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CHANGING PATTERNS OF SOCIAL VARIATION IN STATURE IN POLAND: EFFECTS OF TRANSITION FROM A COMMAND ECONOMY TO THE FREE-MARKET SYSTEM?

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Summary. The aim of this analysis was to examine the effects on stature in two nationally representative samples of Polish 19-year-old conscripts of maternal and paternal education level, and of degree of urbanization, before and after the economic transition of 1990. Data were from two national surveys of 19-year-old Polish conscripts: 27,236 in 1986 and 28,151 in 2001. In addition to taking height measurements, each subject was asked about the socioeconomic background of their families, including paternal and maternal education, and the name of the locality of residence. The net effect of each of these social factors on stature was determined using four-factor analysis of variance. The secular trend towards increased stature of Polish conscripts has slowed down from a rate 2·1 cm per decade across the period 1965–1986 to 1·5 cm per decade between 1986 and 2001. In both cohorts, mean statures increase with increasing size of locality of residence, paternal education and maternal education. The effect of each of these three social factors on conscript height is highly significant in both cohorts. However, the effect of maternal education has increased substantially while that of size of locality of residence and paternal education diminished between 1986 and 2001. These results imply that the influence of parental education on child growth cannot be due solely to a relationship between education and income, but is also perhaps a reflection of household financial management which benefits child health and growth by better educated parents, regardless of level of income. In addition they suggest that, irrespective of whether there are one or two breadwinners in the family, it is the mother, more so than the father, who is principally responsible for the extent to which such management best favours child health and growth. The asymmetry between the importance of maternal as against paternal education for child growth, clearly seen in the 1986

cohort, became more accentuated in 2001, after the abrupt transition from a command to a free-market economy in the early 1990s.

Introduction

Height-for-age is one of the characteristics of physical growth which, although in part conditioned genetically (Bergman, 1988), is also sensitive to changes and/or inequalities of living standards in a population, especially to the adequacy of nutrition and of health care (Tanner, 1981; Ulijaszek, 1995; Bielicki, 1999). Indeed, this sensitivity of physical growth to socioeconomic conditions is such that it made Tanner (1990) remark that data on growth and the tempo of maturation provide what is probably the most meaningful measure of the extent of 'classlessness' of society. It is with this idea in mind that the present study was undertaken. Social variation of stature is analysed in two large national samples of 19-year-old Polish men from two birth cohorts. The cohorts, although only 15 years apart, span two markedly different periods in Poland's recent history: the twilight years of the era of the socialist, command economy and the first decade of the free-market economic system. The purpose of this study is to see whether this dramatic systemic change, which in Poland (as in most other countries of East-Central Europe) took place at the turn of the 1980s and 1990s, has affected the patterns of variation in stature in young adults, with a particular interest in determining whether the transition has changed the strength of influence upon growth of the degree of urbanization and maternal and paternal education levels.

Methods

The present study explores two national surveys of Polish conscripts carried out during May and June of the years 1986 and 2001. A total of 27,235 subjects in 1986 and 28,151 subjects in 2001, aged 18·6–19·5 years at the time of examination, were measured and interviewed during a medical examination at district recruiting boards throughout the country. All recruiting boards were asked to provide information on the first, and subsequently every tenth subject reporting for examination. This sampling method yielded a 10% systematically selected national sample representing all social strata and all regions in the country, because reporting for registration and examination at the exact specified date was compulsory for all 19-year-old males. In addition to taking height measurements at the time of examination, each subject was asked about the socioeconomic background of their family, including parental education, and his place of residence.

Three social variables, henceforth called factors, are considered in this study. They were each scored on a four-level ordering scale as follows. (A) Degree of urbanization, expressed as the population size of the locality of the subject's residence: 1. large cities (population over 100,000); 2. medium-sized cities (population 25,000–100,000); 3. small towns (population under 25,000, with urban administrative status); and 4. rural settlements (villages). (B) Educational status of the father: 1. postgraduate and university; 2. secondary school; 3. basic trade school (2–3 years of above-primary

Table 1. Body heights of Polish conscripts from two birth cohorts by degree of urbanization, paternal education and maternal education

Factor[a]	1986			2001		
	n	Mean	Weighted mean	*n*	Mean	Weighted mean
Degree of urbanization						
Large cities	8504	176·3	176·0	7412	177·9	178·4
Medium-size cities	4214	176·4	175·9	5222	177·6	177·9
Small towns	4049	175·8	175·5	4700	177·7	177·5
Rural settlements	10,468	175·1	174·1	10,817	176·7	176·4
Paternal education						
University	2307	176·4	177·0	3342	177·9	179·1
Secondary school	4227	176·3	176·4	8084	177·8	178·2
Basic trade school	9115	175·4	175·2	13,448	177·2	176·8
Primary school	11,586	175·5	174·3	3277	177·0	176·0
Maternal education						
University	1555	176·5	177·2	3493	178·8	179·2
Secondary school	5764	176·4	176·6	11,643	177·8	177·9
Basic trade school	5365	175·3	175·3	9513	177·1	176·6
Primary school	14,551	175·4	174·3	3502	176·2	175·8
Whole population mean	27,235	175·9	175·2	28,151	177·5	177·4

[a]Levels of factors are defined in the Methods section.

education in a specific craft, such as car mechanic, tailor or cook); 4. primary school. (C) Educational status of mother: classified by the same typology as B.

The statistical method used to assess the effect of a given factor on stature was four-factor analysis of variance (ANOVA), as described by Federer & Zelen (1966), where urbanization, parental education and cohort were independent variables and stature was the dependent variable. The model explored the type I sums of squares, which involved a sequential partitioning of the whole model sums of squares and which were called hierarchical sums of squares. It allowed for testing the effect of one variable after removing the other variable effects.

Results

Table 1 shows both unweighted and weighted mean heights of conscripts according to the three social factors, in 1986 and 2001. The mean height of conscripts in the general population rose from 175·9 cm in 1986 to 177·5 cm in 2001. The rate of the secular trend, at 1·1 cm per decade, is moderately high relative to other European countries (Schmidt *et al.*, 1995). Each of the four factors – degree of urbanization, maternal educational status, paternal educational status and cohort – exerts a highly significant ($p<0·001$) influence on variation in stature. Total explained variation of

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Table 2. Four-factor ANOVA of body height of Polish conscripts, based on four factors: urbanization, paternal education, maternal education and cohort

Factors	Sum square	df	Mean square	*F* ratio	*p* value
Total	2449590·1	56021	43·7		
Within groups	2288003·0	55894	40·9		
Between groups	161587·1	127	1272·3	31·1	0·0000
(1) Urbanization	40147·4	3	13382·5	326·8	0·0000
(2) Maternal education	79138·3	3	26379·4	644·2	0·0000
(3) Paternal education	6240·9	3	2080·3	50·8	0·0000
(4) Cohort	29577·9	1	29577·9	722·4	0·0000
Interaction					
1 × 2	589·5	9	65·5	1·6	0·1089
1 × 3	420·5	9	46·7	1·1	0·3292
2 × 3	518·6	9	57·6	1·4	0·1784
1 × 4	360·7	3	120·2	2·1	0·0648
2 × 4	545·8	3	181·9	4·4	0·0039
3 × 4	131·1	3	43·7	1·1	0·3614
Model R=0·256					
Model R^2=0·066					

Note: the analysis was restricted to second-order interactions.

conscripts' height accounts for 6·6% (Table 2). The pattern of that influence remains the same: in each cohort, mean stature of conscripts increases monotonically with increasing levels of urbanization, maternal education and paternal education. This means, for example, that having a well-educated mother is associated with greater stature relative to the population mean, while having a poorly educated mother is associated with lower stature, even after the effects of paternal education and urbanization have been partialled out.

Only one among six second-order interactions has a significant effect on stature, i.e. maternal education status with cohort (Table 2). It seems that maternal education status increased in power between the two cohorts. The strength of influence of paternal education and urbanization on stature was lower in 2001 than in 1986, while that of maternal education was markedly greater (Fig. 1).

Discussion

This analysis shows clear differences in parental factors associated with the stature of their sons. However, they should be considered with caution, given that many aspects of Polish society have changed across this period. The marriage dissolution rate in 1986 was 1·4 per thousand existing marriages, while in 2001 the rate was 4·9 per thousand. Thus, a greater proportion of fathers in 2001 may not be biologically related to their sons, although the number remains small relative to values for the United States and the United Kingdom. The level of education has also increased for

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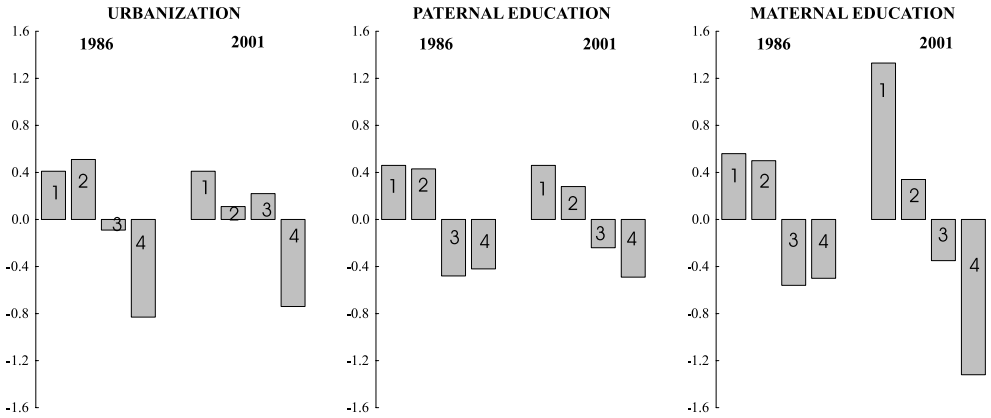

Fig. 1. Effects of four levels of three social factors on stature in two cohorts of Polish conscripts. The vertical bars depict the level-specific main effects of each social factor. Each level-specific main effect is the difference between the unweighted mean of mean statures of the sixteen 'cells' representing a given level (e.g. mother college education) in the 4^3 classification and the unweighted mean of all 64 'cells' formed by that classification. Levels 1, 2, 3 and 4 for each factor are defined in the Methods section.

Table 3. Education level of conscripts' parents (percentages in parentheses)

	Father's education		Mother's education	
	1986	2001	1986	2001
University	2307 (8·5)	3342 (11·9)	1555 (5·7)	3493 (12·4)
College	4227 (15·5)	8084 (28·7)	5764 (21·2)	11,643 (41·4)
Trade	9115 (33·5)	13,448 (47·8)	5365 (19·7)	9513 (33·8)
Elementary	11,586 (42·5)	3,277 (11·6)	14,551 (53·4)	3502 (12·4)

both males and females between 1986 and 2001 (Table 3). Economic circumstances have also shown great change, even across short time-frames, across this period, the two cohorts considered here having lived through different economic times. The 1986 cohort consists of men born in 1967, who spent their entire growing years under the socialist command economy. The country's internal situation went through several twists and turns across the period 1967–1986, of which two were particularly noticeable. The first took place during the first half of the 1970s, the so-called 'early Gierek' period, when, owing to massive foreign loans to Poland, living standards (salaries, availability of food and of imported goods, consumer spending) went up considerably. Then, at the end of the decade and during the early 1980s, the situation deteriorated rapidly, with the introduction of martial law in 1981 and rationing of food (meat, sugar, butter) and with severe shortages of a wide variety of items on the market. Thus, the 1986 cohort experienced different living conditions across childhood

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and adolescence, with material well-being having been higher during mid-childhood, but lower during adolescence.

The 2001 cohort comprises men born in 1982, who are likely to have experienced difficult economic circumstances during early childhood and were then, from the age of 8 years onwards, exposed to the impact of the 1989–1990 abrupt economic transition from a centrally planned to a market economy. The decade 1990–2000 saw runaway inflation in the early 1990s, which came down to one-digit levels in the late 1990s and to below 3% by the year 2001. There was also a dramatic increase in the share of the private sector in Gross National Product, from less than 30% in 1990 to 65% in 2000. Unemployment was largely unknown prior to the transition; during the 1990s it peaked at 15% of the workforce in 1993, declined markedly with increasing GNP in the mid-1990s, then rose again to nearly 18% at the end of the decade. Unemployment mainly affected urban manual workers, especially those who were poorly educated, and agricultural workers from the state-owned big farms which were disbanded in the early 1990s. Inequalities in income, and a positive correlation between income and education (Zienkowski, 1998; Kudrycka & Rodziukiewicz, 2000), also appear to have increased in the 1990s. It should be noted that in socialist Poland the correlation between income and education was weak among occupationally active persons, and even slightly negative in younger adults (Kedelski, 1977). With the advent of the free market the idea that employees with higher professional qualifications should be paid more finally started to make headway.

These socioeconomic and political changes are primarily reflected in the secular trend towards greater tallness, which continued, albeit at a slower rate than earlier, between 1986 and 2001, despite the widely publicized hardships to which the 2001 cohort was apparently exposed during the 1980s and early 1990s. Three possible explanations are offered for this observation.

The first is that young adult stature is a cumulative result of all the 'ups' and 'downs' that might have occurred during growth. Across the 19 years of an individual's growth period, there is enough time for catch-up growth to compensate for short-term slowdowns. Thus, a 'smoothing out' mechanism may be at work. Martorell *et al.* (1994) and Golden (1994) have identified ways in which catch-up growth in response to poor growth due to poor environmental circumstances can take place across childhood and into adolescence. In the Polish case, catch-up growth could very plausibly compensate for short-term growth reversals. A more difficult question is the extent to which variation in childhood and pubertal growth can affect adult stature. Stoltzfus (2001) has identified four broad patterns of growth that deviate from the normal patterns predicted by growth references. These are: (1) pre-pubertal catch-up growth; (2) late catch-up growth; (3) pre-pubertal stunting combined with late catch-up growth; and (4) pre-pubertal stunting with no late catch-up growth. The 2001 cohort of conscripts fits the third category, while the 1986 cohort presents an additional category: that of pubertal stunting with no growth faltering in childhood. There is no evidence that childhood growth deficits can be fully counterbalanced by catch-up in adolescence. The smoothing out of growth can take place in different ways, but catch-up does not necessarily result in achievement of genetic potential for growth, although the 2001 cohort of conscripts may be closer to having achieved this than the 1986 cohort.

The second possible explanation invokes a buffering effect of the family environment on the health and growth of children. In times of hardship, when food shortages are more likely, and state-based health care provision deteriorates, the living standards of children decline much less than do those of adults, because family resources are managed by parents, most notably the mother, in such a way that children's needs become a high priority. Evidence in support of this view comes from studies of within-household food allocation under conditions of scarcity and plenty, which show that children are protected against food shortages, while mothers are not (Ulijaszek & Strickland, 1993).

The third possible explanation is that periods of presumed hardship in Poland may, in fact, have been less harsh than generally assumed. For example, during the 1980s, when Poland was under martial law, and food rationing was in place, the GNP of the country grew by 4% (Kalinski & Landau, 2003), a very modest but real improvement over earlier times. In addition, some non-economic characteristics of Polish society of relevance to family living standards continued to improve. For example, the proportion of mothers of conscripts with college or high-school education doubled across the 1986–2001 period, from 27% in the 1986 to 54% in the 2001 cohort. The proportions of fathers attaining the same levels of education rose from 24% to 40% during the same period. Thus the dramatic improvement in parental education level may have contributed to the continuation of the secular trend, even during periods of economic downturn.

Maternal and paternal education, even after their effects are statistically separated from one another, have each a highly significant, but different, influence on son's stature in both the 1986 and 2001 cohorts (Table 2 and Fig. 1). This indicates that even if education is positively correlated with income, the influence of parental educational level on children's growth is not wholly or necessarily caused by differences in wealth. Even with the same financial resources available per head in a household, such resources can be managed more rationally or less rationally from the point of view of the children's nutritional and health needs; and such differential management is likely to be strongly dependent upon the educational level of the parents. However, in Polish society, and probably elsewhere, while the father is usually the principal breadwinner, it is the mother who, as a rule, is the parent mainly responsible for the manner in which the family budget is oriented towards securing the well-being of the children. The current analysis indicates that this maternal role may have increased significantly in its relative importance with the transition from the socialist to a free-market economy, while the role of the father relative to that of the mother has declined (Fig. 1). It is speculated that this may be due to three possibly interrelated factors. The first of these is that the newly established free market suddenly filled the shelves of stores with a formerly unknown variety of foods and health care items, and thus enormously widened a housewife's possibilities for making intelligent education-dependent health and nutrition choices, even with no greater income. The second is that a great diversity of women's magazines, brochures, guides and handbooks became suddenly available, the contents of which included many aspects of family health and nutrition. Better-educated mothers would have been able to access, read and take advantage of such information, which could in turn influence for the better their consumer choices with respect to children's health and nutrition,

again, even in the absence of greater income. Finally, it may be that with the new pressure created on the job market by the rise of unemployment, men in some occupational groups may have extended their daily working hours at the expense of their role as fathers.

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