Children's Height and Parental Unemployment: A Large-Scale Anthropometric Study on Eastern Germany, 1994–2006

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Abstract. The average height of children is an indicator of the quality of nutrition and healthcare. In this study, we assess the effect of unemployment and other factors on this variable. In the Eastern German Land of Brandenburg, a dataset of 253,050 preschool height measurements was compiled and complemented with information on parents' schooling and employment status. Unemployment might have negative psychological effects, with an impact on parental care. Both a panel analysis of districts and an assessment at the individual level yield the result that increasing unemployment, net out-migration and fertility were in fact reducing height.

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1. INTRODUCTION

After an initial substantial height increase of school starters in the Eastern German *Land* of Brandenburg between the re-unification of 1990 and 1995, the upward trend stopped suddenly and even developed into a downturn in children's heights between 1997 and 2000. Since 2000, heights have been stagnating at a low level. This is all the more remarkable, as heights have never declined over longer time spans in Eastern German *Länder* since 1880 – except for the most recent period 1997–2006 (Table 1). This astonishing development has motivated us to study the determinants of height in this region and period. As shown in a large amount of literature, the average height of children serves as an indicator for the quality of nutrition and

Table 1 Long-run height development in Jena (Thüringen) and Brandenburg

Region	Period	Height increase (cm)	Height increase per decade (cm)
Jena	1880–1921	4.7	1.1
Jena	1921–32	3.0	2.7
Jena	1932–44	0.5	0.4
Jena	1944–54	1.2	1.2
Jena	1954–64	1.1	1.1
Jena	1964–75	2.8	2.5
Brandenburg	1987–97	2.7	2.7
Brandenburg	1997–2006	–0.3	- 0.3

Source: Jena: Ja¨ger *et al*. (1990), Brandenburg: see text.

healthcare (see, among many others, Komlos, 1989; 1996; Steckel and Floud, 1997; Tanner, 1990). In the present study, we employ this indicator to assess determinants of social development in Eastern Germany. Among other factors, we will study the influence of the exorbitant unemployment rates in the past two decades.

At first glance, economic factors might be deemed to have little impact on children's height in an affluent country like Germany. After all, one might assume that even the low income of unemployed parents would suffice for the provision of all basic needs. However, in a cross-

sectional study on Britain in the mid-1980s, such a detrimental effect caused by unemployment has been found for 10,172 primary-school children (Rona and Chinn, 1991). Rona and Chinn controlled for the height of parents, social class, family size and other characteristics, and still estimated the independent influence of unemployment to be as large as 1.2 cm. In this study, we will assess the hypothesis that height is indeed influenced by unemployment, even in Organization for Economic Cooperation and Development (OECD) countries such as Germany. In our study on Eastern Germany, we can assess this hypothesis over time, between 1994 and 2006, which provides further insights. Furthermore, we maintain that the study of heights can yield important insights into the social and economic development of Eastern Germany. Our findings are based on a new dataset of 253,050 height measurements of children around the age of six years, which was used for the first time in this study.

Unlike most other regions, Eastern Germany is ideal for assessing the impact of unemployment on children's height, since it has been suffering from drastic unemployment rates for a long time. Especially if both parents are unemployed, the quality of nutrition, medical resources and family life could decline in many cases. Thus, frustration and psychological

stress might pave the way for reduced care or other compensating behaviour, resulting in parents allowing more unhealthy behaviour than before. In our study, we assess (1) whether the share of parental unemployment in a district has a significant negative influence on the development of heights and (2) whether this can also be found on an individual level. Other potential determinants of height, such as out-migration, fertility, income and education, will also be studied.

Height differences are uniquely important, as, for example, self-confidence is often influenced by height. Based on this relationship, economists use height as an indicator for the willingness to accept risks (Dohmen *et al*., 2006; Goerke and Pannenberg, 2007). Robert F. Fogel (1993) stressed in his lecture to the Nobel Prize committee that a height gap of 17.5 cm meant even for modern Norwegian males in the 1960s and 1970s a higher probability of dying in the following period of not less than 71%, clearly a large amount (see appendix).[1] He based his work on Waaler (1984), who measured several thousands of Norwegians and followed them in a longitudinal study. Norway had one of the populations with the best nutrition in the late twentieth century. Baten and Komlos (1998) estimated that a centimetre of height equals about 1.2 years of life expectancy, with only negligible coefficient

change over time between the birth cohorts of 1860, 1900 and 1950, i.e. the latter being adults in the 1970s to the present. Hence, 1 cm is clearly a meaningful amount, as living 1.2 years more or less is a substantial asset in the quality-of-life portfolio. For children, the relationship between height and longevity is even closer (Billewicz and MacGregor, 1982; Martorell, 1985).

This paper is structured as follows. After a short review of the literature on height determinants, especially in Germany and former socialist countries, the new dataset is described, along with its strengths and limitations. In the third section, we analyse the effects of regional parental u nemployment and a number of other variables in a panel of districts and annual observations. Section 4 tests the robustness of our results by adding a number of other variables. Moreover, height determinants are analysed at the individual level. For example, we study whether female education plays a particularly large role in determining children's height. Other determinants could include the number of siblings or the number of adults in a household who can provide additional care.

2. LITERATURE

Adult height is influenced by the quality of nutrient intake, disease environment and the care received by parents and other persons, which leads to optimal resource usage and avoidance of hazards. This effect on adult height is particularly important during the first three years of life, because growth is most pronounced in those years. However, in the case of still- growing children, the environmental determinants of the period directly preceding height measurements are even more important than the first years of life (Baten, 2000; see also appendix, compare footnote 1). This influence of the last few months before measurement has been amply documented in the anthropological literature. For example, Tanner (1990) describes this as a 'target-seeking process': growing individuals adjust their subsequent growth to current circumstances. For example, if in one year the amount of healthy nutrients is poor or the disease burden is high, the body waits and does not grow. If the situation stays bad, adult stature is accordingly stunted. If times get better, catch-up growth is possible and adult stunting might be minimal. The advantage of stunting during chronic malnutrition periods is that shorter individuals need to consume less energy, and

hence survival is more likely. In conclusion, poor nutrition, health environment or parental care during the months before measurement can lead to lower growth paths of children. This strong influence of the 1–12 months before measurement has also been confirmed in a study by Baten and Wagner (2003) on the height of school children in Germany during the first half of the twentieth century (Figures 1 and 2). Heights declined strongly during World War I and the malnutrition period of 1946–48. In contrast, redistribution programmes and medicohygienic improvements in the Weimar period increased human stature dramatically. Interestingly, during the national socialist period – and even before World War II – heights stagnated. Baten and Wagner (2003) have argued that this was caused by the national socialist antitrade (and antisemitic) policies, as well as by the national socialists' striving for autarchy.

After World War II, the German states developed radically different in

terms of productivity and purchasing power (van Ark, 2001). What is less well known, however, is that height and health were diverging as well. Komlos and Kriwy (2003) found, for example, that while East and West Germans born

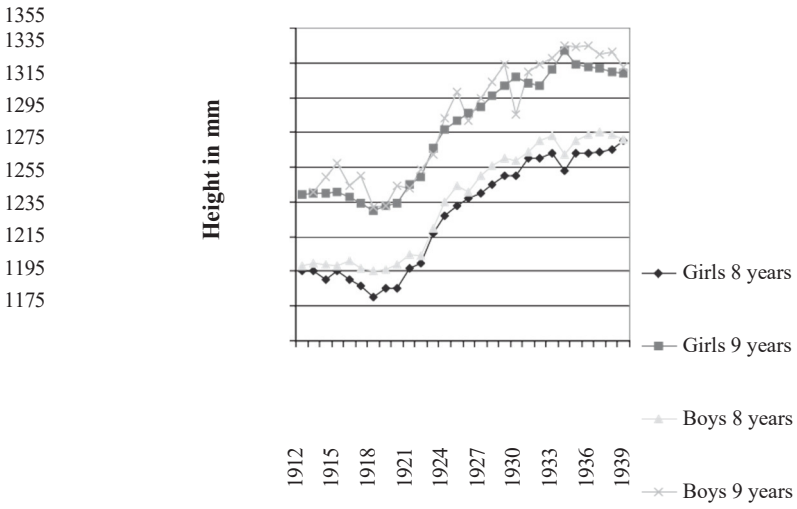

Figure 1 Heights of children in Stuttgart

Source: Tanner (1990).

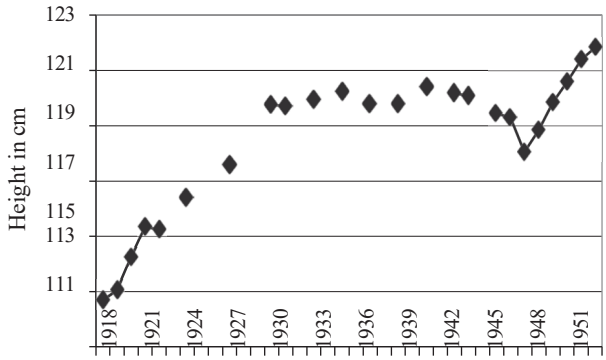

Figure 2 Heights of children in Leipzig (seven years old)

Source: The original series was measured by Koch, cited after Marcusson (1962). The height data of children aged six years, nine months and seven years, three months were averaged.

in the 1940s were of similar stature, those born in the GDR period fell significantly behind their Western counterparts (although an absolute height increase could be observed in both parts). Interestingly, social and gender differences were slightly smaller in the GDR, although social differences did not disappear, as was the official policy goal. After re-unification, the heights of male children and even military conscripts in the East converged rapidly towards the higher Western level (Hermanussen, 1995; 1997; Komlos and Kriwy, 2003), although the exact dimension of the previous gap is still debated (Greil, 1998).

Increasing heights were common in rich and well-developing

countries over the twentieth century. Height increases have been observed in all European countries, and the upper limit might not have been reached until now. For example, Dutch heights – already the tallest in the world – still increased from 180 cm to no less than 184 cm on average in recent years. In contrast, countries with economic problems and unfavourable development conditions did not experience increases in height. For example, girls' heights in the Czech Republic have been stagnating during the difficult years after transition (Bláha *et al*., 2001). Children's stature in Kazakhstan – one of the former Soviet republics in Central Asia – has been stagnating or declining, with the height of girls developing even worse than boys' height due to religiously induced discrimination in the labour market (Dangour *et al*., 2003).[2] Hence, the relationship between height and economic development is astonishingly pronounced for the late twentieth century, especially if

1. Moreover, in most of the poorly developing African countries, heights also developed poorly during the last three decades of the twentieth century (Moradi, 2005).

Table 2 Descriptive statistics of the Brandenburg sample

	Boys	Girls	Total
Year			
1994	15,411	14,297	29,708
1995	15,099	13,603	28,702
1997	13,243	12,298	25,541
1998	9,620	8,752	18,372
1999	8,511	7,545	16,056
2000	8,169	7,387	15,556
2001	8,322	7,753	16,075
2002	9,066	8,214	17,280
2003	10,126	9,074	19,200
2004	10,109	9,363	19,472
2005	12,873	11,652	24,525
2006	11,916	10,647	22,563
Total	132,465	120,585	253,050
Age			
4	43	80	123
5	39,660	39,745	79,405
6	87,988	77,968	165,956
7	4,691	2,725	7,416
8	83	67	150
Total	132,465	120,585	253,050

Note: Cases with unknown gender, height or age were excluded.

intergenerational-level effects and the influence of distinct nutritional traditions are taken into account.

3. DATA

Anthropometric measurements from all Brandenburg school starters are available from 1994 onwards until 2006, with only the year 1996 missing (Table 2, panel A).[3] The data were collected by public health services. All children in Brandenburg are medically examined by default before starting school. While medical examinations of school starters are carried out in other German *La¨nder* as well, what sets the dataset at hand apart from all other German datasets is the inclusion of economic variables on parental occupational status, parental education, the number of siblings and the number of adults living in the household. These data derive from an interview in the medical examination. During 1994–95, the first two years of examinations, the aforementioned socioeconomic background variables were

3. In 1996, the data were not collected for internal reasons in the Ministry.

only recorded for half of the dataset. However, this missing data problem resulted not from a selectivity of responses, but rather from the fact that some physicians avoided asking questions about unemployment and social back- ground, fearing violations of data security or non-compliance. However, we find no systematic distortion when comparing the share of 'non-employ- ment' responses with aggregated data. Until 2006, more than 90% of the data are complemented with socioeconomic background variables. The Branden- burg health reporting has been using these economic variables to assess the association between social inequality and infant morbidity from the late 1990s onwards (Böhm *et al*., 2003; MASGF, 1999). Besides, an awareness of the health consequences of social inequality is growing among both experts and the general public.

The handbook for child and youth health services in Brandenburg explains

the definition of unemployment (Landesgesundheitsamt Brandenburg, 2008): when the child is brought to the school entry examination, the accompanying person is interviewed whether father, mother or both parents are employed or unemployed. If the person decides not to

answer, or the child comes from an orphanage, the cell is coded as missing value. If mother (or father) lives with another partner instead of the official father (or mother), the data for this partner are coded. The definition of ‘unemployed’ applies to those persons who work less than one hour per week. Publicly supported employment (‘ABM’, etc.) is coded here as employment. Unfortunately, no information about the duration of employment is recorded.

For all of the 253,050 children in the dataset, height, gender and age were recorded. The complete set of socioeconomic variables was recorded for 166,387 cases. The quality of the anthropometric measurement can be rated high, since a standardized procedure was used. Initially, about 30,000 children were measured per year, but figures shrank to 15,000–25,000 children annually after 1998. This was not the effect of selective measure- ment, but rather mirrors the demographic development of Brandenburg: while birth rates had already begun to decline during the GDR period of the 1980s, this trend was dramatically reinforced in the first half of the 1990s. Increasing pessimism about social and economic development, the higher average age of mothers and migration of young people led to a smaller frequency of births.

Most children in the dataset were measured at age six years, while

approximately one-third had already been measured by age five years. Some 7,000 children were seven years old, and negligible amounts were aged four and eight years. The typical family in Brandenburg over the period under study had either one or two children, with more children occurring relatively infrequently. Finally, the employment and schooling characteristics of the parents need to be addressed: about two-thirds of the school starters' mothers were employed. About 15% of the mothers had an *Abitur* degree (i.e. 12 years of successful schooling), while slightly less mothers did not even finish ten years of schooling.

4. THE DEVELOPMENT OF UNEMPLOYMENT AND HEIGHT

The *Land* of Brandenburg is located around the German capital, Berlin. It experienced a remarkable positive economic development in the first half of the 1990s, with wages growing at 10–15% and gross domestic product (GDP) per capita even slightly more. There was modest convergence to Western Germany, albeit this was mostly due to large income transfers from there. From the mid-1990s to the early 2000s, wages stopped growing and even declined somewhat after 2001. GDP per capita grew only modestly (around 2– 3%). This was typical of the entire Eastern part of re-unified Germany. In the second half of the 1990s, unemployment began to increase strongly and has hitherto remained at high levels.

Overall, the heights of six-year-old boys increased from the GDR times of the late 1980s (117.2 cm in a study by Greil and Schilitz, 1999) to 119.9 cm in 1997 (our study, age six years). In contrast, after 1997 there is a decline, followed by a very slight recovery (Figure 3). In assessing this time trend, we take great care to control for age in years and months (see the note under Figure 3). Interestingly, boys in Brandenburg were taller than girls in the period under study, which is

not normally the case in this age range. In fact, none of the available growth reference charts for the US suggests a height advantage for boys of this age (see http://www.cdc.gov/growthcharts/), although a recent German survey did (Stolzenberg *et al*., 2007). The same phenomenon has been observed in other post-socialist societies (Dangour *et al*., 2003). Komlos and Kriwy (2003) note that male heights in Brandenburg

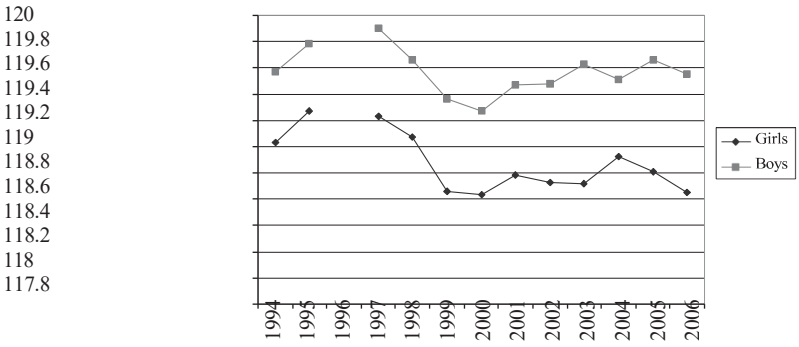

Figure 3 Height (in cm) of six-year-old children from Brandenburg

Note: This trend is adjusted for ages in months and on the level of six-year-olds; see regression A.1. The value for 1994 and six-year-olds is represented by the constant, and the values for 1995– 2006 is the constant plus the year coefficient, always for six-year-olds. We control the age structure with month dummies, and include only 6.0–6.99-year-olds here. This is important, because if a disproportionately high number of children, say aged six years and 11 months, had been measured during the early phase, and many children aged six years and one month during the later phase, then simple averages could be misleading.

improved more during and after re-unification, as was the case in other areas of Eastern Germany (see also Kromeyer *et al*., 1997; Schilitz, 2001). Zellner *et al*. (1996; 2004) postulate that the height of seven-year-old girls in Jena was

124.5 cm in 2001, whereas boys were 126.4 cm tall (Jena is situated in the *Land* of Thüringen, south-west of Brandenburg). These trends could be related to social behaviour, but might also have biological reasons. We intend to address these issues in a separate study.

Next, we consider the correlation between parental occupational status and children's height, comparing the heights of children whose parents were reported as 'both unemployed' vs. 'at least one parent employed' (Figure 4). Children of parents who were reported as 'both unemployed' were always significantly shorter, by about 1.5 cm in 1995 and 1997, and still more than 1 cm in 2006. It is interesting to note, however, that the height of children with employed parents declined over this period. This might have been caused by external effects from the difficult situation in this region. As the number of children with two unemployed parents also increased dramatically, the height reduction might indeed have been partially caused by this factor.

Another potential explanation could be that an increasing number of children were living in single-parent households, which tend to be more vulnerable economically. However, we reject this variable, since the height decline of single-parent households was almost identical to the overall decline in height (figure not shown, available from authors).

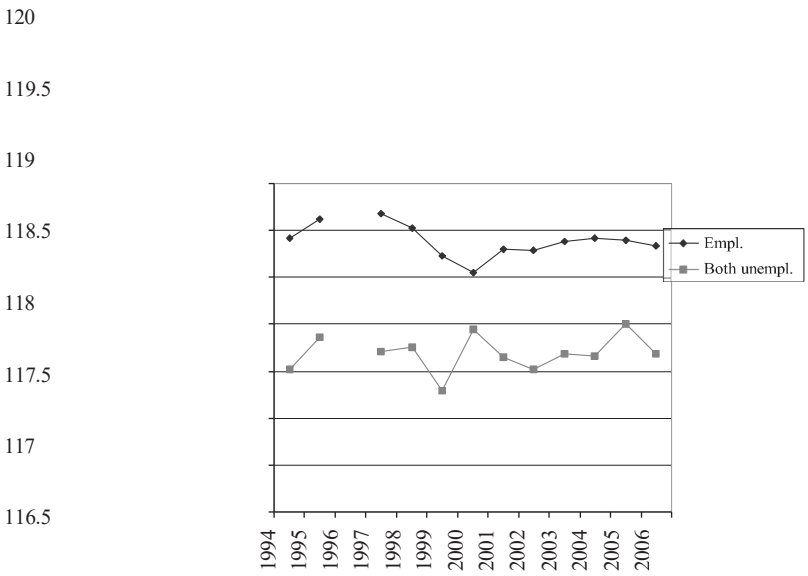

Figure 4 Height (cm) of female and male children (six years old), with 'at least one parent employed' vs. 'both unemployed'

Note: This trend is adjusted for ages in months, and on the level of six-year-olds; see regression A.2. The value for 1994 and six-year-olds is represented by the constant (minus the coefficient for unemployed parents in the lower line), and the values for 1995–2006 is the constant plus the year coefficient, always for six-year-olds (with or without the unemployment coefficient subtracted). We control the age structure with month dummies, and include only 6.0–6.99- year-olds here.

Table 3 Expected signs of the explanatory variables

	Expected sign	District regressions	Individual regressions
Variables			
Unemployment of parents	-	Incl.	Incl.
Total unemployment Long-	-	Incl.	
run unemployment	-	Incl.	Incl.
Out-migration	-	Incl.	
Education Income	þ	Incl.	Incl.
Education of mothers	þ	Incl.	Incl.
	þ þ		
Education of fathers	þ	Incl.	Incl.
Fertility (birth rate/number of siblings)	-		Incl.
Number of adults in household	þ		Incl.
Interaction variables			
Education x out-migration	-	Incl.	
Unemployment x number of siblings	-		Incl.
Unemployment x adults in household	þ		Incl.

4.1. District-level regression analysis

In the following, we will use panel regression techniques for districts, age groups and years (Tables 3 and 4). In order to minimize measurement error from normal growth patterns, we distinguish three age groups: those aged 5.5–5.99, 6.0–6.49 and 6.5–7.00 years. We

obtain 12 annual observations for those 18 districts and three age groups. We regressed height on explanatory variables in a number of panel regressions, using the least-squares dummy variable model that is equivalent to the fixed-effects estimator. We always included a full set of dummies for the regions and the age half years, in order to limit the problem of heterogeneous age.[4]

As a core result, the children who were born in districts and years in which many parents reported 'both unemployed' were in fact significantly shorter, and the coefficient is not small (Table 4, columns 1, 4–7). We also decided to assess different concepts of unemployment as explanatory variable. We used not only the share of parents who reported to be both unemployed, but also the total unemployment rate in a district, and the share of total long-term unemployment (more than a year). If we compare the coefficient of parental unemployment with the total unemployment rate (column 2), it turns out that the latter is actually insignificant. The total unemployment rate also

4. The effect of the latter is an R^2, which is always quite large, because clearly older children were taller than younger children. If we omit the age half years, the results do not change much. The only major changes are that the coefficient for unemployment of both parents increases quite strongly. It increases between factors 2 and 3. Moreover, the R^2 declines to values around 0.10–0.12, which are still acceptable.

Table 4 Determinants of height on the district and age group level (panel with annual observations)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployed parents	-1.12***			-0.75*	-0.83*	-1.11**	-0.90**
	(0.0080)			(0.084)	(0.078)	(0.034)	(0.039)
Unemployed total		1.61					
		(0.11)					
Unemployed long			0.40				
			(0.79)				
Out-migration	-0.16***	-0.16***	-0.17***	-0.16***	-0.18***	-0.10	-0.12***
	(0.00000017)	(0.0000073)	(0.000010)	(2.36e-09)	(0)	(0.45)	(0.0012)
Income	-0.11	-0.27	-0.16		0.27**	-0.13	0.04
	(0.44)	(0.12)	(0.33)		(0.034)	(0.39)	(0.82)
High school	-1.40	0.16	1.14			-1.48	-1.16
	(0.17)	(0.90)	(0.40)			(0.16)	(0.26)
High school x out-migration						-0.20	
						(0.67)	
Birth rate				-0.10***	-0.13***		
				(0.000093)	(0.000040)		
Constant	118.76***	117.92***	117.70***	118.49***	118.24***	118.82***	117.92***
	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dummies incl. districts	Y	Y	Y	Y	Y	Y	Y

Table 4 Continued

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Time[a]	N	N	N	N	N	N	Y
Age half year	Y	Y	Y	Y	Y	Y	Y
Observations	455	411	405	638	587	455	455
R^2	0.94	0.94	0.94	0.94	0.94	0.94	0.94

Notes:

[a] Five-year cohorts.

*,**,***Significant at the 10%, 5% and 1% level, respectively. *p*-Values estimated based on robust standard errors. Estimator is the least-squares dummy variable (LSDV) model. All regressions are weighted least-squares estimations, weighting the panel observations by the underlying number of children in the dataset for each year and district. Dummy coefficients for districts, age half years and time dummies not reported. *Sources*: On the height variable and parental unemployment, see text. Out-migration, birth rates and population: Landesvertrieb fu¨r Datenverarbeitung und Statistik Land Brandenburg (Gebietsstand: 31 December 2004). 'Beitrag zur Statistik'. *Bevo¨lkerungsbilanz der Gemeinden im Land Brandenburg 1992 bis 2004*, pp. 16–27; Landesvertrieb fu¨r Datenverarbeitung und Statistik Land Brandenburg (2005). 'Statistische Berichte (A I 1 – j/05) (A V 2 – j/05)'. *Bevo¨lkerungsentwicklung und Fla¨chen der kreisfreien Sta¨dte, Landkreise und Gemeinden im Land Brandenburg 2005*, pp. 4–5; Landesvertrieb fu¨r Datenverarbeitung und Statistik Land Brandenburg (2006). 'Statistischer Bericht (A I 1 – j/06) (A V 2 – j/06)'. *Bevo¨lkerungsentwicklung und Fla¨chen der kreisfreien Sta¨dte, Landkreise und Gemeinden im Land Brandenburg 2006*, pp. 4–5; Incomes: Statistik Regional Berlin Brandenburg (2005). 'Statistischer Bericht (P I 6 – j/05) – Volkswirtschaftliche Gesamtrechnung'. *Verfu¨gbares Einkommen und Prima¨r- Einkommen der privaten Haushalte in den kreisfreien Sta¨dten und Landkreisen des Landes Brandenburg, 1996, 2000 bis 2005*, p. 8; Education: INKAR CDROM and http://www.statistik-berlin-brandenburg.de/Publikationen/Stat_Berichte/2007/SB_AVI8_j-06.pdf (accessed on 23 August 2008). Unemployment, different specifications: friendly communication by the Bundesagentur fu¨r Arbeit, Mr Thomas Bertat.

includes, of course, many people without young children. This could be a source of measurement error, as the effect of unemployment on children's height might be mainly caused by the parental situation. The same might apply to the rate of those who were unemployed for more than a year. This component of unemployment also turns out to be insignificant (column 3). Apart from unemployment, a number of other factors could have impacted on height, which are listed in Table 3. We also describe in this table which variables we will include on the district level and on the individual level (see
next section).

(1) Net outflow or net inflow of well-educated (and perhaps taller) individuals. One could imagine that in the districts of Brandenburg that were in a particularly bad situation, the outflow of individuals who were well educated was quite strong. Given the relationship between education and height, one could further imagine that well-educated migrants might have been taller on average. Burda (1993) analysed an opinion poll in which former GDR citizens were asked about their potential wish to emigrate. He found that individuals with a college degree (*Abitur*) mentioned more often that they could

imagine emigrating. On the other hand, he did not find a significant difference between those with a university degree and the unskilled.[5] The districts with the largest losses were situated at the periphery of Brandenburg (the 'outer development area', as it is termed in Brandenburg official documents). On average, nine districts had net outflow and nine districts (the latter adjacent to Berlin) had net inflow of migrants, the balance being almost equal in terms of migrants per capita. Apart from the migration of educated and tall families, a second mechanism might be that the net out-migration rate might be another proxy for the economic condition of a given district and year, with high out-migration from the peripheral districts of high unemployment and other bad prospects, and substantial immigration into the well-developing districts around Berlin. In fact, the correlation between the total unemployment rate and net out-migration is 0.39 (p 5 0.00).[6] Related to this, the differential of land prices between Berlin and the adjacent Brandenburg districts plays a role here, bringing in immigrants with often above-average incomes into the Berlin–Branden- burg border area. As a result, the share of net out-migration had in fact a quite consistent negative effect on height (Table 4).

5. Hunt (2000) confirmed this with other data, keeping the age structure constant. Bru¨cker and Tru¨bswetter (2007) argue that the migrating Eastern Germans received actually less schooling than the population that stayed, based on the 1% sample of all German employed persons generated by the Institute for Employment Research (IAB).
6. The correlation with the unemployment of both parents is 0.32 (p 5 0.00), with long-term unemployment 0.29 (p 5 0.00) and with short-term unemployment only 0.05 (p 5 0.29); i.e. in the latter case, there is no significant correlation. Short-term employment did not have a negative effect on height (results available from the authors, not shown here).

(2) Education might have a direct influence on the height and health of children. On the district level, we calculate the share of those who leave school with a high school degree (*Abitur*).[7] For example, in the big cities the share of high-school-educated persons is much higher, and there might be both direct effects of educated parents on children's health and positive externalities created from higher education on the health attitudes towards children in a region. The share of those who leave school with a high school degree (*Abitur*) is insignificant, perhaps because this is too rough an indicator of education. We also tested an interaction term between net out-migration and share of persons with high school degrees (*Abitur*) who leave school (column 6). The idea was to assess whether there was an effect if many leave from districts of higher human capital. This interaction term is also insignificant. However, also, this variable is only a very rough indicator of the interaction between outflow and higher education.

(3) Another factor that we need to control is income. It could be that it is not

the psychological effects of unemployment that are detrimental to children's health, but the income in a given region and period

might be simply so low that high-quality food and medical resources cannot be as easily bought by the poorest part of the population as elsewhere.[8] Income is mostly insignificant, except in one of the numerous specifica- tions, which does control for the fertility rate (and not for education, column 5). Now, unemployment also comes with lower income. But it would be particularly interesting to see whether the coefficient of unemployment gets smaller if we control for income. Hence, we did the direct comparison: in column 4, we do not control for income, but we do so in the otherwise identical regression in column 5. It turns out that the coefficient for unemployment is not reduced after controlling for income. As a result, we might tentatively conclude that the relationship between unemployment and reduced height is not as strongly deter- mined by the reduced income, but rather by the psychological effects of unemployment.

(4) *Demographic factors*. The birth rate could be a strong exogenous influence

on height, as a higher number of children might leave less resources for each individual child, and the children might infect each other with illnesses more often, which tend to reduce height, at least in the

short term. The birth rate has in fact a negative influence on average height (columns 4 and 5).

7. Data on the education of the total population are not available.
8. Of course, the total income in the region also reflects capital and other non-wage/non- transfer incomes, which might be earned more often by the richer part of the population, who clearly do not face these problems. Fortunately, the official district statistics also include the 'wages and social transfers' earned in each district and year, and we may assume that this is a good proxy for the incomes of the middle and lower income groups.

As a robustness test, we also included time dummies into the model (column 7). Those refer to five-year periods (as annual time dummies would have reduced the degrees of freedom much more). Even with including those time dummies, the unemployment effect survives.[9] We may conclude that unemployment mattered for the height of East German children, even at the quite disaggregate district level. Similarly, out-migration mattered in at least one of the interpretations given above. Fertility actually had a negative influence on height, perhaps because of the additional infection risk and reduced resources (time, attention, money) per child.

5. INDIVIDUAL HEIGHT REGRESSIONS

We now turn to assess the influence of unemployment and other potential determinants on height at the individual level. In general, we also expect at this level a negative influence of unemployment on the health and social integration of a family, including the children (Table 3). The literature on the medical, psychological and social consequences of unemployment provides clear arguments for this relationship, and as

our previous analysis has shown, the effects of unemployment on children's height can even be measured in an OECD country like Germany during the 1990s and 2000s. Simply put, the question is therefore whether the frustration of unemployment and the lower income of unemployed parents results in a reduced investment in their children, as in the form of allowing unhealthy behaviour, and perhaps taking less care of them when they are ill – and whether this effect is so strong that it results in lower height even at the individual level.

Clearly, this could also depend on other variables such as the number of

people in the household who can provide additional income and care, or on the number of children who must be sustained with the unemployment income, and other similar factors (Table 3). First, a factor supplementing unemployment could be the number of children relying on the purchasing power and available energy for care taking of the household. In other words, was children's height in Brandenburg reduced once additional children demanded care and nutrients? From an anthropological point of view, we would expect the opposite, since the second and further children are usually taller than the first child for biological reasons. Hence, we would *ceteris paribus* expect shorter

children in one-child households. However, *ceteris* need not always be *paribus*. Our expectation for this variable is therefore not explicitly positive or negative per se, but when correlated with unemployment, we expect its marginal effect to be negative.

9. Another robustness test was to run the regressions in first differences (see appendix, compare footnote 1). However, there were some influential observations outside of the area of five standard deviations (2.5 above and below the mean). Only if those influential outliers are removed, is the effect of unemployment also visible in first differences.

Second, we are interested in parental education, distinguishing between the mother's and father's education. With higher education, children could benefit from better health behaviour in general, and particularly from their parents' knowledge of the most appropriate food and healthcare items (Bogin, 1988; Cigno, 1991). In principle, one might also imagine that better- educated parents will face higher opportunity costs since they can expect higher incomes on the labour market; yet this effect does not seem strong enough to justify a mixed expectation. Hence, our expectation of education per se is positive.

Third, we are able to measure the effect of additional adults living in the household. Clearly, it makes a difference whether or not only one adult has to take care of the offspring, while additional adults (such as grandmothers or other persons) can provide additional care to children. If the parents themselves are unemployed, additional adults may even be a source of further income. Our expectation of additional adults living in the household is therefore positive.

5.1. Results on the individual level

Table 5 informs us about the individual effects of unemployment on children's height. Those regressions were estimated with OLS. Apart

from age year dummies, dummies for age months were also included that had the expected magnitudes (not shown). We first discuss the most general model (column 1), and then compare more simplified models (columns 2–4).

With the mother employed, a positive effect on children's height was observable. A child was 0.41 cm taller (compared with the reference group in which both parents were not employed), if the mother had an occupation and information on the father was available. It was even 0.67 cm, if the employment status of the father was not reported (which was typical for single-female-headed households). This might be explained by higher income and, perhaps more importantly, the fact that employed mothers develop other desirable human capital characteristics that were also good for the health development of the child. In the model of column 4, which does not control for parental schooling, the unemployment coefficient is even larger (0.8–1.3 cm). The father's employment also mattered for a child's height. Those results serve as an empirical 'microfoundation' for the results presented above, even if at the individual level, where we regressed heights at the district level.

In development economics, a frequent finding is that investments into

female basic education has much stronger health effects than investments into male education, since females decide more often about health-related resources and care for children. We find the same tendency in our German sample: if mothers reported less than ten years of schooling, children were 0.8–0.9 cm shorter (models 1–3 in Table 5). If fathers reported the same schooling, the effect was negligible, except for a few cases in which data about

Table 5 Regressions of individual heights

Regression model	(1)	(2)	(3)	(4)
Employment				
Moth. empl., fath. not miss. data	0.41*** (0)	0.42*** (0)	0.44*** (0)	0.78*** (0)
Moth. empl., fath. miss. data	0.67*** (0)	0.69*** (0)	0.73*** (0)	1.28*** (0)
Fath. empl. moth. not miss. data	0.39*** (0)	0.41*** (0)	0.51*** (0)	0.63*** (0)
Fath. empl., moth. miss. data	0.50*** (0.0022)	0.54*** (0.00077)	0.57*** (0.00014)	0.68*** (4.5e-09)
Schooling of parents				
Moth. not 10 years, fath. not miss. data	-0.86*** (0)	-0.87*** (0)	-0.90*** (0)	
Moth. not 10 years, fath. miss. data	-0.80*** (0)	-0.78*** (0)	-0.78*** (0)	
Fath. not 10 years, moth. not miss. data	-0.08 (0.11)	-0.07 (0.12)	-0.08* (0.082)	
Fath. not 10 years, moth. miss.	-0.86*** (0.0024)	-0.83*** (0.0031)	-0.82*** (0.0036)	

data			
Moth. has high school, fath. not miss. data	0.20***	0.21***	
	(0.0000011)	(0.00000015)	
Moth. has high school, fath. miss. data	0.19	0.24**	
	(0.10)	(0.036)	
Fath. has high school, moth. not miss. data	-0.19***	-0.18***	
	(0.0000023)	(0.0000057)	
Fath. has high school, moth. miss. data	-0.32	-0.33	
	(0.40)	(0.38)	
Migration			
Out-migration (district/year level)	-0.04***		
	(0.0000015)		
Household has			
2 children	-0.41***	-0.41***	-0.44***
	(0)	(0)	(0)
3 children	-0.94***	-0.93***	-1.01***
	(0)	(0)	(0)

Table 5 Continued

Regression model	(1)	(2)	(3)	(4)
4 and more children	-1.75*** (0)	-1.73*** (0)	-1.79*** (0)	
1 adult	-0.07	-0.07	0.07	
(0.30)		(0.32)	(0.12)	
3 and more adults	0.23***	0.22***	0.23***	
(0.0015)		(0.0014)	(0.00055)	
Interactions of unemployment				
x 2 children	-0.27***	-0.26***		
	(0.00033)	(0.00055)		
x 3 children	-0.46***	-0.47***		
	(0.0000026)	(0.0000015)		
x 4 and more children	-0.28**	-0.29**		
	(0.016)	(0.011)		
x 1 adult	0.30***	0.29***		
	(0.0012)	(0.0018)		
x 3 and more adults	-0.03	-0.03		
	(0.89)	(0.89)		
Female	-0.71***	-0.70***	-0.70***	-0.68***
	(0)	(0)	(0)	(0)
Constant	113.75***	110.66***	110.60***	112.82***
	(0)	(0)	(0)	(0)
Observations	162,363	166,387	166,387	216,186
Adjusted R^2	0.14	0.14	0.14	0.13

Notes:

*,**,***Significant at the 10%, 5% and 1% level, respectively. The constant refers to a male child of four years zero months, with mother and father reported as unemployed, measured in a fictional district and year with zero out-migration. In columns 1 and 2, education is average, whereas the constant in columns 3 and 4 refers to at least ten years of education. In columns 1–3 there is no sibling and two adults in the household, whereas column 4 refers to the average.

Cases with unknown gender or age were excluded. This and missing information on employment and family structure accounts for the difference to the maximum number of cases. Eleven dummies for each additional complete month of age were included, zero month was the constant and age dummies for years of birth. Sources on out-migration: see Table 4.

the mother were reported as 'unknown' (mostly single-father-headed house- holds). The difference between high school (*Abitur*) and the group with at least ten years of schooling was less pronounced, compared with the difference between 'less than ten years' and those two groups. A maternal high school effect of only 0.2 cm was estimated; in the case of father's high school attendance there was even a similarly small negative effect.

We also added the district-level out-migration rate to those regressions, as this variable was quite consistent in the district-level regressions. Literally, this variable cannot have a result on heights of remaining children, but it can be interpreted as a proxy for the economic and educational conditions of a

given district in a certain time period – as discussed above, districts with high out-migration rates might have been characterized by bad prospects, and the remaining population by lower educational status (and perhaps shorter height). This proxy indicator has a significantly negative influence on individual height. However, the sizes of the other coefficients do not change much if we include this variable (comparing columns 1 and 2).

Another set of variables measures the number of children in the house- hold. There is no evidence for the anthropological hypothesis that children of large families are taller (because the second and following children tend to be taller than the first). On the contrary, offspring of families with two or more children turned out shorter, since resources and care had to be shared – just like infectious illnesses might also have been shared more often. In households with two children, height was about half a centimetre lower than in one-child households (represented by the reference group). Four and more children equalled as much as 1.8 cm less in height. Although one might be inclined to hypothesize that households with many children invest less in education, we actually found no significant correlation between high school education (*Abitur*) of the parents and the number of children in the household.

The number of adults was only significantly positive for households with three and more adults, so that a grandmother (or other adult) living in the household does indeed make a positive difference regarding childcare. In contrast, single-headed households did not display lower heights of children. Finally, the puzzling fact that Eastern German girls were substantially shorter than male children of the same age has already been discussed above. The age dummy variables yield coefficients of a magnitude we would have expected. We also added interaction terms of household structure variables with unemployment. When correlated with unemployment, single-headed house- holds did have a small, but positive coefficient. Most of the single-household heads were women, who apparently used their additional time to take care of the children and appeared relatively robust against the frustration effects of

unemployment (as opposed to households with unemployed males).

The interaction terms of unemployment and additional children are remarkably large. Above, it was already shown that households with four and more children fall behind smaller households with regard to children's height, the former's children being significantly shorter (- 1.8 cm). The unemployment variable subtracts another height coefficient of

- 0.3 cm, in addition to the ‘normal’ sibling effect! Hence, we conclude that the interaction terms with unemployment are important components of our empirical model, even if the adjusted R^2 does not change much.

6. CONCLUSION

The main finding of this study is that, actually somewhat contrary to our initial expectations, unemployment mattered for the height of young

children in Eastern Germany, 1994–2006. Our result that parental unemployment renders children shorter, even after controlling for a number of other potential determinants, has substantial economic, political and social implications. Other variables that mattered were the rate of out-migration from a district and fertility.[10]

Could endogeneity have played a role here in that shorter parents, who genetically tend to have shorter children, ended up more often in unemployment? After all, Hamermesh and Biddle (1994) have shown that individual height influences income, and hence it could also matter for employment prospects. However, as was shown above, unemployment also matters over time and at the district level. In the district-time panel, individual genetic height dispersion averaged out, and should not impact on changes in height. In addition, the timing is important here: while the height of six-year-old children is strongly influenced by the year before measurement, a potential genetic height effect should already have been transmitted at the time of conception seven years earlier.[11] Moreover, in the study on the UK cited above, Rona and Chinn (1991) controlled for the height of parents, and still found an independent influence of unemployment of 1.2 cm. However, the role of genetics can potentially play a role via selective migration,

as we found a significant out-migration effect.

What are the wider implications of this research? It is important to

consider new measures for the effects of unemployment. Children's height can be used as a sensitive social indicator, since height is correlated with health and longevity and is hence a proxy for important components of the human utility function (Fogel, 1993; Waaler, 1984). Income, in contrast, is, to

10. Did other factors share the same trend that we showed for heights after 1997? For example, the education of mothers did not trend towards lower values. It has even shifted towards the higher schooling categories (see appendix, compare footnote 1): thus, the share of mothers with 12 and more years of successful schooling (*Abitur*) has increased from 12% to 22%, whereas the share with less than ten years of schooling has declined slightly from 10% to 7%. The number of children in a household (in our group) has remained constant in this dataset, varying very modestly between 1.92 and 2.05. In a similar vein, health spending did not have the opposite trend as children's height in Brandenburg. The number of physicians per capita rather increased over time.

11. Could economic post-unification effects explain the decline of height of children entering school after 1997? After all, most of our children were between 5.5 and 6.99 years old, so many were born directly after unification. However, the height of school children is mainly determined by the months directly preceding measurement (see appendix, compare footnote 1), and hence the effect might be relatively small. One could also imagine a phenomenon that some women with high abilities postponed childbirth directly after unification, in order to make use of the new educational possibilities. The risks of birth increase if the mother reaches or passes the age of 40, and hence could it be that heights

of children might also be negatively affected? Available studies do not indicate that height of children declines with the age of mothers. We thank an anonymous referee for raising this important point, and we thank Barry Bogin, a leading anthropologist, for providing answers to this question.

a certain extent, an input to utility – more income does correlate with higher utility, but the correlation is far from perfect. For example, health-related goods might be accessible to, or even free of charge for, unemployed people in some regions, in which case income would matter less. Moreover, utility as derived from household income might be unequally distributed among the various household members, thus making household structure another important factor in this regard. For example, we found in this study that children's height is very sensitive to the number of siblings. A six-year-old Brandenburg child entering school is on average 1.8 cm shorter if it has three or more siblings. In addition, if the parents are unemployed, the detriment is even larger.

Results from social epidemiology show the association between the health status and the social status. That is true for adults and children. Therefore, the World Health Organization says that epidemiologic studies and health reporting should always include socioeconomic variables (Kunst and Mackenbach, 1995). From an anthropometric point of view, we suggest the use of socioeconomic data to understand secular changes of height. In the important debate over the effects of unemployment, such a measure is certainly a step forward and we would suggest that socioeconomic variables should not only be collected for

Brandenburg, but for all countries. In this study, we used for the first time a unique dataset, which is, as of now, not available for other countries of the world. Hence, we would argue that a more systematic collection of such data – at low marginal costs, since children entering school are measured anyway – could yield important information about the success of public health infrastructure investments and deepen our understanding of the relationship between unemployment and the biological components of welfare.

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REFERENCES

Baten, J. (2000), 'Height and Real Wages: An International Comparison', *Jahrbuch fu¨r Wirtschaftsgeschichte* 1, 17–32.

Baten, J. and J. Komlos (1998), 'Height and the Standard of Living', *Journal of Economic History* 57, 866–870.

Baten, J. and A. Wagner (2003), 'Autarky, Market Disintegration, and Health: The Mortality and Nutritional Crisis in Nazi Germany 1933–37', *Economics and Human Biology* 1, 1–28.

Billewicz, W. Z. and I. A. MacGregor (1982), 'A Birth-to-Maturity Longitudinal Study of Heights and Weights in Two West African (Gambian) Villages', *Annals of Human Biology* 39, 241–250.

Bla´ha, P., J. Vignerova´, J. Kobzova´, L. Krejcˇovsky´ and J. Riedlova´ (2001), 'VI. Celosta´tn´ı antropologicky´ vy´zkum deˇt´ı a mla´de&e' (6th Nation-Wide Anthropological Survey of Children and Adolescents 2001)', *Cˇesko-slovenska´ Pediatrie* 12, 766–770.

Bogin, B. (1988), *Patterns of Human Growth*, Cambridge University

Press, Cambridge. Bö hm, A., G. Ellsa¨Ber and J. Kuhn (2003), 'Arme Kinder, kranke Kinder? Was man aus

Einschulungsuntersuchungen alles lernen kann', *Mabuse* 45, 18–19.

Brü cker, H. and P. Trü bswetter (2007), 'Do the Best Go West? An Analysis of the Self- Selection of Employed East–West Migrants in Germany', *Empirica* 34, 371–395.

Burda, M. (1993), 'The Determinants of East–West German Migration. Some First

Results', *European Economic Review* 37, 452–461.

Cigno, A. (1991), *Economics of the Family*, Clarendon Press, Oxford.

Dangour, A., A. Farmer, H. L. Hill and S. J. Ismail (2003), 'Anthropometric Status of Kazakh Children in the 1990s', *Economics and Human Biology* 1, 43–53.

Dohmen, T., A. Falk, D. Huffman, J. Schupp, U. Sunde and G. G. Wagner (2006),

'Individual Risk Attitudes: New Evidence from a Large, Representative, Experimen- tally-Validated Survey', CEPR Discussion Paper No. 5517.

Fogel, R. W. (1993), 'New Sources and New Techniques for the Study of Secular Trends

in Nutritional Status, Health, Mortality, and the Process of Aging', *Historical Methods*

26, 5–43.

Goerke, L. and M. Pannenberg (2007), 'Risk Aversion and Trade Union Membership', Working Paper, University of Tübingen/DIW Berlin.

Greil, H. (1998), 'Age- and Sex-Specifity of the Secular Trend in Height in East

Germany', in: J. Komlos and J. Baten (eds.), *The Biological Standard of Living in Comparative Perspective*, Steiner, Stuttgart, pp. 483–496.

Greil, H. and A. Schilitz (1999), 'Körperbau und körperlicher Entwicklungsstand von

Brandenburger Schülern und Schülerinnen am Ende des 20. Jahrhunderts', in: Ch. Helmke, P. Haase and C. U. Rückert (eds.), *Zur Situation des Schulsports im Lande Brandenburg und Wege zur Erho¨hung seiner Qualita¨t*, Aktionsbündnis für den Schulsport Potsdam.

Hamermesh, D. S. and J. Biddle (1994), 'Beauty and the Labor Market', *American*

Economic Review 18, 1174–1194.

Hermanussen, M. (1995), 'Die Körpergröße deutscher

Wehrpflichtiger vor und nach der deutschen Wiedervereinigung', *Die Medizinische Welt* 46, 391–392.

Hermanussen, M. (1997), 'Catch-up in Final Height after Unification of Germany',

Acta Medica Auxologica 29, 135–141.

Hunt, J. (2000), 'Why Do People Still Live in East Germany?' DIW Discussion Paper No. 201, DIW, Berlin.

Ja¨ger, U., K. Zellner and K. Kromeyer (1990), 'Ergebnisse Jenaer anthropologischer Schulkinderuntersuchungen zwischen 1880 und 1985', *Anthropologischer Anzeiger* 48, 239–245.

Komlos, J. (1989), *Nutrition and Economic Development in the Eighteenth Century Habsburg Monarchy: An Anthropometric History*, Princeton University Press, Prince- ton, NJ.

Komlos, J. (1996), 'Anomalies in Economic History: Towards a Resolution of the 'Antebellum' Puzzle', *Journal of Economic History* 56, 202–214.

Komlos, J. and P. Kriwy (2003), 'The Biological Standard of Living in the Two Germanies', *German Economic Review* 4, 459–473.

Kromeyer, K., R. C. Hauspie and C. Susanne (1997), 'Socioeconomic Factors and Growth during Childhood and Adolescence in Jena Children', *Annals of Human Biology* 24, 343–353.

Kunst, A. E. and J. P. Mackenbach (1995), *Measuring Socioeconomic*

Inequalities in Health,

World Health Organization, Copenhagen.

Landesgesundheitsamt Brandenburg (2008), *Handbuch fu¨r den Kinder- und Jugendge- sundheitsdienst im Land Brandenburg. Leitlinien zur einheitlichen Durchfu¨hrung und Dokumentation der kinder- und jugenda¨rztlichen Untersuchungen*, Landesgesundheit-samt, Zossen. Available at http://www.masgf.brandenburg.de (accessed on 12 September 2008).

Marcusson, H. (1962), *Die Gesundheit des Kindes im Vorschulalter*, 3rd ed., Verlag Volk

und Wissen, Berlin.

Martorell, R. (1985), 'Child Growth Retardation: A Discussion of its Causes and its Relationship to Health', in: K. Blaxter and J. C. Waterlow (eds.), *Nutritional Adaptation in Man*, John Libbey, London, pp. 13–29.

MASGF (1999), *Einschu¨ler in Brandenburg: Soziale Lage und Gesundheit*, Ministerium fu¨r

Arbeit, Soziales, Gesundheit und Frauen, Potsdam. Available at http://www.masgf. brandenburg.de (accessed on 11 November 2008).

Moradi, A. (2005), 'Erna¨hrung, wirtschaftliche Entwicklung und

Bürgerkriege in Afrika
südlich der Sahara (1950–2000)', Dissertation, University of Tübingen. Available at http://www.ub.uni-tuebingen.de (accessed on 29 October 2008).
Rona, R. J. and S. Chinn (1991), 'Father's Unemployment and Height of Primary
School Children in Britain', *Annals of Human Biology* 18, 441–448.
Schilitz, A. (2001), *Ko¨rperliche Entwicklung und Ko¨rperzusammensetzung von Brandenbur- ger Schulkindern im Geschlechter- und Altersgruppenvergleich*, Shaker, Aachen.
Statistik Regional Berlin Brandenburg. Available at http://www.statistik.brandenburg.
de, various pages.
Steckel, R. and R. Floud (eds.) (1997), *Health and Welfare During Industrialization*, University of Chicago Press, Chicago, pp. 331–377.
Stolzenberg, H., H. Kahl and K. E. Bergmann (2007), 'Körpermaße bei Kindern und Jugendlichen in Deutschland. Ergebnisse des Kinder- und Jugendgesundheitssur-
veys (KiGGS)', *Bundesgesundheitsbl – Gesundheitsforsch – Gesundheitsschutz* 50, 659– 669, doi 10.1007/s00103-007-0227-5.

Tanner, J. (1990), *Fetus into Man: Physical Growth from Conception to Maturity*, Harvard

University Press, Cambridge, MA (revised edition, first published in 1978).

van Ark, B. (2001), 'Convergence and Divergence in the European Periphery: Productivity in Eastern and Southern Europe in Retrospect', in: B. van Ark and N. Crafts (eds.), *Quantitative Aspects of Post-War European Economic Growth*, Cambridge University Press, Cambridge, pp. 271–326.

Waaler, H. (1984), 'Height, Weight, and Mortality: The Norwegian Experience', *Acta Medica Scandicana* 679(Suppl.), 1–56.

Zellner, K., U. Ja¨ger and K. Kromeyer-Hausschildt (2004), 'Height, Weight and BMI of Schoolchildren in Jena, Germany – Are the Secular Changes Levelling Off?', *Economics and Human Biology* 2, 281–294.

Zellner, K., K. Kromeyer and U. Ja¨ger (1996), 'Growth Studies in Jena, Germany: Historical Background and Secular Changes in Stature and Weight in Children 7–14 Years', *American Journal of Human Biology* 8, 371–382.