Is Intergenerational Social Mobility Related to the Type and Amount of Physical Activity in Mid-Adulthood? Results from the 1946 British Birth Cohort Study

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PURPOSE: Greater levels of leisure-time or moderate-vigorous physical activity have consistently been found in those with greater socioeconomic position (SEP). Less is known about the effects of intergenerational social mobility.

METHODS: We examined the influence of SEP and social mobility on mid-adulthood physical activity in the Medical Research Council National Survey of Health and Development. Two sub-domains of SEP were used: occupational class and educational attainment. Latent classes for walking, cycling, and leisure-time physical activity (LTPA) were used, plus sedentary behavior at age 36. Associations between types of physical activity and SEP were examined with the use of logistic or multinomial logistic regression.

RESULTS: Being a manual worker oneself or having a father who was a manual worker was, relative to nonmanual work, associated with lower levels of sedentary behavior and greater walking activity, but also with lower LTPA. Compared with those who remained in a manual occupational class, upward occupational mobility was associated with more sedentary behavior, less walking, and increased LTPA. Associations with downward mobility were in the opposite directions. Similar results were obtained for educational attainment.

CONCLUSIONS: This study found clear evidence of social differences in physical activity. Persistently high SEP and upward social mobility were associated with greater levels of LTPA but also increased sedentary behavior and less walking.

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INTRODUCTION

Epidemiological evidence has confirmed the benefits of regular physical activity on health and well-being (1). Promoting a physically active lifestyle is now considered a major element of public health policies, and increases in leisure-time physical activity (LTPA) have been reported in some countries (2, 3).

Recently, time spent in sedentary behavior, as defined by prolonged sitting or reclining characterized by low energy expenditure, has been shown to be associated with obesity (4–6), metabolic syndrome (7, 8), type 2 diabetes mellitus (5, 9), markers of cardiovascular disease (CVD) risk (4), and all-cause and CVD mortality (10), independently of levels of physical activity.

Greater levels of leisure-time or moderate-vigorous activity have consistently been found in those with greater socioeconomic position (SEP) (11). However, most studies to date have focused on LTPA only (12). In addition, many studies of physical activity and SEP use only a single subdomain of SEP (11), reducing the robustness of their conclusions.

Little is known about the effects of social mobility on levels of physical activity. One recent study of more than 2000 Australian adults age 26 to 36 years found that persistently high SEP and upward social mobility (indicated by educational level) from childhood to adulthood were associated with increased physical activity (13). Upward social mobility has also been found to be associated with decreased prevalence of physical inactivity in studies of health behaviors among Finnish adolescents (14) and older women in the UK (15). Better understanding the relationship between social mobility and physical activity may provide important insights into how social inequalities lead to poorer health.

The Medical Research Council National Survey of Health and Development is a nationally representative...
population-based birth cohort study that provides an opportunity to study the patterns of physical activity in a sample of more than 3800 men and women between age 31 and 53 years and relate them to SEP and inter-generational social mobility.

The aim of this work is to examine whether inter-generational change in SEP (as indicated by occupational class and educational attainment) was associated with differences in the types and patterns of physical activity, and if so, how.

**METHODS**

**Participants**

The sample comprised National Survey of Health and Development participants, an initial sample of 2815 men and 2547 women followed since their birth in March 1946 (16). Medical and social data have been collected 23 times by home visits, medical examinations, and postal questionnaires.

**Measures**

Self-reported information about physical activity was collected to differing extents at several sweeps of data collection. At ages 31, 36, and 43, a number of questions were asked about specific types of physical activity, and at age 53 a more general question was asked regarding sports, vigorous leisure activities, or exercises. In addition, at 36 years, more detailed information was collected, with study participants asked about the frequency and duration of participation in many different leisure time activities in the preceding month on the basis of the Minnesota leisure time physical activity questionnaire (17). In the present analysis we focused on four different types of self-reported physical activity: (1) sedentary behavior during the working day; (2) walking during the working day and for pleasure; (3) cycling during the working day and for pleasure; and (4) LTPA. Sedentary behavior was examined at age 36 years; walking at 36 and 43 years; cycling at 31, 36, and 43 years; and LTPA at ages 36, 43 and 53. To summarize, categorical variables in each of these dimensions were derived at available ages on the basis of self-reported questionnaire information. A total of 16 response variables were used across the four types of physical activity, and 3847 study participants (71.7% of the original cohort) were included on at least one of these measures. By the beginning of the period considered in the present analysis, 6.0% of the original cohort had died, 9.7% had permanently refused, and 12.0% were living abroad (16).

Two different subdomains of SEP were examined: occupational class and educational attainment. Prospectively collected data were used to classify study members according to the occupational class of the head of the household at age 36 years and the occupational class of their father in 1950 (i.e., at age 4 years) on the basis of the British Registrar General's Social Classification (18): 'I and II', 'III non-manual', 'IV manual', or 'V and V'. Intergenerational occupational mobility was defined by combining 'I and II' with 'III non-manual' ("nonmanual") and 'IV manual' with 'V and V' ("manual") then defining the following four groups: 'manual/manual', 'manual/nonmanual (upward)', 'nonmanual/manual (downward)', and 'nonmanual/nonmanual'.

Prospectively collected information on study members' educational qualifications achieved by age 26 years were grouped into 'no qualifications', 'lower secondary' ('O'-levels or equivalent, usually attained at 16 years), 'advanced secondary' ('A'-levels or equivalent, usually attained at 18 years), and 'degree-level or equivalent'. Father's educational level, reported in 1952, was classified as 'primary only', 'primary and further education (no qualifications attained)', 'secondary only or primary and further education or higher', or 'secondary and higher'. Intergenerational educational mobility was defined by combining the lower two classes in each education variable ('lower') and the more advance two classes ('advanced') then defining the following four groups: 'lower/lower', 'lower/advanced (upward)', 'advanced/lower (downward)', and 'advanced/advanced'. Of the 3847 study members with at least one measure of physical activity, 77.7% had information on intergenerational occupational mobility and 84.5% had information on inter-generational educational mobility.

**Statistical Analyses**

Different self-reported measures of physical activity were obtained at different time points, leading to complex, correlated data. Latent class analysis (LCA) was used to reduce the many derived measures of physical activity to a more useable form. LCA models identify a categorical latent (i.e., unobserved) class variable which is measured by a number of observed response variables. The objective is to identify the response variables that best distinguish between classes and to categorize people into their most likely classes given their observed responses (19).

A more detailed account of how the LCA was performed is available elsewhere (20). The purpose of the present paper is to use the previously derived latent classes, so only a brief description is given here. LCA was conducted separately for...
each type of physical activity (apart from sedentary behavior, for which data reduction was not required), and all participants with at least one measure of a given type of physical activity were included. Separate LCA models for males and females were used because these were found to give the best fit to the data. The most appropriate number of latent classes for each type of physical activity was determined with the use of several different measures of model fit (20). Posterior probabilities were derived by the LCA to quantify the probability with which an individual with given values for the response variables belonged to each latent class.

Logistic or multinomial logistic regression of one latent variable on another was used to examine pairwise associations between the latent variables for each type of physical activity. These analyses used robust standard errors and were weighted by LCA posterior probabilities to account for the uncertainty in class membership where appropriate. Associations between the latent variable for each type of physical activity and each measure of SEP were examined in the same manner. Analyses were repeated by use of the most likely latent class in unweighted logistic regressions for comparison.

Analyses were repeated by use of the study member’s own occupational class at age 36 years (rather than the head of household’s) and mother’s educational level (rather than father’s) as comparisons. Models were also fitted with adjustment for the season of data collection. Latent class analysis was performed with Mplus 6 (21), whereas (multinomial) logistic regression was conducted using Stata 11 (22).

RESULTS
For the majority of physical activity and SEP variables, there was strong ($p < .001$) evidence of a gender difference (Tables 1 and 2). The LCAs for walking, cycling, and LTPA included 3587, 3776, and 3671 study participants, respectively. The most appropriate number of latent classes was found to be two for walking (both males and females), two for cycling (both males and females), and three for LTPA (both males and females) (20).

More details regarding the interpretation of the latent classes are available elsewhere (20). To summarize, the two walking latent classes can be considered as ‘low’ (males 52.8% using estimated posterior class membership probabilities, females 33.5%) and ‘high’ (males 47.2%, females 66.5%) levels of activity; the two cycling classes as ‘low’ (males 91.4%, females 82.1%) and ‘high’ (males, 8.6%; females, 17.9%) levels of activity; and the three LTPA classes as ‘low’ activity (males 46.2%, females 48.2%), ‘gardening and do-it-yourself’ (males 22.8%, females 16.5%), and ‘sport and leisure’ (males 31.0%, females 35.3%).

In LCA the separation of the classes is often quantified in terms of entropy, which takes values between 0 and 1, with scores close to 1 indicating clearer classifications (23). The male walking classes (0.66) and cycling classes (0.87 and 0.64 for males and females, respectively) were clearly separated and the LTPA classes reasonably so (0.56 and 0.57), although entropy for female walking was low (0.37).

The three latent variables (walking, cycling, LTPA) and sedentary behavior at age 36 were associated with each other (Tables 3 and 4). Male respondents who reported being most sedentary during the working day at age 36 were much less likely to be in the high walking and cycling latent classes compared with those in the least sedentary group but more likely to be in the sport and leisure LTPA latent class. In females, only the association with walking latent class was observed. Males in the high walking latent class were less likely to be in the sport and leisure LTPA latent class compared with those in the low walking latent class. Both males and females in the high cycling latent class were more likely to be in the sport and leisure LTPA latent class.

Tables 5 and 6 show cross-tabulations of the physical activity latent variables with the SEP variables for males and females, respectively. For males, being a manual worker was relative to being a nonmanual worker, associated with lower levels of adult sedentary behavior during the working day (13.4% much sitting in classes IV and V compared with 43.6% in classes I and II), greater levels of walking (66.1% high compared with 32.8%), but also lower LTPA (24.3% sport and leisure compared with 39.4%). For female respondents, LTPA showed a similarly strong association, walking was somewhat less marked, and sedentary behavior showed a nonlinear association, with the III nonmanual class corresponding to the greatest level of adult sedentary behavior.

Similar patterns were observed for father’s occupational class in 1950, although differences between manual and nonmanual occupational classes were generally reduced. Compared with participants who remained in the manual occupational class, those from a similar background but who were upwardly mobile by age 36 reported more sedentary behavior during the working day and less walking in men only, and increased LTPA in both men and women. Compared with men who remained in the nonmanual occupational class, men who were downwardly mobile reported less sedentary behavior, more walking, and less LTPA. In women whose fathers were nonmanual occupational class there were similar patterns, although the magnitudes of the differences were reduced.

In women who were nonmanual occupational class at age 36, there were residual differences in LTPA between those with manual and nonmanual occupational class fathers. This effect also was observed in those who were manual occupational class at age 36.
Although the effects of occupational class on physical activity were most often seen as a manual/nonmanual split, the effects of educational class were more linear. In both men and women, having more advanced educational qualifications was associated with increased sedentary behavior during the working day and decreased walking, but also...
with increased LTPA. Similar patterns were observed for study members’ father’s educational level, although the magnitudes of the associations were generally reduced.

Those with upward intergenerational mobility into the advanced educational class reported more sedentary behavior during the day and less walking but more LTPA. Similarly, study participants demonstrating downward educational mobility reported less sedentary behavior during the working day and more walking (men only) but less LTPA (women only).

There was some evidence of a residual effect of father’s educational class. Among study members of advanced educational class, having a father of advanced rather than lower educational class led to increased sedentary behavior during the working day (men only), reduced walking (men only), and increased LTPA (women only). A similar residual effect was seen for sedentary behavior in male study members of lower educational class.

Repeating the analysis using most likely latent classes in unweighted logistic regressions made little difference to the percentage of study participants corresponding to each level of SEP and did not affect the conclusions drawn (results not shown).

In models with adjustment for the effects of seasonal variation of physical activity the estimated associations changed very little (results not shown).

Repeating the analyses using women’s own occupational class at age 36 led to an amplification of the effects of occupational class and intergenerational occupational mobility on sedentary behavior and, to a lesser extent, walking in

| TABLE 2. Socioeconomic position variables in subjects who have data for at least one dimension of physical activity in the Medical Research Council National Survey of Health and Development |
|---------------------------------------------------------------|
| Socioeconomic position variable                          | Males (n = 1940) | Females (n = 1907) | Total (n = 3847) |
|---------------------------------------------------------------|
| Head of household’s occupational class at age 36*                  | n   | %    | n   | %    | n   | %    |
| I and II                                                                                           729   | 44.9 | 623   | 39.6 | 1352 | 42.3 |
| III nonmanual                                                                                       166   | 10.2 | 257   | 16.3 | 423  | 13.2 |
| III manual                                                                                          523   | 32.2 | 429   | 27.3 | 952  | 29.8 |
| IV and V                                                                                           204   | 12.6 | 265   | 16.8 | 469  | 14.7 |
| Total                                                                                              1622  | 1574  | 3196 |
| Father’s occupational class in 1950                                                                |
| I and II                                                                                           405   | 22.8 | 392   | 22.7 | 797  | 22.7 |
| III nonmanual                                                                                       329   | 18.5 | 328   | 19.0 | 657  | 18.7 |
| III manual                                                                                         540   | 30.4 | 531   | 30.7 | 1071 | 30.5 |
| IV and V                                                                                           504   | 28.3 | 478   | 27.6 | 982  | 28.0 |
| Total                                                                                              1778  | 1729  | 3507 |
| Intergenerational occupational mobility                                                            |
| Manual/manual                                                                                       519   | 34.7 | 474   | 32.6 | 993  | 33.7 |
| Manual/nonmanual (upward)                                                                            359   | 24.0 | 368   | 25.3 | 727  | 24.7 |
| Nonmanual/manual (downward)                                                                           144   | 9.6  | 174   | 12.0 | 318  | 10.8 |
| Nonmanual/nonmanual                                                                                   475   | 31.7 | 436   | 30.0 | 911  | 30.9 |
| Total                                                                                              1497  | 1452  | 2949 |
| Educational qualifications achieved by age 26*                                                          |
| No qualifications                                                                                     712   | 39.0 | 694   | 38.7 | 1406 | 38.9 |
| Lower secondary                                                                                       370   | 20.3 | 616   | 34.3 | 986  | 27.3 |
| Advanced secondary                                                                                     486   | 26.6 | 395   | 22.0 | 881  | 24.4 |
| Degree level                                                                                         256   | 14.0 | 89    | 5.0  | 345  | 9.5  |
| Total                                                                                              1824  | 1794  | 3618 |
| Father’s education                                                                                     |
| Primary only                                                                                        959   | 56.4 | 979   | 58.2 | 1938 | 57.3 |
| Primary and further education (no qualifications attained)                                             242   | 14.2 | 212   | 12.6 | 454  | 13.4 |
| Secondary only or primary and further education or higher                                               235   | 13.8 | 225   | 13.4 | 460  | 13.6 |
| Secondary and greater                                                                                 265   | 15.6 | 267   | 15.9 | 532  | 15.7 |
| Total                                                                                              1701  | 1683  | 3384 |
| Inter-generational educational mobility*                                                                 |
| Lower/lower                                                                                         804   | 49.4 | 979   | 60.4 | 1783 | 54.9 |
| Lower/advanced (upward)                                                                               343   | 21.1 | 170   | 10.5 | 513  | 15.8 |
| Advanced/lower (downward)                                                                             169   | 10.4 | 210   | 12.9 | 379  | 11.7 |
| Advanced/advanced                                                                                      312   | 19.2 | 262   | 16.2 | 574  | 17.7 |
| Total                                                                                              1628  | 1621  | 3249 |

All % are column percentages.

*p< .001.
women, although the LTPA results were essentially unchanged (results not shown). When mother’s rather than father’s educational level was used (and intergenerational educational mobility defined on this basis), the direction and overall strength of associations were generally very similar (results not shown).

**DISCUSSION**

In a large, population-based, prospective study we found SEP and intergenerational social mobility to be associated with previously identified latent class variables for different types of physical activity and an additional observed variable for sedentary behavior. Manual occupational classes and lower educational classes, both for the study member and their father, were associated with lower levels of sedentary behavior during the working day and greater levels of walking activity, most likely through the subject having a type of job that requires more walking. Greater levels of LTPA (particularly sport and leisure activity) were found to be more common in those of nonmanual occupational class and those with more advanced educational qualifications, most likely as a conscious compensation for the detrimental effect on their health of having a more sedentary occupation.

The large differences in physical activity generally found between study members whose SEP (occupational or educational class) changed from their father’s and study members whose SEP remained the same as their father’s suggests that it was largely their own SEP that determined their pattern of physical activity rather than their parents’, illustrating the

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### TABLE 3. Associations between physical activity (latent) variables in the Medical Research Council National Survey of Health and Development (males)

| Walking latent class | Cycling latent class | Leisure time physical activity latent class |
|----------------------|---------------------|--------------------------------------------|
| n Low (%) High (%) LRT p | n Low (%) High (%) LRT p | n Low (%) Gardening and DIY (%) Sport and leisure (%) LRT p |
| Sedentary behavior | | |
| at age 36 years | | |
| Much sitting | 1640 | 98.3 1.7 <.001 | 1639 | 94.3 5.7 .003 | 1638 | 38.7 22.1 39.2 <.001 |
| Average sitting | 1794 | 92.3 7.7 .04 | 1795 | 40.4 23.0 36.7 .001 |
| Little sitting | 1807 | 45.3 22.6 32.1 <.001 |
| Walking latent class | | |
| Low | 1794 | 92.3 7.7 .04 | 1795 | 40.4 23.0 36.7 .001 |
| High | 1807 | 45.3 22.6 32.1 <.001 |
| Cycling latent class | | |
| Low | 1788 | 81.8 18.2 .23 | 1790 | 46.6 14.7 38.8 .03 |
| High | 1793 | 48.3 15.9 35.8 <.001 |

DIY = do-it-yourself; LRT = likelihood ratio test.
All % are row percentages.

### TABLE 4. Associations between physical activity (latent) variables in the Medical Research Council National Survey of Health and Development (females)

| Walking latent class | Cycling latent class | Leisure time physical activity latent class |
|----------------------|---------------------|--------------------------------------------|
| n Low (%) High (%) LRT p | n Low (%) High (%) LRT p | n Low (%) Gardening and DIY (%) Sport and leisure (%) LRT p |
| Sedentary behavior | | |
| at age 36 years | | |
| Much sitting | 1643 | 59.3 40.7 <.001 | 1643 | 81.1 18.9 .38 | 1643 | 48.6 13.8 37.5 .02 |
| Average sitting | 1788 | 81.8 18.2 .23 | 1790 | 46.6 14.7 38.8 .03 |
| Little sitting | 1803 | 33.8 27.5 38.7 |
| Walking latent class | | |
| Low | 1788 | 81.8 18.2 .23 | 1790 | 46.6 14.7 38.8 .03 |
| High | 1793 | 48.3 15.9 35.8 <.001 |
| Cycling latent class | | |
| Low | 1793 | 48.3 15.9 35.8 <.001 |
| High | 1793 | 48.3 15.9 35.8 <.001 |

DIY = do-it-yourself; LRT = likelihood ratio test.
All % are row percentages.
TABLE 5. Associations between physical activity (latent) variables and socioeconomic position in the Medical Research Council National Survey of Health and Development (males)

| Head of household’s occupational class at age 36 years | Sedentary behavior (age 36 years) | Walking (ages 36 and 43 years) | Cycling (ages 31, 36, and 43 years) | LTPA (age 36, 43, and 53 years) |
|------------------------------------------------------|----------------------------------|--------------------------------|-----------------------------------|----------------------------------|
| I and II                                              | n                                | Much sitting % | Average sitting % | Little sitting % | n Low % | High % | n Low % | High % | n Low % | High % | n Low % | High % |
| I and II                                              | 727                              | 43.6           | 39.9              | 16.5             | 729     | 67.2   | 32.8   | 729     | 92.0   | 8.0    | 727     | 35.9   | 24.7   | 39.4   |
| III nonmanual                                         | 164                              | 50.6           | 39.6              | 9.8              | 166     | 72.5   | 27.5   | 166     | 93.2   | 6.8    | 166     | 38.7   | 23.4   | 37.9   |
| III manual                                            | 521                              | 19.2           | 28.8              | 52.0             | 523     | 45.0   | 55.0   | 523     | 91.6   | 8.4    | 523     | 49.4   | 24.3   | 26.3   |
| IV and V                                              | 201                              | 13.4           | 34.8              | 51.7             | 204     | 33.9   | 66.1   | 204     | 88.1   | 11.9   | 204     | 58.8   | 16.9   | 24.3   |
| N                                                      | 1613                             | 1622           | 1622              | 1620             |         |        |        |         |        |        |         |        |        |        |
| LRT p                                                  | <.001                            | <.001          | .17               | <.001           |        |        |        |         |        |        |         |        |        |        |
| LRT p (trend)                                          | <.001                            | <.001          | <.001             | <.001           |        |        |        |         |        |        |         |        |        |        |
| Father’s occupational class in 1950                   |                                  |                |                   |                 |         |        |        |         |        |        |         |        |        |        |
| I and II                                              | 346                              | 41.3           | 35.3              | 23.4             | 375     | 65.1   | 34.9   | 399     | 90.3   | 9.7    | 384     | 39.9   | 22.4   | 37.7   |
| III nonmanual                                         | 277                              | 45.1           | 35.7              | 19.1             | 309     | 67.0   | 33.0   | 322     | 94.1   | 5.9    | 317     | 37.7   | 25.0   | 37.3   |
| III manual                                            | 465                              | 26.9           | 35.9              | 37.2             | 510     | 52.4   | 47.6   | 534     | 92.8   | 7.2    | 516     | 37.7   | 25.0   | 37.3   |
| IV and V                                              | 427                              | 24.6           | 36.3              | 39.1             | 453     | 47.5   | 52.5   | 489     | 89.3   | 10.7   | 476     | 51.9   | 22.6   | 25.5   |
| N                                                      | 1515                             | 1647           | 1744              | 1693             |         |        |        |         |        |        |         |        |        |        |
| LRT p                                                  | <.001                            | <.001          | .01               | <.001           |        |        |        |         |        |        |         |        |        |        |
| LRT p (trend)                                          | <.001                            | <.001          | <.001             | <.001           |        |        |        |         |        |        |         |        |        |        |
| Intergenerational occupational social mobility         |                                  |                |                   |                 |         |        |        |         |        |        |         |        |        |        |
| Manual/Manual                                         | 516                              | 17.1           | 29.7              | 53.3             | 519     | 40.7   | 59.3   | 519     | 90.9   | 9.1    | 519     | 53.4   | 21.8   | 24.9   |
| Manual/nonmanual (upward)                             | 359                              | 38.4           | 45.1              | 16.4             | 359     | 63.5   | 36.5   | 359     | 91.7   | 8.3    | 358     | 38.0   | 26.8   | 35.2   |
| Nonmanual/manual (downward)                           | 143                              | 20.3           | 35.0              | 44.8             | 144     | 49.4   | 50.6   | 144     | 90.0   | 10.0   | 144     | 46.3   | 25.9   | 27.7   |
| Nonmanual/nonmanual                                    | 471                              | 50.3           | 35.5              | 14.2             | 475     | 72.6   | 27.4   | 475     | 93.1   | 6.9    | 474     | 35.1   | 23.4   | 41.5   |
| N                                                      | 1489                             | 1497           | 1497              | 1495             |         |        |        |         |        |        |         |        |        |        |
| LRT p                                                  | <.001                            | <.001          | <.001             | <.001           |        |        |        |         |        |        |         |        |        |        |
| Educational qualifications achieved by age 26 years    |                                  |                |                   |                 |         |        |        |         |        |        |         |        |        |        |
| No qualifications                                     | 585                              | 18.5           | 33.3              | 48.2             | 646     | 40.6   | 59.4   | 698     | 91.0   | 9.0    | 668     | 54.8   | 20.7   | 24.5   |
| Lower secondary                                       | 332                              | 31.6           | 38.9              | 29.5             | 352     | 58.5   | 41.5   | 363     | 91.0   | 9.0    | 360     | 44.1   | 21.8   | 34.1   |
| Advanced secondary                                    | 427                              | 38.2           | 37.7              | 24.1             | 463     | 62.9   | 37.1   | 480     | 92.7   | 7.3    | 469     | 37.3   | 26.5   | 36.2   |
| Degree level                                           | 219                              | 58.9           | 35.2              | 5.9              | 236     | 80.0   | 20.0   | 252     | 88.6   | 11.4   | 241     | 29.4   | 27.1   | 43.5   |
| N                                                      | 1563                             | 1697           | 1793              | 1738             |         |        |        |         |        |        |         |        |        |        |
| LRT p                                                  | <.001                            | <.001          | .18               | <.001           |        |        |        |         |        |        |         |        |        |        |
| LRT p (trend)                                          | <.001                            | <.001          | <.001             | <.001           |        |        |        |         |        |        |         |        |        |        |
| Father’s educational level                            |                                  |                |                   |                 |         |        |        |         |        |        |         |        |        |        |
| Primary only                                           | 813                              | 25.0           | 36.2              | 38.9             | 884     | 49.4   | 50.6   | 937     | 91.8   | 8.2    | 913     | 48.7   | 23.0   | 28.3   |
| Primary and further education (no qualifications attained) | 219                              | 34.2           | 35.6              | 30.1             | 229     | 59.1   | 40.9   | 238     | 90.9   | 9.1    | 233     | 40.9   | 24.9   | 34.2   |
| Secondary only or primary and further education or greater | 204                              | 39.2           | 40.2              | 20.6             | 221     | 62.9   | 37.1   | 233     | 90.7   | 9.3    | 225     | 41.1   | 24.9   | 34.0   |
| Secondary and greater                                  | 219                              | 48.9           | 38.4              | 12.8             | 244     | 71.0   | 29.0   | 260     | 91.9   | 8.1    | 250     | 35.4   | 21.9   | 42.8   |

(Continued)
positive potential of social mobility. However, the residual effect of father’s SEP in those with the same SEP in adulthood suggests that when SEP changes between generations, it may take further generations before the full implications are felt.

Our findings suggest that it is important to consider several types of activity rather than extrapolating from only one in studies of physical activity. We cannot be certain whether doing more LTPA (generally those of greater SEP) amounts to more total physical activity than being less sedentary and walking more (lower SEP). People who are particularly active during their working day may well be too tired to engage in greater levels of activity in their leisure time.

The observed associations were often less clear in female respondents. Although this may be attributable to less distinct separation of the latent classes (21), it may also indicate that using the occupational class of the head of household (usually a male) at age 36 years is a relatively poorer measure of SEP in women, leading to attenuation. Using women’s own occupational class at age 36 led to stronger associations with sedentary behavior and, to a lesser extent, walking. Although women’s own occupational class may naturally be more strongly associated with occupational-based physical activity, sedentary behavior was based on time sitting down during the day—head of household’s occupational class is likely to provide a more reliable general measure of SEP at age 36 years because many women in this cohort were at home looking after children.

The data used in the present analysis were collected from 1977 to 1999 and secular trends in physical activity and women’s employment may mean that the relationships observed in this cohort have changed in later cohorts. In recent years, decreases in occupational physical activity coupled with an upward trend in sports participation have been noted in the UK (24). In addition, the increase in the female labor market (25) is likely to have led to more similar patterns of occupational activity across the sexes.

The acknowledged association between greater SEP and greater levels of leisure-time or moderate-vigorous activity (11) was clearly replicated in our study. Cleland et al. (13) found that persistently high SEP and upward social mobility from childhood to adulthood were associated with increases in physical activity. Although our study did not allow us to examine changes in physical activity, we found that high SEP in childhood or adult life, or upward intergenerational social mobility are felt. Our findings suggest that it is important to consider several types of activity rather than extrapolating from only one in studies of physical activity. We cannot be certain whether doing more LTPA (generally those of greater SEP) amounts to more total physical activity than being less sedentary and walking more (lower SEP). People who are particularly active during their working day may well be too tired to engage in greater levels of activity in their leisure time.

|                          | Sedentary behavior (age 36 years) | Walking (ages 36 and 43 years) | Cycling (ages 31, 36, and 43 years) | LTPA (age 36, 43, and 53 years) |
|--------------------------|-----------------------------------|-------------------------------|-----------------------------------|-----------------------------------|
|                          | n                                | Much sitting % | Average sitting % | Little sitting % | n | Low %       | High %       | n | Low %       | High %       | n | Low %       | Gardening and DIY % | Sport and leisure % |
| N                        | 1455                             |                      |                      |                  | 1578                     | <.001 |                      |                      |                  | 1668 | <.001 |                      |                      | 1621 | <.001 |                      |                      |
| LRT p                    | <.001                            |                      |                      |                  | <.001                   | <.001 |                      |                      |                  | .90             | .81             |                      |                      | <.001 |                      |                      |
| LRT p (trend)            | <.001                            |                      |                      |                  | <.001                   | <.001 |                      |                      |                  |<.001            |<.001            |                      |                      |<.001            |                      |
| Intergenerational educational social mobility |                      |                      |                      |                  |                          |                      |                      |                      |                  |                          |                      |                      |                          |                      |
| Lower/lower              | 688                              | 21.8               | 34.3               | 43.9             | 739                      | 45.7 | 54.3             |                      |                  | 788             | 91.1             | 8.9             |                      |                      | 763             | 51.9             | 21.5             | 26.6             |
| Lower/advanced (upward)  | 306                              | 37.3               | 40.2               | 22.5             | 328                      | 63.5 | 36.5             |                      |                  | 338             | 92.4             | 7.6             |                      |                      | 332             | 36.3             | 28.6             | 35.1             |
| Advanced/lower (downward)| 145                              | 29.7               | 44.1               | 26.2             | 159                      | 54.4 | 45.6             |                      |                  | 166             | 92.9             | 7.1             |                      |                      | 163             | 45.3             | 20.6             | 34.1             |
| Advanced/advanced        | 264                              | 52.3               | 36.7               | 11.0             | 287                      | 74.6 | 25.4             |                      |                  | 308             | 90.4             | 9.6             |                      |                      | 293             | 33.1             | 25.1             | 41.8             |
| N                        | 1403                             |                      |                      |                  | 1513                     | <.001 |                      |                      |                  | 1600            | <.001 | <.01             |                      |                      | 1551            | <.001 |                      |                      |

LRT = likelihood ratio test; LTPA = leisure-time physical activity.

All % are row percentages.
TABLE 6. Associations between physical activity (latent) variables and socioeconomic position in the Medical Research Council National Survey of Health and Development (females)

| Head of household's occupational class at age 36 years | Sedentary behaviour (age 36 years) | Walking (ages 36 and 43 years) | Cycling (ages 31, 36, and 43 years) | LTPA (age 36, 43, and 53 years) |
|--------------------------------------------------------|-----------------------------------|--------------------------------|-----------------------------------|---------------------------------|
|                                                        | Much sitting (%) | Average sitting (%) | Little sitting (%) | n Low (%) | High (%) | n Low (%) | High (%) | n Low (%) | High (%) | n Low (%) | High (%) |
| I and II                                                | 613 | 18.1 | 36.4 | 45.5 | 623 | 38.4 | 61.6 | 623 | 80.6 | 19.4 | 623 | 36.6 | 17.0 | 46.4 |
| III nonmanual                                           | 256 | 36.7 | 28.8 | 37.5 | 257 | 37.0 | 63.0 | 257 | 81.7 | 18.3 | 257 | 49.3 | 13.6 | 37.1 |
| III manual                                              | 425 | 21.6 | 31.5 | 46.8 | 429 | 33.2 | 66.8 | 429 | 79.1 | 20.9 | 429 | 52.0 | 17.2 | 30.8 |
| IV and V                                                | 262 | 12.2 | 28.6 | 59.2 | 265 | 25.3 | 74.7 | 265 | 83.6 | 16.4 | 265 | 54.5 | 17.9 | 27.6 |
| N                                                       | 1556 |        |      |      | 1574 |        |      | 1574 |        |      | 1574 |        |      |      |
| LRT p value                                             | <.001 |        |      |      | <.001 |        |      | <.001 |        |      | <.001 |        |      |      |
| LRT p value (trend)                                     | <.001 |        |      |      | <.001 |        |      | <.001 |        |      | <.001 |        |      |      |
| Father's occupational class in 1950                    | 341 | 19.6 | 36.7 | 43.7 | 373 | 37.2 | 62.8 | 387 | 77.7 | 22.3 | 389 | 33.8 | 18.3 | 47.9 |
| I and II                                                | 287 | 25.1 | 33.1 | 41.8 | 308 | 40.0 | 60.0 | 326 | 79.7 | 20.3 | 311 | 36.7 | 19.6 | 43.7 |
| III nonmanual                                           | 467 | 20.3 | 29.8 | 49.9 | 500 | 33.2 | 66.8 | 524 | 83.7 | 16.3 | 508 | 50.7 | 16.3 | 33.0 |
| III manual                                              | 415 | 17.6 | 33.7 | 48.7 | 451 | 30.6 | 69.4 | 469 | 80.6 | 19.4 | 459 | 55.8 | 14.2 | 30.0 |
| N                                                       | 1510 |        |      |      | 1632 |        |      | 1706 |        |      | 1657 |        |      |      |
| LRT p                                                   | .08  |        |      |      | .04  |        |      | .05  |        |      | <.001 |        |      |      |
| LRT p (trend)                                           | .02  |        |      |      | .02  |        |      | .09  |        |      | <.001 |        |      |      |
| Intergenerational occupational social mobility          | 469 | 17.7 | 30.7 | 51.6 | 474 | 29.0 | 71.0 | 474 | 81.9 | 18.1 | 474 | 57.5 | 16.0 | 26.5 |
| Manual/manual                                           | 364 | 22.3 | 30.5 | 47.3 | 368 | 34.8 | 65.2 | 368 | 82.5 | 17.5 | 368 | 48.3 | 13.8 | 37.9 |
| Nonmanual/manual (upward)                              | 173 | 20.2 | 31.4 | 48.5 | 174 | 33.8 | 66.2 | 174 | 77.6 | 22.4 | 174 | 40.0 | 20.7 | 39.3 |
| Nonmanual/nonmanual (downward)                          | 430 | 24.9 | 35.6 | 39.5 | 436 | 40.8 | 59.2 | 436 | 78.8 | 21.2 | 436 | 32.9 | 18.7 | 48.4 |
| N                                                       | 1435 |        |      |      | 1452 |        |      | 1452 |        |      | 1452 |        |      |      |
| LRT p                                                   | <.001 |        |      |      | <.001 |        |      | <.001 |        |      | <.001 |        |      |      |
| Educational qualifications achieved by age 26 years     | 600 | 14.7 | 31.5 | 53.8 | 655 | 28.4 | 71.6 | 683 | 81.8 | 18.2 | 665 | 57.1 | 15.9 | 27.0 |
| No qualifications                                       | 543 | 28.0 | 27.1 | 44.9 | 578 | 36.0 | 64.0 | 611 | 81.4 | 18.6 | 586 | 45.2 | 17.5 | 37.3 |
| Lower secondary                                         | 349 | 14.9 | 44.4 | 40.7 | 347 | 40.3 | 59.7 | 391 | 79.9 | 20.1 | 379 | 30.7 | 17.2 | 52.1 |
| Advanced secondary                                      | 77  | 26.0 | 42.9 | 31.2 | 81  | 50.3 | 49.7 | 86  | 72.7 | 27.3 | 84  | 28.6 | 13.5 | 57.9 |
| Degree level                                            | 1569 |        |      |      | 1688 |        |      | 1771 |        |      | 1714 |        |      |      |
| LRT p                                                   | <.001 |        |      |      | <.001 |        |      | <.001 |        |      | <.001 |        |      |      |
| LRT p (trend)                                           | <.001 |        |      |      | <.001 |        |      | <.001 |        |      | <.001 |        |      |      |
| Father's educational level                              | 855 | 20.1 | 30.8 | 49.1 | 919 | 32.0 | 68.0 | 963 | 82.3 | 17.7 | 935 | 52.9 | 15.7 | 31.4 |
| Primary only                                            | 183 | 23.5 | 32.8 | 43.7 | 193 | 35.8 | 64.2 | 211 | 78.9 | 21.1 | 199 | 43.5 | 18.4 | 38.1 |
| Primary and further education (no qualifications attained)| | | | | | | | | | | | | | |
TABLE 6. (Continued)

| Sedentary behaviour (age 36 years) | Walking (ages 36 and 43 years) | Cycling (ages 31, 36, and 43 years) | LTPA (age 36, 43, and 53 years) |
|-----------------------------------|---------------------------------|-----------------------------------|---------------------------------|
| n                                | Much sitting (%) | Average sitting (%) | Little sitting (%) | n | Low (%) | High (%) | n | Low (%) | High (%) | n | Low (%) | Gardening and DIY (%) | Sport and leisure (%) |
| Secondary only or primary and further education or higher | 201 | 19.9 | 34.3 | 45.8 | 217 | 37.6 | 62.4 | 225 | 79.3 | 20.7 | 217 | 36.8 | 19.4 | 43.8 |
| Secondary and higher              | 226 | 20.4 | 38.9 | 40.7 | 251 | 40.8 | 59.2 | 262 | 77.8 | 22.2 | 255 | 31.1 | 16.6 | 52.3 |
| N                                 | 1465 | 1582 | 1661 | 1606 | LRT $p$ | .25 | .14 | <.001 | LRT $p$ (trend) | .03 | <.001 |
| Intergenerational educational social mobility | Secondary only or primary and further education or higher | 854 | 20.4 | 28.6 | 51.1 | 917 | 30.6 | 69.4 | 965 | 82.0 | 18.0 | 933 | 53.4 | 16.2 | 30.3 |
| Secondary and higher              | 152 | 18.4 | 48.0 | 33.6 | 158 | 42.7 | 57.3 | 167 | 79.5 | 20.5 | 162 | 37.9 | 15.9 | 46.2 |
| N                                 | 1418 | 1999 | 1548 | LRT $p$ | <.001 | <.001 | .07 | <.001 |

LRT = likelihood ratio test; LTPA = leisure-time physical activity.
All % are row percentages.

Although the physical activity data were almost always a residual effect of father’s SEP for some types of physical activity, and after adjustment for current SEP, only in female subjects. A Dutch prospective cohort of 25- to 74-year-old subjects, van de Mheen et al. (28) similarly found childhood SEP to be associated with frequent physical activity after adjustment for current SEP, although only in female subjects. There is much strength to this analysis. Several different measures of physical activity obtained from questionnaires may be prone to nondifferential measurement error. The retrospectively self-reported measures may have led to recall bias, potentially differentially through social desirability and approval influencing the responses (31). Although the physical activity data were almost always a residual effect of father’s SEP for some types of physical activity, and after adjustment for current SEP, only in female subjects. A Dutch prospective cohort of 25- to 74-year-old subjects, van de Mheen et al. (28) similarly found childhood SEP to be associated with frequent physical activity after adjustment for current SEP, although only in female subjects. There is much strength to this analysis. Several different measures of physical activity obtained from questionnaires may be prone to nondifferential measurement error. The retrospectively self-reported measures may have led to recall bias, potentially differentially through social desirability and approval influencing the responses (31).
collected between spring and autumn, misclassification caused by seasonal variability of activity behaviors (32) may have been present. However, adjustment for the season of data collection made very little difference to the estimated associations.

In addition, some of the physical activity items may be differentially relevant to people in different socioeconomic groups. For example, those of lower SEP may be less likely to have homes with gardens, so would by necessity do less gardening. This may partially confound apparent social differences in physical activity (33).

This descriptive analysis has made no attempt to disentangle the complex relationships between socioeconomic position, physical activity, and the many potential confounding or mediating variables between the two, such as health status, mobility limitation, and obesity. Each of these could be considered as either a cause or an effect of low levels of physical activity, and a rigorous investigation of these issues is beyond the scope of the present analysis. As such, we cannot rule out the possibility that the observed associations may be at least partly the result of unmeasured confounders.

An alternative approach to that used in the present analysis would have been to include all the physical activity response variables in a single LCA to derive overarching physical activity latent classes. We decided against this approach because we wanted to capture specific types of physical activity that would also be applicable to different settings and to maintain comparability with other cohorts, as most studies concentrate on a single type of physical activity.

In conclusion, this study found clear evidence of social differences in different types of physical activity. Persistently high SEP and upward social mobility were associated with greater levels of LTPA but also with greater levels of sedentary behavior during the working day and less walking. In addition, the lack of strong correlation between most of the types of physical activity suggests that studies examining relationships between physical activity and health should consider many types of activity rather than extrapolating from only one.

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