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Socioeconomic disadvantage from childhood to adulthood and locomotor function in old age: a lifecourse analysis of the Boyd Orr and Caerphilly prospective studies

Kate Birnie¹, Richard M Martin¹, John Gallacher², Antony Bayer², David Gunnell¹, Shah Ebrahim³, and Yoav Ben-Shlomo¹

¹Department of Social Medicine, University of Bristol, Bristol, UK

²Department of Primary Care and Public Health, Centre for Health Sciences Research, School of Medicine, Cardiff University, UK

³London School of Hygiene & Tropical Medicine, London, UK

Abstract

Background—Socioeconomic influences over a lifetime impact on health and may contribute to poor physical functioning in old age.

Methods—We examined the impact of both childhood and adulthood socioeconomic factors on locomotor function at 63–86 years (measured with the get up and go timed walk and flamingo balance test), in the UK-based Boyd Orr (n=405) and Caerphilly (n=1,196) prospective cohorts.

Results—There was a marked reduction in walking speed and balance time with increasing age. Each year of age was associated with a 1.7% slower walk time and a 14% increased odds of poor balance. Participants who moved from a low socioeconomic position in childhood to a high socioeconomic position in adulthood had walking times 3% slower (95% CI: -2%, 8%) than people with high socioeconomic position in both periods. Participants who moved from a high socioeconomic position in childhood to a low adulthood socioeconomic position had walking times 5% slower (95% CI: -2%, 12%). Participants with a low socioeconomic position in both periods had walking times 10% slower (95% CI: 5%, 16%; *P* for trend <0.001).

In Boyd Orr, low socioeconomic position in childhood was associated with poor balance in old age (OR per worsening category = 1.26; 95% CI 1.01, 1.57; *P*=0.043), as was socioeconomic position in adulthood (OR = 1.71; 95% CI 1.20, 2.45; *P*=0.003). Similar associations were not observed in Caerphilly.

Conclusion—Accumulating socioeconomic disadvantage from childhood to adulthood is associated with slower walking time in old age, with mixed results for balance ability.

Keywords

Aged; Gait; Physical performance; Social Class; Socioeconomic Factors

Author for correspondence: Kate Birnie Department of Social Medicine University of Bristol Canynge Hall 39 Whatley Road Bristol BS8 2PS UK Tel: 0117 928 7343 Fax: 0117 928 7325 Kate.Birnie@Bristol.ac.uk.

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INTRODUCTION

With increasing life expectancy, men in the UK aged 65 can expect to live a further 16.9 years and women a further 19.7 years.¹ Ageing, however, is associated with impairments in many physiological systems², vulnerability to adverse outcomes (e.g. acute illness, chronic disease, social vulnerability) and loss of functions important for daily living.^{3,4} Gait speed, rising from a chair and balance are simple, objective measures of physical performance that predict subsequent functional disability in older people.⁵⁻⁷ Socioeconomic influences impact on health and mortality.^{8,9} Studies have found that low educational attainment is associated with the prevalence of disability in old age.^{10,11} Manual occupational social class and home and car ownership are associated with the risk of disability.¹² Lower occupational social class has also been associated with poorer balance ability,¹³ walking speed¹⁴ and a physical performance battery.¹⁵ Few studies, however, have investigated associations of socioeconomic circumstances in both childhood and adulthood with objective measures of physical performance in old age.

From a lifecourse perspective, different general models have been suggested to illustrate the possible influences of childhood and adult socioeconomic circumstances on adult health:^{16,17} one model proposes that adverse social circumstances may accumulate over a lifetime to increase the risk of poor health.¹⁸ Possible mechanisms linking early life socioeconomic influences with functional limitation in old age are illustrated in our research model (Figure 1). Adverse childhood circumstances could be detrimental to final educational attainment, in turn influencing choices of health behaviours in adulthood, leading to chronic diseases that impair locomotor function. Other models postulate that there are critical periods in an individual's development during which there is increased vulnerability to external influences that may have lasting effects on later health.¹⁸ Like critical periods, sensitive periods are also times of rapid individual change but exposures outside specific time windows have weaker long-term effects.¹⁸ We test the hypotheses that adverse socioeconomic circumstances in childhood have long-term effects on physical function and are associated with slower walking speed and reduced balance times in old age. We test which of various lifecourse models (accumulation, critical or sensitive periods) of adverse socioeconomic exposures at two time points (childhood and adulthood) in relation to physical performance are more appropriate¹⁹ for data from the Boyd Orr cohort and the Caerphilly Prospective Study (CaPS). We do not examine a separate social mobility model, as with social class measurements at only two time points, social mobility is imbedded in the accumulation, critical and sensitive period models, as others have suggested.²⁰ We also test whether associations of social circumstances remain after taking account of health behaviours and diseases in adulthood.

METHODS

Participants

The Boyd Orr study is an historical cohort based on the Carnegie (Boyd Orr) Survey of Diet and Health in Pre-War Britain, 1937-1939.^{21,22} In the original 1930s survey, 4,999 children aged 0-19 years in 16 centres across the UK underwent physical measurements, the family completed a week long dietary account and detailed assessments of socioeconomic environment were made. In 2002, all 732 surviving study members who lived near clinics in Bristol, London, Wisbech, Aberdeen and Dundee, and had previously consented to clinical follow-up, were contacted; of these 405 (55%) agreed to take part in a detailed clinical examination, including the get up and go²³ and flamingo balance¹³ physical performance tests, when aged 63-83 years. Ethical approval was obtained from the Multicenter Research Ethics Committee for Scotland. All participants gave informed consent.

Data are also available from the Caerphilly Prospective Study (CaPS). The benefits of using two cohorts are to examine whether there is replication of results and to increase power where pooling the data is appropriate. CaPS recruited 2,512 men aged 45–59 years between 1979 and 1983 from the town of Caerphilly, South Wales and the adjacent villages (<http://www.epi.bris.ac.uk/caerphilly/caerphillyprospectivestudy.htm>).²⁴ A unique feature of the area that may have influenced the lifecourse exposures of the cohort is that Caerphilly prospered and expanded in the late 19th and early 20th century because of the success of the coal mining industry but subsequently declined from the mid-1980s with the closure of many coal mines across the UK. For the second examination (phase II 1984–1988), the original cohort was supplemented with all men of a similar age who had moved into the defined area, giving a final sample of 2,398 men. Since then the men have completed questionnaires and been examined on three further occasions: phases III (1989–1993), IV (1993–1996) and V (2002–2004). 1,196 men aged 66–86 years attended the phase V examination where the ‘get up and go’ and flamingo tests were undertaken. Ethical approval for the different phases of the study was given by the Ethics Committee of the Division of Medicine of the former South Glamorgan Area Health Authority and Gwent Research Ethics Committee.

Measurement of locomotor function

The get up and go test: is a standardised objective measure of functional leg strength, power, mobility and balance that is strongly correlated with activities of daily living and integrates a number of basic mobility manoeuvres considered necessary for successful ageing and protection from later disability.²³ The participant is observed and timed while they rise from a chair, walk 3 meters, turn, walk back and sit down. The test was performed on each participant twice and the mean value used in the analysis to minimise measurement error and give a better estimate of the true underlying walking speed.

The flamingo test: measures the ability to maintain postural stability in the upright position, a pre-requisite for locomotor mobility.¹³ Balance disturbances are associated with future disability²⁵, are a frequent cause of hospital admission²⁶ and predict mortality.²⁷ The flamingo test was performed by timing how long subjects could lift one leg, whilst the other leg remained straight (eyes open). The position was held for as long as possible, for a maximum of 30 seconds. Participants used their preferred leg to stand on. The flamingo test was performed twice, unless the maximum score of 30 seconds was achieved in the first attempt. The best score was used in the analysis. The tests were measured using the same standardised protocol in both cohorts and the researchers trained by the same investigator (RMM).

Childhood socioeconomic circumstances

In Boyd Orr, a detailed record was made of income and food expenditure for each family (both measured per head per week) at the original 1937–39 survey, as described previously.²⁸ Socioeconomic position (SEP) in childhood was determined from the occupation of the male head of the household at the time of the original survey (four categories: I/II, professional and managerial; III, skilled; IV/V, partly skilled, unskilled, other, unclassifiable; unemployed), classified according to the Registrar General’s Decennial Supplement for 1931. In CaPS, the men were asked at recruitment about their father’s occupation (social class combined into five categories: I/II, professional and managerial; III skilled non-manual; III skilled manual; IV/V, partly skilled, unskilled, other, unclassifiable; unemployed).

Education

In Boyd Orr, participants were asked their age on leaving school and whether they had any part- or full-time higher education, in a follow-up questionnaire administered in 1997-1998. In CaPS, education was recorded at phase III, as the age at leaving school and the highest achieved qualification, dichotomised into whether the participant did or did not achieve higher education.

Adult SEP

In Boyd Orr, SEP in adulthood was based on the main employment of the subject (for men and unmarried women) or spouse (women) measured in 1997-1998 and classified using the 1966 Classification of Occupations in three categories (I/II, professional and managerial; III, skilled; IV/V, partly skilled, unskilled, other, unclassifiable). In CaPS, SEP in adulthood was based on participants' present or last job at phase II (1984-1988) and classified into four categories (I/II, professional and managerial; III skilled non-manual; III skilled manual; IV/V, partly skilled, unskilled, other, unclassifiable). In CaPS information was also available on how much time the participant spent sitting, walking and lifting or carrying heavy things in their job.

SEP from childhood to adulthood

Using the occupation of each participant's father and their own SEP in adulthood we dichotomised social class into 'high' and 'low' and determined which of four lifetime social class groups the participants fell into: high SEP in both childhood and adulthood (high to high); low in childhood and high in adulthood (low to high); high in childhood and low in adulthood (high to low); and low in both childhood and adulthood (low to low). We classified 'high' SEP as the top third of participants. In Boyd Orr in childhood, this was classes I and II; in adulthood social class I. In CaPS 'high' SEP was considered to be classes I, II and III non-manual at both time points; the remaining groups were 'low' SEP.

Measures of health behaviours and status

Boyd Orr questionnaire data included general health, major diseases (cancer, stroke), the Rose angina questionnaire²⁹ and health-related behaviours (smoking, alcohol and exercise). A diagnosis of diabetes was derived from a combination of self-reported doctor diagnosis and fasting glucose measurement. Cancer prevalence at the time of the measurement of locomotor function was based on either self-reported cancer or a notification of cancer registration received from the National Health Service Central Register. Body mass index (BMI) was measured at research clinics, (weight (kg)/height (m)²) and divided into three groups (<25; 25 to <30; 30+ kg/m² (obese)).

In CaPS, a detailed medical and lifestyle history was obtained at research clinics, including major diseases (cancer, stroke, angina and diabetes) and health-related behaviours (smoking, alcohol and exercise³⁰) and BMI was obtained from measurements of height and weight.

Statistical analyses

All analyses were carried out using Stata version 11.³¹ Walking times were natural log transformed because of a skewed distribution. Linear regression models were used to investigate associations of childhood and adulthood SEP, education, health behaviours, diseases and BMI with walking time, adjusting for age, sex and clinic location. We back transformed the regression coefficients to obtain the percentage change in walk time per unit change in exposure (percentage change = $100 \times (\exp(\beta) - 1)$).³² Robust standard errors were calculated to account for clustering of siblings within families. Over a third of participants achieved the maximum balance of 30 seconds so we dichotomised the flamingo test at the

lowest 20% of performers, using a cut-point of < 5 seconds (poor balance). Logistic regression models examined associations of socioeconomic circumstances on the binary balance outcome, adjusting for age, sex and clinic location, giving the odds ratio (OR) and 95% confidence interval (95% CI) for poor balance. To assess whether it was suitable to pool the data from the two cohorts, we tested for interactions and applied a more liberal P value of $P < 0.1$ as the sample size may be too small to detect significant interactions at the conventional threshold. We treated age and age at leaving school as continuous variables, as there was no evidence of non-linear relationships (P values ranged from 0.24 to 0.69).

To test if either the accumulation or the critical period models best fit the data we adapted an approach presented by Mishra, Nitsch and colleagues.¹⁹ We compared a series of nested models (representing either the accumulation or critical period models) with a fully saturated model that assumes that each of the possible trajectories in SEP between childhood and adulthood is associated with physical function (see Appendix for further details). Large P values indicate that the goodness of fit of the nested model is as good as the saturated model and therefore that the hypothesis for the nested model of interest is supported by the data. We test for a sensitive period using the 'lincom' command in Stata,³¹ with small P values suggesting a difference between the time periods, providing support for a sensitive period model. In a sensitivity analysis we classified the flamingo test into three approximately equal sized groups (0 to 6.9; 7 to 29.9; and 30 seconds) and performed ordinal logistic regression, to see if this method of classification detected any non-linear effects. The validity of the proportional odds assumption was checked using a Brant test.³³ Performance tests often cannot be used for people who have difficulty undertaking the tests³⁴ and non-participation can be higher in subjects who are cognitively impaired, had fallen in the previous year, use a walking aid, or have impaired activities of daily living.³⁵ To address these concerns we assessed the impact of missing data in CaPS by conducting a sensitivity analyses using multiple imputations by chained equations.^{36;37} The analysis assumes any systematic difference between the missing values and the observed values can be explained by differences in observed data. We used the 'ice'³⁸ command in Stata to impute confounder and outcome missing data. Ten cycles of regression were carried out and 25 datasets imputed. In Boyd Orr, only one participant did not do the timed walk and two participants who did not attempt the balance test.

RESULTS

The characteristics of the study members are shown in Table 1.

The get up and go test

Each year of age was associated with a 1.7% slower walk time in old age in both Boyd Orr and CaPS (95% CIs: 1% to 2%; $P < 0.001$ in both cohorts) (Figure 2a). More deprived SEP in childhood was associated with a 3% (95% CIs: 1% to 5%; $P = 0.002$) slower walk time per category of worsening SEP in CaPS; the estimate in Boyd Orr was a 2% slower walk time (95% CIs: 0% to 4%; $P = 0.12$) per category of worsening SEP (Table 2). For both cohorts, increased educational attainment and duration were associated with 2-4% faster walk times per extra year at school. Slower walk times were observed for those in more deprived adult SEP categories (4-5% slower per SEP category). Smoking, the lowest exercise group and greater BMI were all associated with slower walk times. The diseases with the largest effects on walk time were history of stroke and angina.

We combined the educational exposures for Boyd Orr and CaPS (P for interaction between cohorts and age left school = 0.11 and for higher education = 0.10), in order to maximise power when adjusting for variables shown in Figure 1. For the pooled unadjusted model, each extra year at school was associated with a 2% faster walk time (95% CI -3%, -1%;

$P < 0.001$) and achieving higher education was associated with a 5% faster walk time (95% CI: -7%, -2%; $P = 0.001$). The association between education and walk speed remained the same after adjusting for health behaviours and disease status. After adjusting for adult SEP, associations were attenuated by 50%: a 1% slower walk time was observed per extra year at school (95% CI: -2%, 0%; $P = 0.032$), achieving higher education was associated with a 3% faster walk time (95% CI: -6%, 0%; $P = 0.055$).

The flamingo test

Each year of age was associated with a 14% increased odds of poor balance in Boyd Orr (OR 1.14; 95% CI 1.06, 1.21; $P < 0.001$) and a 15% increased odds of poor balance in CaPS (OR 1.15; 95% CI: 1.11, 1.19; $P < 0.001$) (Figure 2b).

Those from more deprived SEP classes, fewer school years and lower family income and food expenditure in childhood had the shortest balance times in Boyd Orr (Table 3). For CaPS, there was weak evidence that lower childhood SEP, but not fewer years at school were associated with the poor balance. Poorer adult SEP was associated with poor balance in Boyd Orr but not CaPS. We were surprised by this and speculated that Caerphilly men, who come from a mining community, might have been protected from deterioration in balance in old age because of the physical nature of their work. Stratifying the analysis by levels of occupational physical activity showed that for men with low occupational physical activity (those who spent most of their time sitting whilst at work and little of their time walking or lifting or carrying heavy things) gives a 43% increased odds of poor balance amongst the IV/V/Other category compared with social class III manual (OR 1.43; 95% CI: 0.84, 2.43). Conversely, for men with high occupational physical activity, the odds ratio of poor balance amongst the IV/V/Other category compared to social class III manual was 0.63 (95% CI: 0.28, 1.38). However, a test of statistical interaction between SEP in adulthood and work conditions on balance ability was consistent with chance variation ($P = 0.21$). Poor balance was associated with smoking in adulthood, less exercise and increased BMI (Table 3). In both cohorts, the disease with the highest odds for poor balance was diabetes.

Lifecourse models and SEP

There was no evidence that associations of lifetime SEP with walk time differed between cohorts ($P_{\text{interaction}} = 0.77$) so data were pooled. Participants who moved from low SEP in childhood to high SEP in adulthood had walking times that were 3% slower compared to people who had a high SEP in both periods (Table 4). Participants who moved from a high SEP in childhood to a low adulthood SEP had walking times that were 5% slower compared to people with high a SEP in both periods. People who had a low SEP in both childhood and adulthood had walking times that were 10% slower ($P < 0.001$). Adjusting for health behaviours and co-morbidities attenuated the associations slightly, but the association still remained ($P < 0.001$). There was evidence that the accumulation model provides the best fit to the data, as there was no difference from the saturated model ($P = 0.81$). There was no evidence of a critical period (Childhood $P < 0.001$; Adulthood $P = 0.03$) and no evidence of a difference between the two time points, rejecting the sensitive period model (please see the Appendix for a full description of the tests).

There was evidence that associations of lifetime SEP with balance ability differed between cohorts ($P = 0.04$) so balance data were not pooled. In Boyd Orr, participants who had a low SEP in childhood but high SEP in adulthood had 61% increased odds of poor balance compared to those who had high SEP in both periods (Table 4). Participants who moved from high to low SEP between childhood and adulthood had a 163% increased odds of poor balance and participants who had low SEP in both periods had a 292% increased odds of poor balance when compared to those with high SEP in both childhood and adulthood, ($P <$

0.001). There was evidence that the accumulation model provides a good fit to the data, as there was no difference from the saturated model ($P=0.61$) (see Appendix). However, there was also evidence that the critical period model in adulthood was also a good fit ($P=0.40$), but no evidence to support a critical period in childhood ($P=0.014$) or a sensitive period model. Similar graded associations were not observed in CaPS.

Sensitivity analyses

We performed ordinal logistic regression on the flamingo test outcome divided into three approximately equal sized groups (no evidence against the proportional odds assumption). The association of balance ability with social class did not differ from the logistic regression results on the binary outcome. All estimates were similar in the multiple-imputation analyses compared to the complete case analysis, indicating that non-participation in performance tests was unlikely to have biased the results.

DISCUSSION

There was a rapid reduction in walking speed and balance time with increasing age. Poor childhood socioeconomic circumstances were associated with slower walking times in old age. The association between education and walk speed remained unchanged after adjusting for health behaviours and diseases and was partly attenuated after adjusting for adult SEP. We found evidence that greater accumulation of socioeconomic disadvantage throughout the lifecourse was associated with slower walking times in old age, with participants experiencing low SEP in both childhood and adulthood having the slowest walk times. There were mixed results for the balance outcome: there was weak evidence of an association of childhood SEP with balance in CaPS but no evidence for level of education or adult SEP; conversely we found evidence that greater accumulation of socioeconomic disadvantage was associated with poor balance in Boyd Orr. There was also evidence to suggest that a critical period in adulthood could be operating for balance ability in Boyd Orr. However, our subjects were aged over 70 years on average and the timing of SEP measurements were not equally spaced. The indicator of SEP in adulthood was measured as the main occupation in Boyd Orr, which would represent more years of exposure over the lifetime than childhood SEP. Adult smokers, those with lower exercise levels and those with an increased BMI had slower walk times and poorer balance in both cohorts. The disease with the largest effect estimate on walking time was stroke, while diabetes had the biggest impact on balance time. Walking speed and balance disturbances have been shown to be associated with risk of mortality in other studies;^{27;39} our data indicate that these important measures of physical function are associated with adverse socioeconomic circumstances and are, therefore, potentially modifiable outcomes.

In other studies, gait speed and physical performance scores were lower among individuals reporting lower education level^{40;41} and the occupation of a person's father was associated with reduced physical performance at 53 years,⁴² even after adjustment for the participant's own adult social class. The latter relationship was attenuated when behavioural risk factors were included in the model but was not changed by co-morbidity. Poorer socioeconomic conditions in adulthood contributed to poorer balance and chair rise times in middle age.¹³ These results are consistent with Boyd Orr, but there are some discrepancies with the CaPS cohort for associations of adult social class with balance. Repeating the analysis excluding men with high levels of occupational physical activity provided results consistent with Boyd Orr and previous research. Functional balance was better for those whose work also placed importance on balance abilities⁴³ suggesting that performance in functional balance tests is related to the balance demands of a person's work.

The main strength of the study is the prospective data collection, from childhood in Boyd Orr and from mid-life in CaPS. The cohorts provide multiple measures of socioeconomic circumstances e.g. family income and expenditure on food in childhood, information on health behaviour risk factors, BMI and co-morbidities. The studies have objective measures of physical performance, which are known to be associated with risk of progression to disability⁶ and death⁵ in older people.

Limitations of this study include low statistical power for identifying associations in the individual cohorts and the total sample size for both studies may be too small to pick up conventionally significant interactions when pooling data. Loss to follow-up, a common problem for longitudinal studies, may have contributed to lack of power but it seems unlikely to have generated any associations observed via selection bias. We did not always observe consistent findings between Boyd Orr and CaPS. This could be for a number of reasons, including: (i) Boyd Orr contains men and women but CaPS is men only; (ii) exposures were measured differently in the different cohorts e.g. in Boyd Orr, occupational social class was based on the main employment in adulthood, in CaPS it was based on the current occupation at phase II; (iii) the timing of some variables differed e.g. in Boyd Orr, exercise information was recorded at the 2002 clinic, but in CaPS it was measured up to 20 years previously in Phase II. The larger amount of missing data in CaPS at the research clinics could have had an effect, but we were reassured by the results of the multiple imputation analyses. Reverse causality is an unlikely explanation for observed associations with childhood measures, as in Boyd Orr the measures of locomotor performance were taken 65 years after the childhood examination. However, physical impairments during life could influence employment in adulthood, making reverse causality possible for adult social class associations. Childhood social class was measured by recall in CaPS (but still with prospective ascertainment of outcomes) which could have more measurement error than adult SEP. Such measurement error could dilute associations with physical function.

We have attempted to estimate the direct effect of education on walking time, after taking account of adult socioeconomic position, health behaviours and diseases in adulthood. This analysis depends on the assumption that there are no unmeasured confounding factors on (i) education and walking time; and (ii) the intermediate variables (adult SEP, health behaviours, diseases) and walking time.⁴⁴ However, these assumptions may be violated leading to a biased estimate if there is unmeasured confounding.

The findings may not be applicable to contemporary children, if experiencing poor childhood circumstances in the 1930s differs in effects compared with deprivation experienced today. However, socioeconomic inequalities still exist for contemporary children, and socioeconomic differences persist into later life.¹⁷ The results from this study have implications for potential public health interventions aimed at modifying possible mechanisms underpinning the adverse impacts of disadvantage throughout life. This work offers some explanation for data showing widening health inequalities in later life⁴⁵ and it also suggests that in order to reduce health inequalities in the current older population, health promotion advice should target older people of lower socioeconomic status. Estimates of percentage change of lifetime SEP and walking speed may appear small, but they are clinically relevant as slower walking speed is strongly associated with cardiovascular mortality⁴⁶ e.g. people in the lowest third of walking speed had threefold increased risk of cardiovascular death. Various mechanisms could link early-life exposures and accumulating socioeconomic disadvantage with poor physical function in old age, and require further investigation. For example, growth and nutrition in early life may reduce the chances of attaining peak potential physical capacity in adulthood (e.g. via the insulin-like growth factor system), thereby affecting ability and decline in physical performance in old age.

We conclude that there is strong evidence that accumulating socioeconomic disadvantage from childhood to adulthood is associated with slower walking speed, even after taking disease risk factors and co-morbidities into account. There is mixed evidence for associations of socioeconomic disadvantage with reduced balance ability in old age.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Policy Implications

Policy makers need to consider reducing both childhood and adult social adversity to maintain a healthy older population and this may have long-term influences for future generations.

What is already known on this subject

Ageing is associated with loss of physical functions important for daily living. Gait speed, rising from a chair and balance are simple, objective measures of physical performance that predict subsequent functional disability in older people. Socioeconomic influences impact on health and have been shown to be associated with locomotor limitation in later life.

What this study adds

We found that accumulating socioeconomic disadvantage from childhood to adulthood is associated with slower walking speed in old age, after taking disease risk factors and co-morbidity into account. There is mixed evidence for the association between lifetime socioeconomic disadvantage and reduced balance ability in old age.

Figure 1.
Research model

Figure 2.

a Median and upper and lower quartiles of the get up and go test by age group and sex for the Boyd Orr and Caerphilly cohorts

b Median and upper and lower quartiles of the flamingo test by age group and sex for the Boyd Orr and Caerphilly cohorts

Table 1

Characteristics of study members

Measure	Value	Boyd Orr (n=405)	CaPS (n=1196)
		N (%); or mean (SD); or median (quartiles); or mode (range) as indicated	
Age at locomotor tests	Years, mean (SD)	70.7 (4.3)	75.3 (4.3)
Sex	Male	182 (44.9 %)	1196 (100%)
	Female	223 (55.1 %)	0 (0 %)
Get up and go test	Number completed	404 (99.8%)	1114 (93.1%)
	Seconds, median (quartiles)	9.3 (8.2, 10.8)	10.2 (8.9, 12.2)
Flamingo test	Number completed	403 (99.5%)	1123 (93.9%)
	Seconds, median (quartiles)	17.6 (6.3, 30.0)	16.4 (5.0, 30.0)
	Balance for < 5 seconds	81 (20.1%)	290 (25.8%)
Research centre for clinic	Scotland	172 (42.5 %)	-
	London and Bristol	190 (47.0 %)	-
	Wisbech	43 (10.6 %)	-
	Caerphilly - clinic	-	1053 (88%)
	Caerphilly - home visit	-	142 (12%)
Childhood social class	I/II	28 (7.0 %)	75 (8.1%)
	III NM	197 (24.3 %)	55 (5.9%)
	III M		591 (63.8%)
	IV/V/Other *	192 (48.1 %)	166 (17.9%)
	Unemployed	82 (20.6 %)	39 (4.2%)
Childhood family income [†]	< 10 s	245 (61.1 %)	-
	10 to < 15 s	96 (23.9 %)	-
	15 to < 20 s	31 (7.7 %)	-
	20 s	29 (7.2 %)	-
Childhood family food expenditure [‡]	< 5 s	179 (44.3 %)	-
	5 to < 7 s	126 (31.2 %)	-
	7 to < 9 s	60 (14.9 %)	-
	9 s	39 (9.7 %)	-
Age at leaving school	Years, mode (range)	15 (9 to 19)	14 (8 to 21)
Higher education	Yes	107 (30.7 %)	391 (32.7%)
Adult social class	I/II	134 (33.8 %)	297 (26.0%)
	III NM	183 (46.1 %)	146 (12.8%)
	III M		531 (46.5%)
	IV/V/Other *	80 (20.2 %)	167 (14.6%)
Social class from childhood to adulthood	High to high	58 (14.8 %)	69 (7.8%)
	Low to high	74 (18.9 %)	258 (29.5%)
	High to low	65 (16.6 %)	53 (6.0%)
	Low to low	195 (49.7 %)	496 (56.6%)
Smoking status [±]	Current	52 (12.9 %)	407 (35.7%)

Measure	Value	Boyd Orr (n=405)	CaPS (n=1196)
		N (%); or mean (SD); or median (quartiles); or mode (range) as indicated	
Alcohol consumption [±]	Past	180 (44.7 %)	470 (41.3%)
	Never	171 (42.4 %)	262 (23.0%)
	At least weekly	175 (47.7 %)	790 (69.2%)
	Occasionally	159 (43.3 %)	286 (25.1%)
Exercise tertiles [±]	Never	33 (9.0 %)	65 (5.7%)
	1 (Least)	130 (32.3 %)	380 (33.3%)
	2	120 (29.8 %)	380 (33.3%)
	3 (Most)	153 (38.0 %)	381 (33.4%)
Stroke	Yes	22 (5.5 %)	131 (11.9%)
Cancer	Yes	58 (14.4 %)	150 (13.6%)
Diabetes	Yes	39 (9.7 %)	158 (14.4%)
Angina	Yes	75 (18.8 %)	236 (21.7%)
Body mass index (kg/m ²) [±]	< 25	120 (29.7%)	353 (29.5%)
	25 to < 30	185 (45.8%)	622 (52.0%)
	30+	99 (24.5%)	221 (18.5%)

SD = Standard deviation

S = Shillings

The sample sizes vary because of missing data. For Boyd Orr, the variables with the least available data from the total of 405 are: higher education (n=349), age at leaving school (n=358) and alcohol consumption (n=367)

For CaPS, the variables with the least available data from the total of 1196 are: childhood social class (n=926) diabetes (n=1096) and angina (n=1090)

Data are not available to distinguish between the social classes III manual and III non-manual in Boyd Orr

* Armed forces or unclassifiable

[†] Family income and food expenditure per head per week in shillings (s)

[±] In Boyd Orr, recorded at same time as performance test (2002), in CaPS recorded at phase II (1984-1988)

Age-, sex-, and centre-adjusted estimates of percentage change in get up and go test results, in relation to childhood and adult socioeconomic position, health behaviours and diseases, derived from linear regression models

Table 2

Measure	Value	Boyd Orr					CaPS				
		Median walk time (seconds)	% Change vs. ref	95% CI	P	Median walk time (seconds)	% Change vs. ref	95% CI	P		
Childhood social class	I/II	9.6	-3%	(-13, 8)		9.8	-3%	(-8, 3)			
	III NM	9.0	Ref			9.4	-9%	(-15, -2)			
	III M					10.2	Ref				
	IV/V/Other*	9.6	3%	(-4, 9)		10.5	3%	(-2, 8)			
	Unemployed	9.1	5%	(-3, 13)		11.1	12%	(2, 22)			
Childhood family income†	Trend		2%	(0, 4)	0.12		3%	(1.5)	0.002		
	< 10 s	9.6	Ref			-					
	10 to < 15 s	9.1	-4%	(-10, 2)		-					
	15 to < 20 s	9.3	-4%	(-12, 5)		-					
	20 s	8.7	-8%	(-17, 3)		-					
Childhood family food expenditure‡	Trend		-3%	(-6, 0)	0.069						
	< 5 s	9.4	Ref			-					
	5 to < 7 s	9.2	-3%	(-9, 3)		-					
	7 to < 9 s	9.7	1%	(-8, 11)		-					
	9 s	8.9	-10%	(-18, -3)		-					
Age at leaving school	Trend		-2%	(-5, 0)	0.11						
	Years	9.3	-4%	(-6, -1)	0.003	10.2	-2%	(-3, -1)	0.002		
Higher education	No	9.7	Ref			10.4	Ref				
	Yes	9.0	-9%	(-13, -3)	0.002	9.9	-3%	(-6, 0)	0.044		
Adult social class	I/II	9.1	-6%	(-11, 0)		9.5	-9%	(-12, -6)			
	III NM	9.2	Ref			10.1	-5%	(-9, 0)			
	III M					10.4	Ref				
	IV/V/Other*	9.8	4%	(-3, 12)		10.9	2%	(-2, 7)			
Smoking	Trend		5%	(1, 9)	0.007		4%	(3, 6)	<0.001		
	Current	9.6	Ref			10.4	Ref				
	Ex-smoker	9.6	-8%	(-15, 1)		10.4	-8%	(-6, 1)			
	Never										

Measure	Value	Boyd Orr				CaPS			
		Median walk time (seconds)	% Change vs. ref	95% CI	P	Median walk time (seconds)	% Change vs. ref	95% CI	P
status [±]	Never	9.3	-8%	(-17%, -1)		10.7	-3%	(-16, +8)	
	Trend		-4%	(-8, 0)	0.030		-3%	(-5, -1)	0.001
Alcohol consumption [±]	At least weekly	9.2	Ref			10.1	Ref		
	Occasionally	9.3	1%	(-5, 7)		10.4	2%	(-2, 5)	
	Never	10.1	4%	(-6, 16)		10.7	6%	(0, 14)	
	Trend		2%	(-3, 6)	0.47		2%	(0, 5)	0.079
Exercise tertiles [±]	1 (Least)	10.3	Ref			10.8	Ref		
	2	9.4	-10%	(-16, -4)		9.9	-5%	(-9, -2)	
	3 (Most)	8.9	-16%	(-21, -11)		10.0	-5%	(-8, -1)	
	Trend		-9%	(-11, -5)	<0.001		-2%	(-4, 1)	0.010
Stroke	No	9.2	Ref			10.0	Ref		
	Yes	11.7	13%	(-2, 29)	0.085	11.5	12%	(7, 18)	<0.001
Cancer	No	9.2	Ref			10.2	Ref		
	Yes	9.7	1%	(-7, 10)	0.73	9.8	-4%	(-8, 0)	0.053
Diabetes	No	9.3	Ref			10.0	Ref		
	Yes	9.4	4%	(-5, 13)	0.46	10.9	9%	(4, 13)	<0.001
Angina	No	9.2	Ref			9.9	Ref		
	Yes	9.7	9%	(2, 17)	0.013	11.1	11%	(7, 15)	<0.001
Body mass index (kg/m ²) [±]	<25	9.0	Ref			9.9	Ref		
	25 to <30	9.0	1%	(-5, 7)		10.1	2%	(-1, 6)	
	30+	10.3	21%	(12, 29)		11.1	12%	(7, 17)	
	Trend		9%	(5, 14)	<0.001		5	(3, 7)	<0.001

CI= Confidence interval

S = Shillings

The log transformation was used on the time in seconds of the get up and go test

The reference group in each case is equivalent to 0% change; a positive % change indicates a slower walk time; a negative % change indicates a faster walk times

P values for trend are presented

Data are not available to distinguish between the social classes III manual and III non-manual in Boyd Orr

* Armed forces, unemployed or unclassifiable

⁷Family income and food expenditure per head per week in shillings (s)

[±]In Boyd Orr, recorded at same time as performance test (2002), in CaPS recorded at phase II (1984-1988)

Table 3

Age-, sex-, and centre-adjusted estimates of odds ratios of poor balance, in relation to childhood and adult socioeconomic position, health behaviours and diseases, derived from logistic regression models

Measure	Value	Boyd Orr				CaPS			
		Median balance time (seconds)	Odds ratio	95% CI	P	Median balance time (seconds)	Odds ratio	95% CI	P
Childhood social class	I/II	24.5	1.45	(0.47, 4.50)		20.9	0.74	(0.40, 1.37)	
	III NM	23.6	Ref			30.0	0.78	(0.39, 1.56)	
	III M					15.6	Ref		
	IV/V/Other*	16.4	1.73	(0.84, 3.55)		12.0	1.07	(0.70, 1.64)	
	Unemployed	17.3	2.66	(1.17, 6.05)		6.4	1.52	(0.73, 3.19)	
Childhood family income [†]	Trend		1.26	(1.01, 1.57)	0.043		1.17	(0.97, 1.41)	0.10
	< 10 s	16.4	Ref				-		
	10 to < 15 s	24.0	0.49	(0.24, 1.00)			-		
	15 to < 20 s	15.4	0.69	(0.27, 1.76)			-		
	20 s	30.0	0.66	(0.25, 1.70)			-		
	Trend		0.80	(0.60, 1.08)	0.15		-		
	< 5 s	18.8	Ref				-		
Childhood family food expenditure [‡]	5 to < 7 s	18.4	0.85	(0.45, 1.60)			-		
	7 to < 9 s	12.9	0.91	(0.43, 1.92)			-		
	9 s	30	0.43	(0.16, 1.15)			-		
	Trend		0.83	(0.64, 1.08)	0.16		-		
Age at leaving school	Years	17.7	0.77	(0.62, 0.95)	0.017	16.0	1.04	(0.93, 1.17)	0.33
Higher education	No	15.1	Ref			16.4	Ref		
	Yes	19.0	0.51	(0.27, 0.96)	0.038	15.8	1.04	(0.77, 1.40)	0.82
Adult social class	I/II	19.2	0.45	(0.24, 0.86)		16.8	0.93	(0.65, 1.33)	
	III NM	18.9	Ref			17.8	0.84	(0.52, 1.35)	
	III M					15.9	Ref		
	IV/V/Other*	19.7	1.32	(0.70, 2.48)		13.7	1.10	(0.72, 1.70)	

Measure	Value	Boyd Orr					CaPS				
		Median balance time (seconds)	Odds ratio	95% CI	P	Median balance time (seconds)	Odds ratio	95% CI	P		
Smoking status [±]	Trend		1.71	(1.20, 2.45)	0.003		1.06	(0.92, 1.22)	0.44		
	Current	13.8	Ref			14.3	Ref				
	Past	14.7	0.53	(0.24, 1.16)		15.4	0.80	(0.49, 1.09)			
	Never	23.6	0.37	(0.17, 0.83)		21.4	0.73	(0.52, 1.05)			
	Trend		0.63	(0.43, 0.93)	0.019		0.85	(0.69, 1.03)	0.10		
Alcohol consumption [±]	At least weekly	19.0	Ref			15.9	Ref				
	Occasionally	15.4	0.96	(0.54, 1.69)		16.1	0.74	(0.52, 1.05)			
	Never	21.2	1.22	(0.54, 2.73)		14.6	1.01	(0.55, 1.88)			
	Trend		1.05	(0.71, 1.56)	0.81		0.87	(0.68, 1.13)	0.31		
Exercise tertiles [±]	1 (Least)	10.5	Ref			12.5	Ref				
	2	19.3	0.34	(0.18, 0.65)		17.0	0.82	(0.57, 1.17)			
	3 (Most)	29.0	0.30	(0.16, 0.57)		18.9	0.78	(0.55, 1.12)			
	Trend		0.53	(0.37, 0.75)	<0.001		0.88	(0.74, 1.06)	0.18		
Stroke	No	18.6	Ref			18.4	Ref				
	Yes	10.0	1.07	(0.32, 3.53)	0.92	8.4	2.28	(1.47, 3.53)	<0.001		
Cancer	No	18.5	Ref			17.4	Ref				
	Yes	14.6	0.87	(0.43, 1.76)	0.70	17.1	0.68	(0.44, 1.07)	0.10		
Diabetes	No	19.1	Ref			20.0	Ref				
	Yes	7.8	3.67	(1.72, 7.81)	0.001	6.0	3.24	(2.20, 4.76)	<0.001		
Angina	No	19.3	Ref			18.4	Ref				
	Yes	11.6	1.25	(0.38, 2.38)	0.49	13.8	1.24	(0.87, 1.76)	0.23		
Body mass index (kg/m ²) [±]	< 25	22.6	Ref			22.8	Ref				
	25 to < 30	19.3	1.02	(0.55, 1.87)		15.6	1.18	(0.85, 1.65)			
	30+	11.6	2.30	(1.14, 4.65)		10.3	1.80	(1.19, 2.22)			
	Trend		1.53	(1.05, 2.23)	0.027		1.33	(1.08, 1.64)	0.008		

CI= Confidence interval

S = Shillings

The reference group in each case is an odds ratio of 1. An odds ratio >1 indicates a relative increase in odds of poor balance; an odds ratio <1 indicates a relative decrease in odds of poor balance

P values for trend are presented

Data are not available to distinguish between the social classes III manual and III non-manual in Boyd Orr

* Armed forces, unemployed or unclassifiable

[†] Family income and food expenditure per head per week in shillings

[‡] In Boyd Orr, recorded at same time as performance test (2002), in CaPS recorded at phase II (1984-1988)

Table 4
Association of social class status from childhood to adulthood with physical function in old age

Social class from childhood to adulthood	Get up and go test				Flamingo test			
	Boyd Orr and CaPS combined		Boyd Orr		CaPS			
	% Change vs. ref	95% CI	P	Odds ratio	95% CI	P	Odds ratio	P
Minimal adjusted:								
High to high	Ref. [†]			Ref. [±]			Ref. [±]	
Low to high	3%	(-2, 8)		1.61	(0.56, 4.58)		0.91	(0.48, 1.74)
High to low	5%	(-2, 12)		2.63	(0.93, 7.34)		0.52	(0.20, 1.34)
Low to low	10%	(5, 16)	<0.001	3.92	(1.66, 9.25)	<0.001	1.02	(0.56, 1.86)
Fully adjusted:								
High to high	Ref. [†]			Ref. [±]			Ref. [±]	
Low to high	2%	(-3, 7)		1.48	(0.40, 5.41)		0.76	(0.38, 1.53)
High to low	2%	(-4, 9)		2.31	(0.68, 7.86)		0.39	(0.13, 1.14)
Low to low	7%	(2, 12)	<0.001	3.56	(1.22, 10.35)	0.036	0.79	(0.41, 1.54)

CI = Confidence interval

Minimal adjusted models are adjusted for age, sex and research centre

Fully adjusted models are adjusted for age, sex, centre, health behaviours and co-morbidities

The log transformation was used on the time in seconds of the get up and go test

[†]The reference group for the get up and go test is equivalent to 0% change; a positive % change indicates a slower walk time; a negative % change indicates a faster walk times

[±]The reference group for the flamingo test is an odds ratio of 1. An odds ratio >1 indicates a relative increase in odds of poor balance; an odds ratio <1 indicates a relative decrease in odds of poor balance