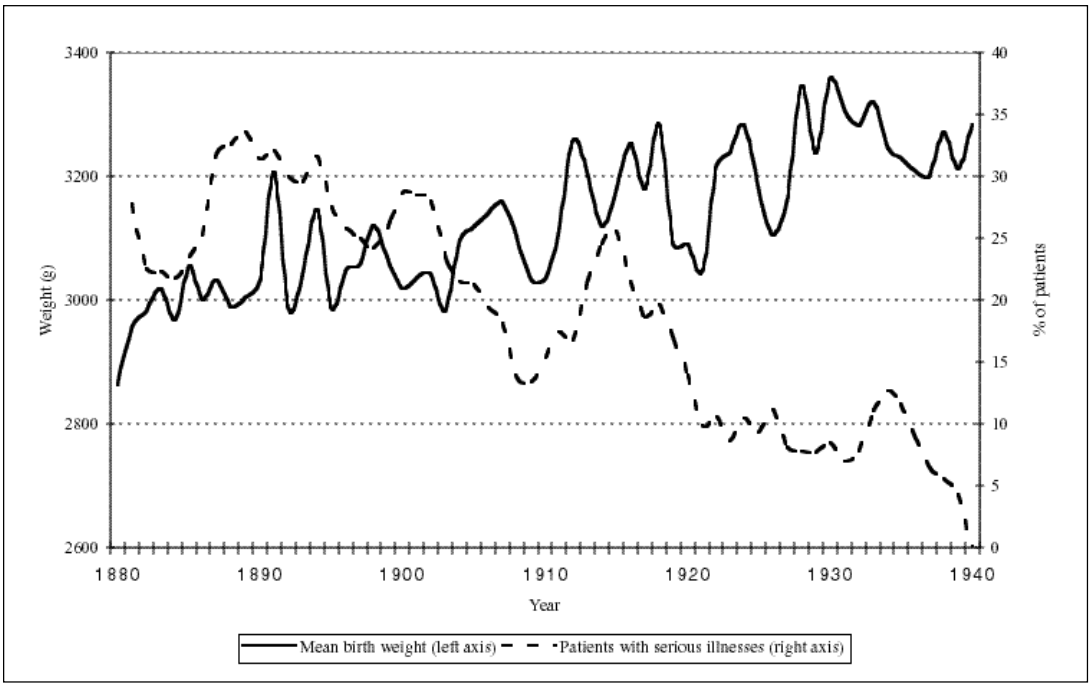
Sources: data base; Ward 1993, 116; Ward 2003, 393.

University Hospital (Ziekenhuis) in Utrecht, where a significant proportion of patients were admitted because of difficult pregnancies. They also were lower than those of the thousands of Viennese working class women who delivered in the Allgemeines Krankenhaus, one of the largest maternity clinics in Europe at the time. By 1910 newborn weights in Bologna had risen to levels found in several other contemporary European maternities, where they remained clustered until 1940, although they still fell below those of Dublin and those noted in the outpatient clinic of Utrecht, which tended to accommodate an older, married, and healthy population.

Thus, while the Bologna birth weight trend supports the view of improving Italian nutrition during these years, from a comparative perspective it also suggests that Italy was – or at least young Italian women in one northern Italian city were – merely catching up to levels already achieved elsewhere in northern Europe. If the birth weight trend was another sign of better nutrition in Italy, it was also a sign of the nutritional disadvantages vis-à-vis its neighbours that the nation had to overcome. In this sense the history of newborn weight in Bologna supports longstanding views about the distinctive place occupied by Italy in European industrialization – as the laggard amongst the modernizing leaders or as the leader amongst the modernizing laggards.

Finally, neither regional nor national data on morbidity rates in Italy exist for this period. Thus the only available general measures of population health are those related to mortality. Two broad indications that health conditions in Bologna and its surrounding area improved dramatically during these years are the sharp

Fig. 9. *Bologna: Major illnesses and mean birth weight*



Source: data base.

declines in both the crude death rate and the infant mortality rate[8]. On the other hand, the Sant'Orsola sample includes information on the health of many patients. Figure 9 plots the proportion of patients per decade suffering from the health conditions during pregnancy identified in Appendix 1 as adverse to fetal growth. From 1880 to 1920 between 20% and 30% of patients experienced one or more of these conditions but during the 1920s the proportion fell below 10%, where it remained until the outbreak of World War II. Although the connection between the birth weight trend and this measure of the incidence of disease is only suggestive, figure 9 hints at an independent relationship between the relative incidence of disease and birth weight outcomes; mean birth weight increased most sharply during the second half of the period, when the disease environment was less virulent.

5. Conclusion. Between 1880 and 1940 mean birth weight in Bologna rose by 10%, from the lower limits of neonatal weight averages recorded in Europe at the time to levels in the mid-range of European newborn populations. The proportion of newborns delivered at low birth weight also declined by more than half during this period. The explanation for these changes had little, if anything, to do with the hospital environment itself, with the nature of obstetric practice, with the social and clinical functions of the maternity service, or with the types of patients attracted to hospital childbirth. The available evidence indicates that the social composition of the patient population in the study changed relatively little during these years, even though the proportion of births in the city occurring in hospital increased dramatically. Consequently, the influences associated with the rising birth weight trend

were exogenous to the hospital and to the processes of social selection that recruited patients to the sample.

Several social and economic factors noted in the clinical records were related to case-by-case variations in birth weight, but the most important of them was year of birth. This fact strongly suggests that environmental improvements affecting women's reproductive health were largely responsible for the secular rise in newborn weight. The specific nature of the factors related to these improvements, however, is somewhat less clear. While the relevance of marital status to birth weight outcomes suggests a welfare effect, in most respects social differences had limited associations with reproductive outcomes. While some seasons and occupations may have had nutritional implications, in this instance their effects on birth weight were small.

A broad range of health factors, however, were associated with variations in newborn size. Many medical conditions occurring during pregnancy were strongly associated with lower birth weight. Given the imprecision of diagnostic language and procedures during this period, not all of them are as obvious as we would like. But several serious infectious diseases and other major health conditions clearly were disadvantageous to birth weight. Many were also associated with premature birth and therefore the smaller size linked to shorter gestational life. Some associations also link women's long-term health histories with adverse birth weight outcomes.

Beyond the factors identified in the case records, it is possible to explore the relationship between broad patterns of environmental change and birth weight trends. Much of the evidence examined here is more suggestive than conclusive. Nevertheless, associations have been identified between the secular trend and short-term variations in birth weight on one hand, and on measures of socio-economic change and health conditions on the other. They imply that economic growth, increased nutrition, and lower levels of major infectious and other diseases, were directly associated with higher birth weight outcomes. These influences improved the health and nutritional status of women in their child bearing years, especially during pregnancy, and they in turn transmitted these benefits to their unborn children. Among the first results of these changes were lower perinatal risks to infants (Ward 2004).

Appendix 1

Linear Regression on Birth Weight. Bologna, 1880-1940

	Based on gestational age			Based on birth weight		
	Coeff. (g)	t	p <	Coeff. (g)	t	p <
Biological factors:						
Male child	115.3	8.365	0.001	122.0	10.39	0.001
Multiple birth	-784.2	-19.480	0.001	-830.2	-22.90	0.001
Parity 1	-129.2	-7.972	0.001	-131.9	-9.27	0.001
Parity 5+	76.9	3.968	0.001	67.0	4.11	0.001
Premature birth	-657.7	-17.31	0.001	-651.8	-18.80	0.001
Maternal health during pregnancy:						
General health:						
Poor health	-95.0	-2.704	0.010	-72.4	-2.429	0.050
Malnutrition	-193.5	-2.811	0.005			
Pregnancy disorders:						
Premature delivery	-237.7	-6.317	0.001	-250.7	-7.832	0.001
Stillbirth				-80.6	-2.487	0.050
Placental disorders	-288.6	-3.642	0.001	-291.8	-4.18	0.001
Infectious diseases:						
Pulmonary tuberculosis				-478.6	-4.85	0.001
Other tuberculosis				-394.7	-2.45	0.050
Other pulmonary infections	-125.2	-3.333	0.001	-116.3	-3.8	0.001
Venereal diseases				-343.7	-6.57	0.001
Circulatory/blood disorders:						
Anemia				-134.0	-3.3	0.001
Cardiovascular disorders	-131.9	-2.258	0.050	-164.6	-3.3	0.001
Haemorrhage	-313.1	-6.324	0.001	-322.4	-7.3	0.001
Renal disorders:						
Oedema	76.4	2.988	0.005	82.1	3.767	0.001
Renal system disorders	-170.3	-2.412	0.050	-260.6	-4.45	0.001
Other disorders:						
Glandular disorders	-399.3	-2.445	0.050			
Liver disorders				-616.6	-2.98	0.005
Rickets				-228.4	-2.77	0.010
Maternal prepregnancy health history:						
General health:						
Poor health	-95.0	-2.704	0.010	-72.4	-2.43	0.050
Malnutrition	-193.5	-2.811	0.005			
Pregnancy disorders:	-237.7	-6.317	0.001	-250.7	-7.83	0.001
Premature delivery				-80.6	-2.49	0.050
Stillbirth	-49.4	-2.285	0.050			

(continued)

	Based on gestational age			Based on birth weight		
	Coeff. (g)	t	p <	Coeff. (g)	t	p <
Other disorders:						
Venereal diseases	-222.8	-2.740	0.010			
Physical deformity	-216.6	-2.746	0.010	-151.8	-2.294	0.050
Other pulmonary infections	-49.4	-2.285	0.050			
Social and economic factors:						
Born 1896-1913	44.2	2.066	0.050	61.7	3.769	0.001
Born 1914-1922	211.4	8.237	0.001	206.2	9.704	0.001
Born 1923-1930	209.1	7.691	0.001	214.0	9.34	0.001
Born 1931-1940	225.7	9.19	0.001	223.1	10.97	0.001
Born in autumn				33.6	2.285	0.050
Born in winter	-41.3	-2.646	0.010	-34.8	-2.44	0.050
Domestic Servant	44.1	2.518	0.050	31.2	2.2	0.050
Hospitalized 1-3 weeks before delivery	67.8	2.545	0.050	62.2	2.962	0.005
Hospitalized 4+ weeks before delivery	110.3	2.225	0.050	149.0	4.901	0.001
Mother unmarried	-76.5	-3.073	0.005	-112.0	-5.79	0.001
(Constant)	3067.3	134.610	0.001	3064.3	165.7	0.001
		n = 5,038			n = 7,473	
		Adj R^2 = 0.208			Adj R^2 = 0.206	
		St. Err. = 487.299			St. Err. = 506.425	
		df = 29			df = 33	

Appendix 2

Pregnancy and pre-pregnancy medical history and gestational age. Bologna, 1880-1940

	Mean (weeks)	St. Dvn.	N	F	$p <$
Maternal health during pregnancy:					
General health:					
Poor health	37.5	2.9	76	29.395	0.001
Malnutrition	37.5	3.2	54	20.459	0.001
Pregnancy disorders:					
Placental disorders	36.0	3.9	45	73.102	0.001
Infectious diseases:					
Pulmonary tuberculosis	37.1	3.8	12	8.005	0.005
Other pulmonary infections	38.4	2.6	214	14.372	0.001
Venereal diseases	37.9	2.8	51	10.190	0.001
Circulatory/blood disorders:					
Anemia	37.5	3.3	84	35.511	0.001
Cardiovascular disorders	37.8	2.9	83	20.673	0.001
Haemorrhage	36.4	3.9	115	142.553	0.001
Renal disorders:					
Oedema	38.7	2.5	449	5.149	0.050
Renal system disorders	37.8	3.0	51	12.981	0.001
Other disorders:					
Glandular disorders	37.8	3.8	9	5.319	0.050
Maternal prepregnancy health history:					
General health:					
Malnutrition	37.9	2.7	60	12.261	0.001
Poor health	38.3	2.6	243	19.635	0.001
Pregnancy disorders:					
Premature delivery	37.9	2.9	187	43.648	0.001
Other disorders:					
Venereal diseases	38.2	2.6	37	4.376	0.050

n = 5,205
Mean gestational age of populations without specified health disorders = 39.0 weeks.

[1] The records remain in the custody of the hospital and are presently housed in the Sant'Orsola document depository in Minerbio.
[2] In addition, at least two other obstetric clinics were established in the city during the late 19th and early 20th centuries, one annexed to one of the two main hospital clinics that offered obstetric services at home, the other a private clinic providing emergency maternity care free to charity patients (Bidone 1904). The number of patients accommodated in the former is unknown. The latter cared for 102 patients in its first 7 months.
[3] These estimates are only suggestive, in part because the data are intermittent. Hospital births consisted of those occurring in both city maternities; most patients were civic residents. A small but growing number of women from the neighbouring provinces also sought hospital delivery in Bologna during the period.
[4] Information on marital status comes from the clinical records and was reported by the patients themselves. But their understandings of their status in some cases may have been at variance with Italian marriage law. After unification only civil marriages were regarded as legal. Thus the children of couples married only in church were considered illegitimate, though subsequent legal (civil) marriage allowed them to be legitimated, a common practice during the period under review. With passing time civil marriage became more frequent. It seems reasonable to suppose that these changes in marriage practices affected the Italian illegitimacy rate and that the downward trend of the period was in part a reflection of them. But it is not possible to estimate the proportion of the decline attributable to these changes. It should also be noted that the Italian trend was consistent with the wider European pattern. Illegitimacy rates were in broad decline throughout much of Europe during the later 19th century and these trends continued after the turn of the century (Laslett 1980).
[5] Because the two sample populations are defined in different ways, the smaller sample is not simply a subset of the larger one. Some cases are common to both samples while others are found only in one. Thus the two are distinct but overlapping; they provide two independent samples of the childbearing population in Bologna during this period.
[6] No data were reported for birth cohorts 1921-1926, who would have been recorded when entering military service during World War II. Before 1927 only recruits for land forces were reported. From 1927 onward naval recruits were also included.
[7] The estimates disagree strikingly for the later 19th century but broadly parallel one another during the early 20th.
[8] The crude death rate fell by 61%, from 28.6 to 11.2 per thousand between 1880 and 1940 (*Bologna in Cifre* 1942, 4-5). Data on infant mortality rates in the Province of Bologna are not continuous during this period but they fell by 54% from 141/1000 in 1884 to 65/1000 in 1931. (Data courtesy of Lucia Pozzi.)

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Summary

Women's health, size at birth and socio-economic change in Bologna, Italy, 1880-1940

This paper examines the history of size at birth in Bologna, Italy between 1880 and 1940. It is based on a sample of 8230 cases from the patient records of the maternity service in the city's largest obstetric clinic. The objective of this paper is to explore the relationship between socio-economic change, maternal health, and birth size. During this period the mean weight of newborns rose from under 2900g to over 3300g, peaking in 1930, with a sharp decline from 1919 to 1921 and a shallow one during the 1930s. Linear regression analysis identified three categories of factors affecting variation in birth weight: biological, health, and socio-economic. Among the latter, those concerning the time trend were most important. There is no evidence to indicate that the long-term rise in the birth weight mean was influenced significantly by changes in the sample's composition. Analysis of a ponderal (body mass) index of growth retarded newborns suggests a decline in low level fetal malnutrition during these years while more severe forms persisted and may have increased. Comparison of the annual birth weight mean with annual estimates of GDP, the mean heights of military recruits, and the estimated per capita caloric value of available foods suggests a direct relationship between all three measures and annual newborn weight means. Data on the health of patients also suggest an association between the secular trend in birth weight and the declining incidence of infectious and other diseases.

Riassunto

Salute delle donne, dimensioni dei neonati e cambiamento socioeconomico a Bologna, Italia, 1880-1940

Questo articolo esamina l'andamento storico delle dimensioni dei neonati a Bologna fra il 1880 e il 1940. L'articolo è basato sull'analisi di un campione di 8.230 casi tratti dalle cartelle cliniche del servizio di maternità della maggiore clinica ostetrica della città. L'obiettivo di questo articolo è quello di esplorare l'influenza dei cambiamenti socioeconomici e della salute materna sul peso e sulla lunghezza neonatale. Nel periodo storico in esame il peso medio dei neonati è cresciuto da valori inferiori a 2.900 g. a valori superiori a 3.300 g. I valori del peso neonatale hanno conosciuto un picco nel 1930, un declino significativo fra il 1919 e il 1921 e un decremento leggero durante gli anni trenta. L'analisi di regressione effettuata ha permesso di identificare tre categorie di fattori determinanti per la varianza nel peso neonatale: fattori biologici, di salute, e socioeconomici. Fra questi ultimi, sono risultati più importanti quelli relativi al trend temporale. La crescita a lungo termine del peso neonatale non è risultata influenzata da cambiamenti nella composizione del campione. Il confronto fra peso medio annuo, stima annua del GDP, statura media delle reclute militari e valore calorico pro-capite dell'alimentazione disponibile per anno ha evidenziato l'esistenza di una relazione fra tutti i fattori considerati e il peso neonatale. È emersa, inoltre, una relazione fra il trend secolare del peso neonatale e il calo dell'incidenza delle malattie infettive.