

## BODY HEIGHT IN RELATION TO RURAL–URBAN MIGRATION IN POLAND

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**Summary.** A survey was conducted among 2800 students studying in Wrocław, Poland. The questionnaire included questions on the body height of the students and their parents, and place of residence and migration patterns of the students themselves, their parents and their grandparents. Body height in both students and their parents was positively correlated with the size of their place of residence. This was particularly true for male students and their fathers. Body height in students and parents from mobile families was not significantly different from that of their peers from non-mobile families. Body height in mobile individuals was generally between that of non-mobile individuals from rural areas and that of non-mobile individuals from large urban centres. Students from families that had migrated from smaller urban centres to larger ones were taller than students from families that had migrated from rural areas to urban centres. Body height in students was also correlated with the kind of migration that took place. In the students' mothers, body height was higher if the maternal grandparents moved from smaller urban centres to larger urban centres than if the maternal grandparents moved from rural areas to urban centres. In female students, body height depended on whether their mothers had migrated from smaller places of residence to larger places of residence, but was not affected by the degree of migration. Intra-generational migration during the generation of the students' grandparents was associated with increased body height in the students' mothers. On the other hand, inter-generational migration during the generations of the students' grandparents and parents was associated with increased body height in the students' fathers and in female students. Body height was not a reliable indicator of whether an individual migrated from rural areas to Wrocław. Far more reliable indicators were the size of the place the student lived their whole life and whether the family had lived in an urban environment for at least two generations.

### Introduction

Social mobility depends on several somatic or behavioural traits, some of which are genetically determined (Schumacher & Knussman, 1979; Charzewski, 1981; Mascie-Taylor, 1984; Bielicki *et al.*, 1988; Panek *et al.*, 1988). Among the traits that are

positively selected for are tallness and early sexual maturity. Proponents of this theory have gathered much empirical evidence to support it. For example, they claim that tall people are more often socially promoted, and tend to occupy higher positions that require better qualifications. This makes them more likely to live in big cities. The data, however, are not unequivocal. Some researchers have not found a connection between body height and migration from rural areas to urban centres (Malina *et al.*, 1982; Zielińska, 1991).

Several hypotheses explaining the mechanism behind social mobility in tall people have been proposed. One hypothesis states that the genes that determine body height are linked to genes for personality traits that enable an individual to attain a privileged social position. Some researchers, however, have concluded that this hypothesis is inadequate (Bielicki & Charzewski, 1983; Bielicki & Waliszko, 1992).

The 'trump card' hypothesis and the 'third factor' hypothesis are believed to better explain the correlation between tallness and social advancement (Bielicki & Waliszko, 1992; Bielicki & Szklarska, 2000).

According to the 'trump card' hypothesis, tallness is a socially desirable trait that boosts self-esteem and self-confidence. Shortness, on the other hand, is generally considered to be socially neutral. Tallness in men is perceived as a component of overall physical attractiveness, and is a significant determinant of social dominance (Ellis, 1994; Bogin, 1999). Taller men are reproductively more successful than shorter men (Pawłowski *et al.*, 2000). Taller women are more likely to be married to better-qualified men (Thomson, 1959). The proponents of this hypothesis argue that social status is causally dependent on body height (Bielicki & Szklarska, 2000).

The 'third factor' hypothesis concentrates on the role of various health-related and psychological conditions. In any group, even a socially homogeneous one, there are families of different economic status. This determines the quality of care the offspring receive. Children from better families grow taller than their less well-to-do peers, and also perform better at school. The connection between tallness and academic achievement, however, seems to be merely coincidental (Bielicki & Waliszko, 1992; Bielicki & Szklarska, 2000).

Tallness is indeed strongly correlated with family conditions that promote both physical well-being and academic achievement. However, this may be because tallness, physical well-being and academic achievement are directly determined by another factor, the eponymous 'third factor'. This is supported by studies on siblings. Even in well-to-do families, physical and psychological development can differ among offspring depending on differences in living conditions during the prenatal period, birth order and parental involvement.

The aim of this study is to examine variation in body height among migrants and non-migrants. The role that intra-generational and inter-generational migration plays in determining body height is also explored.

### Data

A survey was conducted among 2800 students (1023 men and 1777 women) studying in Wrocław (population 720,000), Poland. The questionnaire included questions on the body height of the students and their parents, place of residence and migration

patterns of the students themselves, their parents and grandparents. Data on the age and educational status of each generation have been presented elsewhere (Krzyżanowska, 2007).

Self-reported height generally agrees well with measured height, with a correlation factor of between 0.86 and 0.98 (Himes & Roche, 1982; Palta *et al.*, 1982; Stewart, 1982; Stewart *et al.*, 1987; Nyström-Peck, 1994; Korkeila *et al.*, 1998; Goodman *et al.*, 2000; Krzyżanowska & Umławska, 2002; Spencer *et al.*, 2002; Brener *et al.*, 2003). This justifies the reliance of this study on the self-reported heights given in the survey.

The questionnaire also included questions on the following: (i) where the students lived before they came to study in Wrocław; (ii) where they, their parents and their grandparents lived in early childhood, that is, until age 14; (iii) where the students' parents and grandparents lived the greater part of their life.

Place of residence was recorded as follows:

- (1) rural areas;
- (2) small urban centres with a population under 30,000;
- (3) medium-sized urban centres with a population between 30,000 and 100,000;
- (4) large urban centres with a population over 100,000.

42.5% of the students (and 45.9% of male students) came from large urban centres. Only 13.1% of the students came from rural areas. 41.9% of parents came from large urban centres and 21.6% came from medium-sized urban centres. Another 21.6% came from small urban centres. Only 14.9% of parents came from rural areas (Table 1). The data on students were almost exactly the same as those of their parents. The small differences were mostly due to changes in the family's place of residence shortly before the students moved to Wrocław. 41.7% of the students' grandparents lived in rural areas country. Only 24.1% lived in large urban centres (Table 1).

### Methods

Analysis of the data on place of residence of the three generations revealed that there are two groups of families. The mobile group had migrated from rural areas to urban centres, thereby moving up the social ladder. The non-mobile group had not changed the nature of their place of residence. Not included in this study was a small group of thirty families that had migrated from urban centres to rural areas.

Differences between the two groups were assessed using Student's *t*-test for independent populations. All distributions were assumed to be normal. For non-homogenous variances, the Cochran–Cox test was used. Data on the effect of migration on body height were elaborated using single-factor analysis of variance (ANOVA) and Tukey's *post hoc* test. Means were grouped using the least significant difference test (Hair *et al.*, 1995; Ferguson & Takane, 1997; Coolidge, 2000).

### Results

#### *Body height of parents and mobility of grandparents*

Body height was generally highest in individuals whose parents lived their whole life in large urban areas (4→4), and lowest in those whose parents lived their whole

**Table 1.** Place of residence of students, their parents and their grandparents

Place of residence	Students						Parents						Grandparents					
	Male		Female		Total		Fathers		Mothers		Total		Paternal		Maternal		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1. Rural areas	104	10.2	262	14.8	366	13.1	407	14.6	423	15.2	830	14.9	1070	42.2	1053	41.2	2123	41.7
2. Small urban centres	224	21.9	387	21.8	611	21.9	598	21.5	603	21.7	1201	21.6	502	19.8	513	20.1	1015	19.9
3. Medium-sized urban centres	225	22.0	405	22.8	630	22.5	600	21.6	599	21.5	1199	21.6	356	14.0	372	14.6	728	14.3
4. Large urban centres	469	45.9	720	40.6	1189	42.5	1173	42.2	1156	41.6	2329	41.9	610	24.0	617	24.1	1227	24.1

**Table 2.** Height of students' parents and mobility of grandparents

Place of residence of grandparents		Height of fathers (cm)			Height of mothers (cm)		
EC	GPL	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
Non-mobile grandparents							
1	1	921	174.34	5.90	889	162.46	5.20
2	2	173	175.54	6.59	147	163.50	5.96
3	3	80	176.00	7.28	79	163.54	5.03
4	4	137	176.49	6.47	127	163.35	4.95
Mobile grandparents							
1	2	165	174.80	5.81	201	162.58	5.10
1	3	93	175.41	5.89	123	162.80	4.74
1	4	171	175.97	5.42	169	163.27	5.16
2	3	46	175.06	6.69	39	165.54	4.79
2	4	63	175.52	6.53	49	164.24	4.90
3	4	36	176.42	7.19	30	164.67	6.26
Total from rural areas		429	175.40	5.67	493	162.87	5.03
Total from urban centres		145	175.59	6.75	118	164.78	5.21

EC: Early childhood. GPL: Greater part of life. 1: Rural areas. 2: Small urban centres. 3: Medium-sized urban centres. 4: Large urban centres.

lives in rural areas (1→1). The size of the urban centre was significant if the father's place of residence was considered. On the other hand, body height was about the same in individuals whose mothers lived their whole lives in small, medium-sized and large urban centres (2→2, 3→3 and 4→4), but significantly lower in individuals whose mothers lived their whole lives in rural areas (1→1) (Table 2).

In the mobile group, body height was highest in individuals whose mothers moved from small urban centres to medium-sized ones (2→3), or from medium-sized urban centres to large ones (3→4) (Table 2). Body height of parents was higher if the students' grandparents had migrated from rural areas to urban centres (1→2, 1→3 and 1→4) than if the grandparents had not migrated (1→1). However, most of the differences were not statistically significant. Body height was higher in mothers if the maternal grandparents moved from smaller urban centres to larger urban centres (2→3, 2→4 and 3→4) than if the maternal grandparents moved from rural areas to urban centres (1→2, 1→3 and 1→4). This was not the case with fathers (Table 2).

#### *Body height of parents and mobility of parents*

The students' place of residence during early childhood was most often their parents' place of residence for the greater part of their lives. Likewise, the parents' place of residence during early childhood was most often the grandparents' place of

**Table 3.** Height of students' parents and mobility of students' parents

GPL place of residence		Height of fathers (cm)			Height of mothers (cm)		
Grandparents	Parents	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD
Non-mobile parents							
1	1	353	174.59	6.12	374	162.55	5.14
2	2	268	175.53	6.11	278	162.91	5.56
3	3	220	175.67	5.85	242	163.79	5.01
4	4	552	176.37	6.14	561	163.46	5.27
Mobile parents							
1	2	217	174.21	5.73	228	162.16	5.31
1	3	202	174.72	6.06	188	162.68	5.27
1	4	272	174.13	5.66	238	162.36	4.95
2	3	83	175.06	6.55	70	161.76	5.07
2	4	119	175.13	6.28	137	162.55	5.22
3	4	95	177.53	7.21	98	163.76	4.84
Total from rural areas		691	174.33	5.80	654	162.38	5.17
Total from urban centres		297	175.88	6.65	305	162.76	5.06

GPL: Greater part of life. 1: Rural areas. 2: Small urban centres. 3: Medium-sized urban centres. 4: Large urban centres.

residence for the greater part of their lives. This made it possible to determine the dependence of body height in parents on their migration pattern.

For non-mobile fathers, body height depended on the size of the place of residence, and was highest in individuals living in large urban centres, and lowest in individuals living in rural areas. Aside from this, no other clear correlations were found (Table 3). For non-mobile parents, the difference between the highest and lowest values for each type of residence was about the same for both sexes, with 1.78 cm for fathers, and 1.24 cm for mothers. For mobile parents, the difference was far greater for fathers than for mothers, with 3.4 cm for fathers and 2.0 cm for mothers. Most parents who migrated to larger towns (1→2, 1→4, 2→3 and 2→4) are shorter (not statistically significant) than the non-mobile parents (1→1 and 2→2) (Table 3).

Mobility in the students' grandparents increased body height in the students' mothers more so than in the students' fathers. Mobility in the students' parents, however, increased body height in the students' fathers more so than in the student's mothers (Tables 2 and 4).

Body height in the students' parents depended on their place of residence during early childhood and their place of residence for the greater part of their lives. It did not, however, depend on the degree of migration (Table 3). Parents who migrated during the course of their lives were shorter than those who remained in the same place of residence as the students' grandparents. The exception was for parents who migrated from medium-sized urban centres to large urban centres (3→4). They were significantly higher than others.

**Table 4.** Height of male students and mobility of their parents

GPL place of residence		Height of male students (cm)			Place of residence		Height of male students (cm)		
Paternal grand-parents	Fathers	<i>n</i>	Mean	SD	Maternal grand-parents	Mothers	<i>n</i>	Mean	SD
Non-mobile parents									
1	1	91	179.24	6.72	1	1	116	179.12	7.03
2	2	113	180.26	6.85	2	2	106	180.84	6.81
3	3	88	180.49	5.58	3	3	87	179.99	6.06
4	4	217	181.13	6.28	4	4	209	180.71	6.29
Mobile parents									
1	2	74	179.73	6.44	1	2	79	179.71	6.45
1	3	65	180.25	7.16	1	3	70	180.17	6.48
1	4	115	180.88	6.11	1	4	111	180.68	5.71
2	3	34	179.97	7.64	2	3	23	179.48	5.95
2	4	52	180.17	5.75	2	4	54	180.72	5.91
3	4	40	181.35	7.59	3	4	34	182.18	8.13
Total from rural areas		254	180.38	6.47	Total from rural areas		260	180.25	6.14
Total from urban centres		126	180.49	6.85	Total from urban centres		111	180.91	6.60

GPL: Greater part of life. 1: Rural areas. 2: Small urban centres. 3: Medium-sized urban centres. 4: Large urban centres.

*Body height of students and mobility of parents*

Body height was lowest in students whose parents and grandparents spent their lives in rural areas (1 → 1) (Table 4). For non-mobile fathers, body height of students depended on the size of the place of residence of the paternal grandfathers, being highest when the grandfathers lived in large urban centres, and lowest when the grandfathers lived in rural areas (Table 4). Body height was highest in both male and female students whose families migrated from rural areas (1 → 2, 1 → 3 and 1 → 4) than in students whose parents had not migrated (1 → 1). However, the differences were not statistically significant.

Body height in students whose parents moved from rural areas to large cities (1 → 4) was about the same as in students with non-mobile parents who lived in large urban centres (4 → 4). Body height of students was not affected if their parents moved from small urban centres to medium-sized or large urban centres (2 → 3 and 2 → 4). Body height was significantly highest in students whose parents, especially mothers, migrated from medium-sized urban centres to large ones (3 → 4) (Table 4).

In female students, body height was lowest in students whose mothers were non-mobile and lived in rural areas (1 → 1) or whose fathers were non-mobile and

**Table 5.** Height of female students and mobility of their parents

GPL place of residence		Height of female students (cm)			GPL place of residence		Height of female students (cm)		
Paternal grand-parents	Fathers	<i>n</i>	Mean	SD	Maternal grand-parents	Mothers	<i>n</i>	Mean	SD
Non-mobile parents									
1	1	267	166.66	5.60	1	1	259	166.40	5.45
2	2	160	166.56	5.94	2	2	178	166.60	6.07
3	3	137	167.73	5.32	3	3	164	167.77	5.20
4	4	348	167.29	5.52	4	4	362	167.83	5.80
Mobile parents									
1	2	148	166.59	5.76	1	2	153	166.52	5.80
1	3	140	167.46	5.14	1	3	122	167.52	5.40
1	4	163	166.82	6.06	1	4	136	165.76	5.72
2	3	52	167.04	5.48	2	3	48	166.52	5.13
2	4	68	167.37	6.17	2	4	87	166.89	5.49
3	4	58	168.53	5.90	3	4	65	169.11	4.58
Total from rural areas		451	166.94	5.68	Total from rural areas		411	166.56	5.65
Total from urban centres		178	167.65	5.88	Total from urban centres		200	167.52	5.11

GPL: Greater part of life. 1: rural areas. 2: Small urban centres. 3: Medium-sized urban centres. 4: Large urban centres.

lived in small urban centres (2→2), and also in students whose parents had moved from rural areas to large urban centres (1→4). For non-mobile parents, body height in male students depended on the size of the place of residence of their parents. This was not the case for female students. In female students, body height was highest in students whose parents and grandparents were non-mobile and lived in large urban centres (4→4), and lowest in students whose mothers and maternal grandparents were non-mobile and lived in rural areas (1→1) (Table 5). In female students, body height depended on whether their mothers had migrated from smaller places of residence to larger places of residence, but was not affected by the degree of migration (Tables 4 and 5).

### Discussion

Interpretation of the results of the survey used in this study is limited by the specific nature of the student population surveyed. Students are generally taller than individuals in the general population (Krzyżanowska, 2007).

Body height in students has been reported to depend greatly on their place of residence, and is highest in students who come from large urban agglomerations



(Peplowski, 1990; Malinowski & Jeziorek, 1992; Rogowska, 1992; Mockus *et al.*, 1995; Kolasa, 1997; Asienkiewicz, 1998; Więclaw & Plat, 1998). In other studies, however, body height was essentially the same in students from rural areas and in students from urban centres (Kolasa, 1980; Rodziewicz-Gruhn & Pyzik, 1999). The effect of migration on body height in students and their parents was sex-specific, and was generally greater in males than in females. Most studies to date have focused on the effect of inter-generational changes in living conditions on discrete traits only in two generations (Malina *et al.*, 1982; Steegmann & Haseley, 1988). The results of these studies vary, but certain regularities can be identified. For example, body height is higher in people who change their place of residence. In studies carried out on Chinese children living in London, and on Koreans living in Japan, the individuals in these studies were taller than those whose parents had not migrated (Kim, 1982; Wheeler & Tan, 1983). In another study conducted in Spain, females who migrated to Madrid were taller than those who remained in their home villages (Bernis, 1984). Jews who had immigrated to Israel from Poland and Russia were found to be taller than Jews born in Israel (Kobyliansky & Arensburg, 1977). In the 1700s, British military conscripts who had migrated were found to be taller than those who had not (Steegmann, 1985). Indians who had immigrated to the United Kingdom were found to be taller than Indians born in the United Kingdom. The difference was statistically significant for female subjects (Singh & Harrison, 1996).

The results of the present study are partly consistent with the results of these previous studies. Students and parents from families that migrated from rural areas to urban centres (1→2, 1→3 and 1→4) were taller than their counterparts whose families had remained in rural areas (1→1). In many cases, they were also taller than individuals from non-mobile families from small urban centres (2→2). On the other hand, male and female students and their fathers whose parents migrated from smaller urban centres to larger ones (2→3; 2→4; 3→4) were generally shorter than their counterparts from non-mobile families from medium-sized and large urban centres (3→3; 4→4) (Tables 2, 3, 4 and 5). This means that body height is not necessarily higher in mobile individuals than in their non-mobile peers (Table 6).

Body height in mobile individuals was generally between that of non-mobile individuals from rural areas and that of non-mobile individuals from large urban centres. This agrees well with the results of previous studies (Lasker, 1946; Lasker & Evans, 1961; Kobyliansky & Arensburg, 1977; Kim, 1982; Bernis, 1984). The time at which migration takes place also plays a role in determining body height. A study was carried out on Mexicans who had immigrated to the United States at various ages. Older individuals who migrated when they were under 17 years old were taller than both non-migrants and other migrants. This pattern was not observed in younger individuals (Lasker, 1952). Body height also depends on the length of the interval between the migration of an individual's parents and the birth of the individual. In a study carried out on young people in Wrocław, the longer the interval between the migration of mothers from rural areas to the city, the taller their sons were (Hulanicka, 1990). Unfortunately, the survey used in the present study did not contain questions pertaining to the age of the parents at the time they migrated.

In another study, the effect of migration on body height was different depending on whether the migration of the family was intra-generational or inter-generational,

**Table 6.** Extreme groups of body height in students and their parents in relation type of migration

Body height	Migration during grandparents' life (EC/GPL)		Migration during parents' life (EC/GPL)		Migration during parents' life (EC/GPL)	
	Fathers	Mothers	Fathers	Mothers	Male students	Female students
Highest values	4→4 3→4	2→3 3→4	3→4 4→4	3→3 3→4	3→4 4→4	3→4 4→4
Lowest values	1→1 1→2	1→1 1→2	1→4 1→2	2→3 1→2	1→1 1→2	1→4 1→1

EC: Early childhood. GPL: Greater part of life. 1: Rural areas. 2: Small urban centres. 3: Medium-sized urban centres. 4: Large urban centres.

that is, whether it took place during one generation or over several generations (Susanne, 1977). In the present study, intra-generational migration during the generation of the students' grandparents was associated with increased body height in the students' mothers (Table 2). On the other hand, inter-generational migration during the generations of the students' grandparents and parents was associated with increased body height in the students' fathers and in female students (Tables 3 and 5). In either case, students from families that had migrated from smaller urban centres to larger ones were taller than students from families that had migrated from rural areas to urban centres.

The results of this study seem to support the hypothesis that tall people are more mobile. Tall individuals are more likely to change their environment (Bielicki *et al.*, 1981; Panek *et al.*, 1988). In one study, military conscripts from families that migrated from rural areas to urban centres were taller than their peers from non-mobile families living in urban centres (Kołodziej *et al.*, 2001). Similar results were obtained in a study on inhabitants of Wrocław who were between forty and fifty years old (Szkłarska *et al.*, 2007). On the other hand, other researchers did not find any correlation between body height and the selective rural-to-urban migration (Susanne, 1979; Malina *et al.*, 1982; Hulanicka, 1990; Zielińska, 1991).

In this study, the only support for the hypothesis that tall people are more mobile was that individuals who migrated from rural areas to small urban centres were significantly taller than individuals who did not migrate. However, these migrating individuals were not as tall as non-mobile individuals from medium-sized urban centres. The tallest individuals in the study were non-mobile individuals from large urban centres.

It therefore seems that, for the students in this study, body height was affected by whether an individual migrated from rural areas to Wrocław. Far more important factors were the size of the place the student lived their whole life and whether the family had lived in an urban environment for at least two generations.

### Conclusions

Body height in both students and their parents was positively correlated with the size of their place of residence. This was particularly true for male students and their fathers. Body height in students and parents from mobile families was not significantly different from that of their peers from non-mobile families. Body height in mobile individuals was generally between that of non-mobile individuals from rural areas and that of non-mobile individuals from large urban centres.

Students from families that had migrated from smaller urban centres to larger ones were taller than students from families that had migrated from rural areas to urban centres.

Body height in students was also correlated with the kind of migration that took place. In the students' mothers, body height was higher if the maternal grandparents moved from smaller urban centres to larger urban centres than if the maternal grandparents moved from rural areas to urban centres. In female students, body height depended on whether their mothers had migrated from smaller places of residence to larger places of residence, but was not affected by the degree of migration.

Intra-generational migration during the generation of the students' grandparents was associated with increased body height in the students' mothers. On the other hand, inter-generational migration during the generations of the students' grandparents and parents was associated with increased body height in the students' fathers and in female students.

Body height was affected by whether an individual migrated from rural areas to Wrocław. Far more important factors were the size of the place the student lived his/her whole life and whether the family had lived in an urban environment for at least two generations.

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