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INTRA- AND INTERGENERATIONAL SOCIAL MOBILITY IN RELATION TO HEIGHT, WEIGHT AND BODY MASS INDEX IN A BRITISH NATIONAL COHORT

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Summary. Using a sample of 2090 father and son pairs, the extent of intra- and inter-generational social mobility (migration between social classes) was examined over a 42-year period in a British cohort in relation to height, weight and body mass index (BMI). The mean height difference between the highest and lowest social class decreased from about 4 cm in the fathers' generation to about 3 cm in the sons' generation, indicating a decline in heterogeneity in height between classes. For fathers downward intra-generational social mobility ranged between 11% and 18% while between 16% and 26% were upwardly mobile; for sons 15% were downwardly mobile and 21% upwardly mobile. On average downwardly mobile fathers were shorter by between 0.1 cm and 0.7 cm while upwardly mobile fathers were taller by, on average, 0.6 cm to 1.7 cm. For sons, the downwardly mobile were on average 0.7 cm shorter and the upwardly mobile 0.8 cm taller. For weight and BMI there were no consistent relationships with intra-generational mobility in either the fathers' or sons' generations. Inter-generationally, between 18% and 19% of sons were downwardly mobile and between 39% and 40% were upwardly mobile; the downwardly mobile were shorter by about 0.9 cm and the upwardly taller by between 0.6 cm and 1.2 cm. Sons with higher BMI were more likely to be inter-generationally downwardly mobile.

Introduction

Social class differences in height, weight and body mass index (BMI) have been widely reported in many countries in both children and adults (Mascie-Taylor, 1984; Lasker & Mascie-Taylor, 1996; Komlos & Kriwy, 2003; Heineck, 2006; Batty *et al*., 2009; Cardoso & Caninas, 2010; Kues, 2010; Singh-Manoux *et al*., 2010). There is a general tendency for mean height and weight to decline from higher to lower social classes while BMI shows the opposite trend (Lasker & Mascie-Taylor, 1989; Li *et al*., 2004). If movement between social classes (social mobility) was at random, then the mean

differences between classes would tend to disappear depending on the length of time the mobility is in effect and the number of people moving.

However, if migration is selective, then social class differences would be maintained to a greater or lesser extent. In general social mobility studies show that upwardly socially mobile individuals are, on average, taller and heavier than the non-socially mobile, while the downwardly socially mobile are, on average, shorter (Mascie-Taylor, 1984; Cernerud, 1995; Bielicki & Szklarska, 2000; Hart *et al*., 2008). A similar finding has been reported for IQ and educational attainment (Gibson & Mascie-Taylor, 1973; Mascie-Taylor & Gibson, 1978; Gibson *et al*., 1983; Deary *et al*., 2005; Johnson *et al*., 2010).

This paper examines the association of intra- and inter-generational social mobility with height, weight and BMI using a large British national cohort study.

Methods

The National Cohort Study (NCDS) is a longitudinal study of all children born in England, Wales and Scotland in the week 3–9th March 1958. The children and their families were periodically re-studied in 1965, 1969 and 1974. Thereafter the index child was followed up into adulthood, and there were re-studies when the child was 33 and 40 years of age. This paper focuses on the 2090 father–son pairs for whom there were both height and weight data (anthropometric data when fathers and sons were both 33 years of age were used). Body mass index was also calculated (weight (kg)/height $(m)^2$).

Social class was defined by the Registrar General's 5-point occupational scale, where I refers to professional, II to intermediate (mainly managerial), III skilled worker, IV semi-skilled worker and V unskilled. The extent of social class mobility was determined intra-generationally for the father (between 1958 and 1974) and the son (between 1991 and 2000) as well as inter-generationally between father and son. Social mobility was categorized as none (no change in social class), upwardly mobile (moving up one or more social classes) or downwardly mobile (going down one or more social classes).

Univariate analysis of variance was the main statistical tool used with Hochberg's or Games-Howell's *post-hoc* tests.

Results

Mean anthropometric measures by social class

Table 1 presents the mean height of fathers on four occasions and sons on two occasions. Highly significant differences in means were found between social classes over all father and son follow-up dates, and there was a general tendency for mean height to decrease from social class I to V in both fathers and sons. The overall mean height difference between social class I and V ranged from about 4 cm to 4.8 cm in the fathers' generation but declined to between 2.7 cm and 3.3 cm in sons' generation.

There was much less variation in mean weight between social classes (Table 2), and even less for BMI (Table 3). In fathers the highest mean weight was generally in

Table 1. Fathers' and sons' mean height (cm) and percentage distribution by social class

	I		II		III		IV		V			
	Mean height	%	Mean height	%	Mean height	%	Mean height	%	Mean height	%	*F*	*p*
Fathers												
1958	178.06	4.6	176.22	16.1	174.76	61.5	173.78	11.9	173.23	5.9	11.175	<0.001
1965	177.18	6.1	176.32	16.4	174.84	57.5	173.68	15.6	172.50	4.4	11.364	<0.001
1969	177.37	6.7	176.42	19.6	174.64	54.0	173.59	14.9	173.05	4.7	13.927	<0.001
1974	176.84	6.1	176.08	23.0	174.72	55.0	173.45	12.9	172.80	3.0	10.170	<0.001
Sons												
1991	178.59	9.8	177.81	31.8	176.75	45.6	176.78	10.8	175.28	1.9	5.682	<0.001
2000	178.55	7.4	177.79	40.8	176.69	42.2	176.54	7.4	175.85	2.2	5.307	<0.001

Table 2. Fathers' and sons' mean weight (kg) by social class

	I Mean weight	II Mean weight	III Mean weight	IV Mean weight	V Mean weight	*F*	*p*
Fathers							
1958	77.30	76.62	75.21	75.48	75.77	2.100	ns
1965	76.71	77.04	75.24	75.20	74.82	2.859	0.022
1969	75.93	77.30	75.33	74.92	73.25	5.017	0.001
1974	76.21	77.11	75.12	74.74	75.15	4.095	0.003
Sons							
1991	78.08	79.79	80.80	80.39	77.32	2.662	0.031
2000	78.04	80.09	80.42	80.90	78.28	1.562	ns

social class II, while in sons highest means were found in classes III and IV. Body mass index only differed significantly by social class in sons in 1991 and the main cause of this heterogeneity was the lower mean in social class I.

Intra-generational social mobility

All intra-generational migration matrices were constructed for fathers and sons separately (not shown), and fathers and sons were classified as non-mobile if they remained in the same social class between time periods, downwardly mobile if they moved down one or more classes between time periods, and upwardly mobile if they moved up one or more classes over this time period. The non-mobile group were set as the reference group and assigned a value of zero. The mean height, weight and BMI values presented in Tables 4 to 6 for upward and downward mobile groups are relative to the non-mobile group.

Table 3. Fathers' and sons' mean BMI (kg/m^2) by social class

	I Mean BMI	II Mean BMI	III Mean BMI	IV Mean BMI	V Mean BMI	*F*	*p*
Fathers							
1958	24.37	24.68	24.63	24.98	25.24	2.092	ns
1965	24.43	24.80	24.61	24.93	25.18	1.736	ns
1969	24.16	24.83	24.71	24.86	24.47	1.740	ns
1974	24.38	24.86	24.62	24.87	25.15	1.521	ns
Sons							
1991	24.47	25.22	25.84	25.74	25.14	7.395	<0.001
2000	25.83	26.66	26.69	26.77	26.82	1.285	ns

Table 4. Extent of intra- and inter-generational mobility of fathers and sons in relation to height

	Downward		Upward			
	Mean[a]	%	Mean[a]	%	*F*	*p*
Intra-generational						
Fathers						
1958–1965	−0.59	18.6	1.29	19.3	7.600	0.001
1958–1969	−0.45	18.1	1.67	22.6	12.164	<0.001
1965–1969	−0.70	12.6	0.88	15.9	3.755	0.024
1965–1974	−0.29	11.4	0.59	20.9	1.512	ns
1969–1974	0.88	11.3	1.61	17.7	8.319	<0.001
1958–1974	−0.10	15.4	1.62	26.2	10.586	<0.001
Sons						
1991–2000	−0.71	15.0	0.80	21.0	4.791	0.008
Inter-generational (fathers–sons)						
1965–1991	−0.94	18.2	1.20	40.6	13.302	<0.001
1974–2000	−0.90	19.4	0.59	39.0	6.295	0.002

[a]Mean height difference (cm) from non-mobile reference group (set to zero).

There was a general trend that downwardly mobile fathers were, on average, shorter than the non-mobile group by between 0.1 cm and 0.7 cm, while the upwardly mobile group were taller by between 0.6 cm and 1.7 cm. The only exception was the social mobility between 1969 and 1974, in which both downwardly and upwardly mobile groups were taller than the non-mobile group (respectively by between 0.9 cm and 1.6 cm). Over the whole intra-generational time period from 1958 to 1974, the main finding was of upwardly mobile fathers being taller, on average, than non-mobile fathers, and for downwardly mobile fathers to be slightly shorter. For

Table 5. Extent of intra- and inter-generational mobility of fathers and sons in relation to weight

	Downward Mean[a]	Upward Mean[a]	*F*	*p*
Intra-generational				
Fathers				
1958–1965	−0.92	0.62	2.565	ns
1958–1969	−1.36	0.44	3.812	0.022
1965–1969	−0.65	0.68	1.280	ns
1965–1974	−0.54	0.26	0.498	ns
1969–1974	−0.31	0.10	0.138	ns
1958–1974	−0.86	0.41	1.674	ns
Sons				
1991–2000	0.93	1.41	2.315	ns
Inter-generational (fathers–sons)				
1965–1991	0.24	0.70	0.640	ns
1974–2000	1.18	−0.18	1.424	ns

[a]Mean weight difference (kg) from non-mobile reference group (set to zero).

sons, downwardly mobile sons were significantly shorter, while upwardly mobile were taller than non-mobile sons (Table 4).

There were no significant intra-generational differences in weight between socially mobile groups except the mobility of fathers between 1958 and 1969, where the downwardly mobile were lighter, on average, by 1.4 kg, while the upwardly mobile group were heavier by 0.4 kg. However, there was a tendency for downwardly mobile fathers to be lighter than the non-mobile group, while the upwardly mobile were heavier (Table 5).

The results of intra-generational mobility for BMI are shown in Table 6. Most of the analyses (with the exception of the 1958–1965 data) were insignificant and both upward and downward mobile groups had a lower mean BMI than the non-mobile.

Inter-generational social mobility

Inter-generational mobility was highly significant for height with downwardly mobile sons having, on average, a lower mean stature by about 0.9 cm, while upwardly mobile sons were taller, on average, by between 0.6 cm and 1.2 cm. There were no significant inter-generational weight effects, while for BMI downwardly mobile sons had a higher BMI, on average, while upwardly mobile sons had a slightly lower BMI, on average, than non-mobile sons.

Discussion

Strong social inequalities in height in a British generation born in 1958 have been well documented (Lasker & Mascie-Taylor, 1989; Terrell & Mascie-Taylor, 1991; Power

Table 6. Extent of intra- and inter-generational mobility of fathers and sons in relation to BMI

	Downward Mean[a]	Upward Mean[a]	*F*	*p*
Intra-generational				
Fathers				
1958–1965	−0.11	−0.11	0.362	ns
1958–1969	−0.34	−0.33	3.294	0.037
1965–1969	−0.02	0.00	0.005	ns
1965–1974	−0.07	−0.09	0.182	ns
1969–1974	−0.31	−0.43	4.032	0.018
1958–1974	−0.23	−0.31	2.514	ns
Sons				
1991–2000	0.50	0.23	2.572	ns
Inter-generational (fathers–sons)				
1965–1991	0.30	−0.12	1.484	ns
1974–2000	0.68	−0.07	6.254	0.002

[a]Mean BMI difference (kg/m^2) from non-mobile reference group (set to zero).

et al., 2002; Li *et al*., 2004; Li & Power, 2004). This study shows that differences in mean height between the extreme social classes (I and V) were highly significant but greater for fathers than for sons, and that the differences decreased over time within each generation. For example, for fathers the height difference between social classes I and V was 4.8 cm in 1958 and 4.0 cm in 1974; for sons, it was 3.3 cm in 1991 and 2.7 cm in 2000 (Table 1). The reduction in the extent of social class mean differences in height has also been noted by Li *et al*. (2004) and Li & Power (2004).

Studies on the relationship between social mobility and body height are well known in the literature. Many researchers have found that tall people and those with better health are more mobile, more often socially promoted and tend to occupy higher positions that require better qualifications (Mascie-Taylor, 1984; Lasker & Mascie-Taylor, 1989; Cernerud, 1995; Bielicki & Szklarska, 2000; Power *et al*., 2002).

These results on father–son pairs suggest that there is some selective social mobility in relation to height. It appears that people who are upwardly mobile (who have moved up the social scale) tend to be taller than non-mobile ones, while downwardly mobile tend to be shorter (Table 4).

The inter-generational mobility for BMI suggests a different scenario with the downwardly mobile having a higher BMI, and a risk of obesity in the lower social classes. These findings are in agreement with Swedish data, which also show that obese men are often downwardly mobile (Karnehed *et al*., 2008).

The general conclusion from this study is that there is a trend of diminishing inequalities in height between social classes, but that BMI differences between social classes may be increasing.

References

Batty, G. D., Shipley, M. J., Gunnell, D., Huxley, R., Kivimaki, M., Woodward, M., Lee, C. M. Y. & Smith, G. D. (2009) Height, wealth, and health: an overview with new data from three longitudinal studies. *Economics and Human Biology* **7**, 137–152.

Bielicki, T. & Szklarska, A. (2000) Are social-class differences in stature partly genetic? A hypothesis revisited. *American Journal of Human Biology* **12**, 97–101.

Cardoso, H. F. V. & Caninas, M. (2010) Secular trends in social class differences of height, weight and BMI of boys from two schools in Lisbon, Portugal (1910–2000). *Economics and Human Biology* **8**, 111–120.

Cernerud, L. (1995) Height and social mobility. A study of the height of 10 year olds in relation to socio-economic background and type of formal schooling. *Scandinavian Journal of Social Medicine* **23**, 28–31.

Deary, I. J., Taylor, M. D., Hart, C. L., Wilson, V., Davey Smith, G., Blane, D. & Starr, J. M. (2005) Intergenerational social mobility and mid-life status attainment: influences of childhood intelligence, childhood social factors and education. *Intelligence* **33**, 455–472.

Gibson, J. & Mascie-Taylor, C. G. N. (1973) Biological aspects of a high socio-economic group. IQ components and social mobility. *Journal of Biosocial Science* **5**, 17–30.

Gibson, J. B., Harrison, G. A., Hiorns, R. W. & Macbeth, H. M. (1983) Social mobility and psychometric variation in a group of Oxfordshire villages. *Journal of Biosocial Science* **15**, 193–205.

Hart, C., McConnachie, A., Upton, M. & Watt, G. (2008) Risk factors in the Midspan family study by social class in childhood and adulthood. *International Journal of Epidemiology* **37**, 604–614.

Heineck, G. (2006) Height and weight in Germany: evidence from the German Socio-Economic Panel, 2002. *Economics and Human Biology* **4**, 359–382.

Johnson, W., Brett, C. E. & Deary, I. J. (2010) The pivotal role of education in the association between ability and social class attainment: a look across three generations. *Intelligence* **38**, 55–65.

Karnehed, N. E. K., Rasmussen, F., Hemmingsson, T. & Tynelius, P. (2008) Obesity in young adulthood is related to social mobility among Swedish men. *Obesity* **16**, 654–658.

Komlos, J. & Kriwy, P. (2003) The biological standard of living in the two Germanies. *German Economic Review* **4**, 459–473.

Kues, A. B. (2010) Taller – healthier – more equal? The biological standard of living in Switzerland in the second half of the 20th century. *Economics and Human Biology* **8**, 67–79.

Lasker, G. W. & Mascie-Taylor, C. G. N. (1989) Effects of social class differences and social mobility on growth in height, weight and body mass index in a British cohort. *Annals of Human Biology* **16**(1), 1–8.

Lasker, G. W. & Mascie-Taylor, C. G. N. (1996) Influence of social class on the correlation of stature of adult children with that of their mothers and fathers. *Journal of Biosocial Science* **28**, 117–122.

Li, L., Manor, O. & Power, C. (2004) Are inequalities in height narrowing? Comparing effects of social class on height in two generations. *Archives of Disease in Childhood* **89**, 1018–1023.

Li, L. & Power, C. (2004) Influences on childhood height: comparing two generations in the 1958 British birth cohort. *International Journal of Epidemiology* **33**, 1320–1328.

Mascie-Taylor, C. G. N. (1984) The interaction between geographical and social mobility. In Boyce, A. J. (ed.) *Migration & Mobility, Biosocial Aspects of Human Movement.* Symposia of the Society for the Study of Human Biology, Vol. **23**. Taylor & Francis, London and Philadelphia, pp. 161–178.

Mascie-Taylor, C. G. N. & Gibson, J. (1978) Social mobility and IQ components. *Journal of Biosocial Science* **10**, 263–276.

Power, C., Manor, O. & Li, L. (2002) Are inequalities in height underestimated by adult social position? Effects of changing social structure and height selection in a cohort study. *British Medical Journal* **325**, 131–134.

Singh-Manoux, A., Gourmelen, J., Ferrie, J., Silventoinen, K., Gueguen, A., Stringhini, S., Nabi, H. & Kivimaki, M. (2010) Trends in the association between height and socioeconomic indicators in France, 1970–2003. *Economics and Human Biology* **8**, 396–404.

Terrell, T. R. & Mascie-Taylor, C. G. N. (1991) Biosocial correlates of stature in a 16-year-old British cohort. *Journal of Biosocial Science* **23**, 401–408.