Journals of Gerontology: MEDICAL SCIENCES
Cite journal as: J Gerontol A Biol Sci Med Sci 2014 July;69(7):852–859
doi:10.1093/gerona/glt189

Advance Access publication November 27, 2013

Associations of Childhood Socioeconomic Status and Adulthood Height With Functional Limitations Among Japanese Older People: Results From the JAGES 2010 Project

Takeo Fujiwara,[1] Katsunori Kondo,[2] Kokoro Shirai,[1] Kayo Suzuki,[2] and Ichiro Kawachi[3]

[1]Department of Social Medicine, National Research Institute for Child Health and Development, Setagaya-ku, Tokyo, Japan.
[2]Center for Well-being and Society, Nihon Fukushi University, Nagoya, Aichi, Japan.
[3]Department of Society, Human Development, and Health, Harvard School of Public Health, Boston, Massachusetts.

Address correspondence to Takeo Fujiwara, MD, PhD, MPH, Department of Social Medicine, National Research Institute for Child Health and Development, 2-10-1 Okura, Setagaya-ku, Tokyo 157–8535, Japan. Email: fujiwara-tk@ncchd.go.jp

Background. We examined the associations between childhood socioeconomic status and adulthood height with functional limitations in old age.

Methods. Data were obtained from the baseline survey of the Japan Gerontological Evaluation Study 2010, a population-based cohort of people aged ≥65 years enrolled from 27 municipalities across Japan (N = 15,499). People aged 65–69, 70–74, 75–79, and ≥80 years experienced the end of World War II when they were aged 0–4, 5–9, 10–14, and ≥15 years, respectively. Subjective socioeconomic status during childhood and current height were obtained by self-report through questionnaire in 2010. Higher-level functional capacity was assessed using a validated questionnaire scale. Poisson regression with robust variance estimator was employed to determine the association between childhood subjective socioeconomic status, height, and functional limitations.

Results. Lower childhood subjective socioeconomic status was consistently associated with higher prevalence rate ratio of limitations in higher-level functional capacity, regardless of age cohort. Height was associated with functional limitation only among the group aged 70–74 years: taller (≥170 cm for men and ≥160 cm for women) people were 16% less likely to report functional limitation in comparison with shorter (<155 cm for men and <145 cm for women) individuals in the fully adjusted model (prevalence rate ratio: 0.84, 95% confidence interval: 0.74–0.96).

Conclusions. Low childhood subjective socioeconomic status had a robust association with functional limitation regardless of age cohort. In addition, those who lived through World War II before they reached puberty and attained shorter height were more likely to report functional limitations in old age.

Key Words: Disability—Life-course approach—Subjective socioeconomic status—Height—Childhood environment.

Received April 2, 2013; Accepted October 20, 2013

Decision Editor: James Goodwin, PhD

DISABILITY is a long-term process that is associated with socioeconomic status (SES), health behaviors (eg, smoking or physical inactivity), and disease status (eg, stroke) (1). Social inequalities in health behaviors and disease status lead to corresponding social inequalities in disability status and functional limitations (2). Most studies have focused on risk factors for disability beginning in midlife (3–5), but increasingly studies have adopted a life-course perspective to examine the associations between childhood environment, adulthood SES, health behaviors (6), disability, and activities of daily living (ADL) (7,8).

Few studies have investigated the impact of childhood environment on limitations in higher-level functional capacity (7), such as those social activities or activities that require higher cognitive function (eg, reading a newspaper, visiting a friend's house), which are critical to the concept of "successful" aging (9). For example, the results of the Whitehall II study in the United Kingdom (10) showed that childhood SES was associated with cognitive function among midlife adults, suggesting that there is a sensitive period during childhood development during which adversity can result in limitations of higher-level functional capabilities later in life (11). Notably, the Whitehall results indicated that childhood adversity can result in deleterious effects on health in adulthood even if the individual escapes adverse socioeconomic conditions later in life—which is referred to as the latent effects model. Koyano and colleagues developed a scale to assess limitations in higher-level functional capacity among older people based on Lawton's model of competence (12), which was designed to cover instrumental self-maintenance, intellectual activities, and social roles (13). An investigation of the childhood determinants of limitations in higher-level functional capacity is critical for the development of a strategy to promote healthy and active aging (14).

Most previous studies on the life-course approach have investigated the impact of childhood SES by using paternal occupation as an indicator (6,15–19), while some studies have adopted other proxies, such as perceptions of wealth during childhood (16), housing conditions (20), or number of siblings (21), to measure early childhood social environment. Recent studies have demonstrated the utility of subjective socioeconomic status (SSS) as a predictor of health (22), although an association between childhood SSS and disability has not been reported to our knowledge. An additional proxy for childhood adversity is adulthood height, which can be thought of as a marker of cumulative social and environmental exposures during early childhood (23). Around 20% of variation in height is due to environmental variation (23), which is mainly made up of childhood nutrition, disease status, educational attainment and lower socioeconomic position (24). Previous reviews have indicated a robust link between short stature and a range of diseases (25). To the best of our knowledge, no study has investigated the associations between childhood SSS and height with limitations in higher-level functional capacity among older people.

The Japan Gerontological Evaluation Study Project is a cohort study that evaluated both childhood environment and higher-level functional capacity among community-dwelling people aged ≥65 years in Japan. Baseline surveys were administered in 2010–2011 to individuals who were free of disability as defined by the national long-term care insurance system.

Some of the participants lived through World War II, which lasted from 1937 to 1945, while they were in early childhood. People aged 65–69, 70–74, 75–79, and ≥80 years experienced the end of World War II when they were aged 0–4, 5–9, 10–14, and ≥15 years, respectively. The period during and immediately after World War II (1937–1945) in Japan was associated with food shortages, rationing, and severe restrictions in the nutritional environment (26,27). Thus, this cohort provides a unique opportunity to investigate the impact of height (as a proxy of early childhood nutritional deprivation) on subsequent limitations in higher-level functional capacity.

Methods

Study Population

The goal of the Japan Gerontological Evaluation Study 2010 Project was to evaluate the health status and social determinants of nondisabled people aged ≥65 years sampled from 27 municipalities in 10 of the 47 prefectures in Japan. The municipalities were selected throughout the major islands of Japan (Hokkaido, Honshu, Kyushu, and Okinawa), with the exception of Shikoku. Since the primary objective of the cohort is to examine the predictors of disability onset, older people who were eligible to receive public long-term care insurance benefits were excluded (ie, older people with disability registered in municipality were excluded) from the sample. In 15 municipalities, we sampled the entire population of residents older than 65 years (complete enumeration), while in the remaining 12 municipalities we mailed the surveys to a simple random sample based on the official residential registers obtained from municipal authorities.

A total of 117,494 residents aged ≥65 years at the time of the baseline survey (which took place from August 10, 2010 to May 9, 2011) were targeted for the baseline questionnaire. Of the eligible participants, 78,769 people responded to the survey (response rate: 67.0%, which is quite high for a community-based survey of this type, where response rates of 20% is the norm in many western countries). Of the returned surveys, 4,425 were rejected because of missing data (valid response rate: 63.3%). One-quarter of the sample in 25 municipalities (N = 18,194) was asked about childhood environment. We further limited the sample to respondents who gave nonmissing responses on sex and responded ≥65 years of age (N = 17,723). To focus on the association between childhood environment and limitations in higher-level functional capacity, although initially sample with disability registered in municipality were excluded, the sample was further limited to those who reported no limitations in ADL, defined as those who can walk, take a bath, and do toilet without assistance (N = 16,870). The excluded sample with ADL limitations showed similar childhood SSS with included sample (p = .37), although the height of the excluded sample was shorter in general ($p < .01$). Finally, since the study's main outcome measure is higher-level functional capacity, those who did not respond fully to the Tokyo Metropolitan Institute of Gerontology Index of Competence were excluded; this reduced the size of the analysis sample to 15,499.

Assessment of Limitations in Higher-Level Functional Capacity

Limitations in higher-level functional capacity was assessed using the Tokyo Metropolitan Institute of Gerontology Index of Competence (12), which was derived from Lawton's model of competence, comprised of 13 items (see Supplementary Appendix), designed to cover instrumental self-maintenance (5 items), intellectual activities (4 items), and social roles (4 items) for older people (13). For example, the respondents were asked, "Can you use public transportation (bus or train) by yourself?" with response items of "yes" or "no." If respondents marked "no" for any item, the respondent was classified as having some limitation in higher-level functional capacity, while respondents who marked "yes" for all items were classified as being without limitation in higher-level functional capacity. This scale is widely used in Japan to assess limitations in higher-level functional capacity among older people (28–30).

Childhood SSS and Adulthood Height

Childhood SSS was assessed retrospectively by the following question on the self-administered questionnaire: "How do you rate your social status when you were aged 15 years in comparison with standards at that time?" Responses were rated on a five-point Likert scale with the following anchors: high, middle-high, middle, middle-low, and low. Retrospectively, recalled SSS has been used in a previous study and showed similar association with health status in comparison with objective SES in childhood, although only among men (31). The participants' current height was also reported in the self-administered questionnaire. Previous studies confirmed a high correlation between self-reported and measured height among Japanese (32) and older people in Australia (33). Individuals reporting height above 3 *SD*s from the mean height (as retrieved from the 2010 Japanese National Health and Nutrition Survey (34)) were excluded because considered as potential outliers, yielding 1,617 invalid reports (10.4%). Further, height was categorized into five groups in 5-cm intervals for each sex: for men: <155, 155–159.9, 160–164.9, 165–169.9, and ≥170 cm; and for women: <145, 145–149.9, 150–154.9, 155–159.9, and ≥160 cm.

Adult SES, Health Behaviors, Disease Status, and Other Covariates

Potential mediators of the association between childhood adversity and old age functional limitations—such as adult SES, health behaviors, and disease status—were also assessed by self-administered questionnaire. Indicators of adult SES included years of schooling (<6, 6–9, 10–12, or ≥13 years) and annual household income in the year before the survey (<1.5, 1.5–2.9, 3.0–4.9, or ≥5 million yen, 1 million yen is equivalent to 10,000 dollars). Health behaviors included drinking (current, quit, or never), smoking (current, quit ≤4 years ago, quit ≥5 years ago, or never), vegetable and/or fruit intake during the past month (two servings daily or more, once daily, 4–6 times weekly, 2–3 times weekly, once weekly, less than once weekly, or never), and average walking time per day (<30, 30–59, 60–89, or 90+ min). The respondents were also asked whether they were currently under medical treatment for the following diseases with yes/no responses: cancer, heart disease, stroke, hypertension, diabetes mellitus, obesity, hyperlipidemia, osteoporosis, joint disease/neuralgia, respiratory disease, gastrointestinal disease, liver disease, psychiatric disease, visual impairment, hearing impairment, impaired excretion, sleep disorder, and other. Sex, marital status (married, widowed, divorced, never married, or other), and living status (whether or not the respondent was living alone) were also asked via questionnaire. Further, municipality dummy codes were added to adjust for municipality fixed effects.

Analysis

Poisson regression with robust variance estimator was used to examine the associations between childhood SSS and height with limitations in higher-level functional capacity, stratified by age group. We employed Poisson regression analysis with robust variance estimator because of the relatively high prevalence of limitation of higher-level functional capacity (>10%), which would result in the divergence of odds ratios from the risk ratio (35,36). Model 1 was adjusted for age and sex, model 2 additionally adjusted for adult SES, model 3 additionally adjusted for health behaviors, model 4 additionally adjusted for disease status, and model 5 (the final model) additionally adjusted for marital and living status. All analyses were performed using STATA MP version 12.

Results

The overall and age-stratified characteristics of the study sample are shown in Supplementary Table 1. Of the respondents in the total sample, 72%, 22%, and 11% were married, widowed, and living alone, respectively. Regarding childhood SSS, 44% considered that their childhood SES was low compared with the rest of society; this did not vary by age group. The distribution of participants in the five height categories was as follows: 11% (in the shortest group), 22%, 30%, 19%, and 7% (in the tallest group); 10% of respondents were missing information on height. Around half of participants completed less than 10 years of education. A further 45.2% earned less than 3 million yen in annual income (1 million yen is equivalent to 10,000 dollar). One third were current drinkers, while 10% were current smokers. The major comorbid conditions reported by participants were hypertension (39.8%), visual impairment (14.0%), diabetes mellitus (12.9%), heart disease (11.9%), joint disease or neuralgia (11.5%), and hyperlipidemia (9.3%). In terms of limitations in higher-level functional capacity, 57% of the total sample reported some disability (as did 49%, 54%, 60%, and 71% of the sampled groups aged 65–69, 70–74, 75–79, and ≥80 years, respectively).

Table 1 shows the prevalence rate ratios (PR) of limitations in higher-level functional capacity according to childhood SSS and height, stratified by age group, using Poisson regression. Overall, low childhood SSS showed a positive association with limitations in higher-level functional capacity in all age groups. For example, older people aged

Table 1. Prevalence Rate Ratio of Childhood SES and Adulthood Height for Limitation of Higher-Level Functional Capacity by Poisson Regression Analysis

			Model 1 (adjusted age, sex)		Model 2 (model 1 + adult SES)		Model 3 (model 2 + health behavior)		Model 4 (model 3 + disease)		Model 5 (model 4 + marital, living alone)	
			PR	95% CI	PR	95% CI	PR	95% CI	PR	95% CI	OR	95% CI
65–69 y	SES in childhood	High or middle-high	ref		ref		ref		ref		ref	
		Middle	**1.20**	**1.06–1.36**	**1.14**	**1.01–1.29**	**1.15**	**1.02–1.30**	**1.16**	**1.02–1.30**	**1.16**	**1.03–1.31**
		Middle-low or low	**1.39**	**1.23–1.57**	**1.26**	**1.11–1.42**	**1.27**	**1.13–1.43**	**1.28**	**1.13–1.44**	**1.28**	**1.14–1.44**
	Adulthood height category	Short	ref		ref		ref		ref		ref	
		Middle-short	1.02	0.88–1.18	1.05	0.91–1.21	1.03	0.89–1.18	1.02	0.88–1.18	1.02	0.89–1.18
		Middle	0.95	0.82–1.09	0.99	0.86–1.14	0.97	0.85–1.12	0.97	0.85–1.12	0.97	0.85–1.12
		Middle-tall	0.90	0.78–1.04	0.97	0.84–1.11	0.96	0.83–1.10	0.95	0.82–1.09	0.95	0.82–1.09
		Tall	0.97	0.83–1.13	1.04	0.89–1.21	1.03	0.88–1.20	1.03	0.88–1.20	1.03	0.89–1.20
70–74 y	SES in childhood	High or middle-high	ref		ref		ref		ref		ref	
		Middle	1.10	0.99–1.23	1.06	0.95–1.17	1.05	0.94–1.16	1.05	0.95–1.17	1.06	0.95–1.17
		Middle-low or low	**1.30**	**1.17–1.44**	**1.19**	**1.07–1.31**	**1.17**	**1.06–1.29**	**1.17**	**1.06–1.29**	**1.17**	**1.06–1.30**
	Adulthood height category	Short	ref		ref		ref		ref		ref	
		Middle-short	0.91	0.83–1.01	0.94	0.85–1.04	0.95	0.86–1.05	0.94	0.85–1.04	0.94	0.85–1.05
		Middle	**0.86**	**0.78–0.94**	**0.90**	**0.82–0.99**	**0.89**	**0.81–0.98**	**0.89**	**0.81–0.98**	**0.89**	**0.81–0.98**
		Middle-tall	**0.86**	**0.78–0.95**	0.92	0.83–1.02	0.92	0.83–1.01	0.91	0.82–1.01	0.91	0.83–1.01
		Tall	**0.78**	**0.69–0.89**	**0.85**	**0.74–0.97**	**0.84**	**0.74–0.96**	**0.84**	**0.74–0.95**	**0.84**	**0.74–0.96**
75–79 y	SES in childhood	High or middle-high	ref		ref		ref		ref		ref	
		Middle	1.11	1.00–1.24	1.06	0.95–1.18	1.06	0.95–1.17	1.05	0.95–1.17	1.05	0.95–1.17
		Middle-low or low	**1.31**	**1.18–1.46**	**1.21**	**1.09–1.34**	**1.20**	**1.08–1.33**	**1.20**	**1.08–1.33**	**1.20**	**1.08–1.32**
	Adulthood height category	Short	ref		ref		ref		ref		ref	
		Middle-short	0.99	0.90–1.08	1.02	0.93–1.11	1.01	0.92–1.10	1.02	0.93–1.11	1.02	0.93–1.11
		Middle	0.92	0.84–1.01	0.96	0.88–1.05	0.95	0.87–1.04	0.95	0.87–1.04	0.96	0.88–1.05
		Middle-tall	0.92	0.83–1.02	0.98	0.88–1.08	0.97	0.87–1.07	0.97	0.88–1.08	0.98	0.88–1.08
		Tall	0.99	0.85–1.14	1.06	0.92–1.22	1.04	0.90–1.20	1.05	0.91–1.21	1.05	0.92–1.21
80+ y	SES in childhood	High or middle-high	ref		ref		ref		ref		ref	
		Middle	1.07	1.00–1.17	1.04	0.96–1.12	1.03	0.96–1.11	1.03	0.96–1.11	1.03	0.96–1.11
		Middle-low or low	**1.18**	**1.10–1.27**	**1.12**	**1.04–1.21**	**1.11**	**1.03–1.19**	**1.10**	**1.02–1.18**	**1.10**	**1.02–1.19**
	Adulthood height category	Short	ref		ref		ref		ref		ref	
		Middle-short	0.95	0.89–1.01	0.95	0.90–1.02	0.96	0.90–1.02	0.96	0.90–1.03	0.97	0.91–1.03
		Middle	0.95	0.89–1.02	0.96	0.89–1.03	0.96	0.89–1.02	0.96	0.90–1.03	0.96	0.90–1.03
		Middle-tall	0.98	0.89–1.07	0.99	0.90–1.08	0.98	0.89–1.07	0.99	0.91–1.08	0.99	0.91–1.09
		Tall	1.06	0.93–1.20	1.07	0.94–1.21	1.07	0.94–1.21	1.07	0.94–1.21	1.07	0.94–1.21

Notes: Short, men: <155 cm, women: <145 cm; Middle-short, men: 155–159.9 cm, women: 145–149.9 cm; Middle, men: 160–164.9 cm, women: 150–154.9 cm; Middle-tall, men: 165–169.9 cm, women: 155–159.9 cm; Tall, men: 170+ cm, women: 160+ cm. CI = confidence interval; OR = odds ratio; PR = prevalence rate ratio; SES = socioeconomic status. Values in bold are significant at the $p = .05$ level.

65–69 years who considered their childhood SES as low or middle-low were 1.39 times (95% confidence interval [CI]: 1.23–1.57) more likely to report limitations in higher-level functional capacity in comparison with similarly aged people with high or middle-high childhood SES, after adjustment for age and sex. Similar PRs were observed for other age groups: for older people aged 70–74, 75–79, and ≥80 years, the PRs of limitations in higher-level functional capacity among those with low as opposed to high childhood SSS were 1.30 (95% CI: 1.17–1.44), 1.31 (95% CI: 1.18–1.46), and 1.18 (95% CI: 1.10–1.27), respectively. The significant associations remained in all age groups even after correction for mediators (adult SES, health behaviors, disease status, marital status, and living status), although the point estimates of PR were attenuated by covariance adjustment.

In contrast to childhood SSS, adulthood height was significantly inversely associated with limitations in higher-level functional capacity only among the group aged 70–74 years, that is, among those who experienced the end of World War II when they were aged 5–9 years. Model 1 indicates that in comparison with shorter older people, the PRs of limitations in higher-level functional capacity across ascending height groups were 0.91 (95% CI: 0.83–1.01), 0.86 (95% CI: 0.78–0.94), 0.86 (95% CI: 0.78–0.95), and 0.78 (95% CI: 0.69–0.89), respectively. The "dose-response" relationship was statistically significant according to the test for linear trend (p for trend $< .001$). This association persisted even after adjustment for mediators. Further, the p for linear trend between height and limitations in higher-level functional capacity remained significant in model 5 (p for trend = .008, data not shown). An association between height and functional limitations was not found in the younger age groups.

The impact of childhood SSS and adulthood height on specific type of functional limitations (ie, instrumental self-maintenance, intellectual activities, and social role limitations) was further investigated (see Supplementary Appendix). Then, we found that low childhood SSS was significantly positively associated with limitations in intellectual activities and social role limitations (see Supplementary Table 2). By contrast, limitations in instrumental self-maintenance activities were not associated with childhood SSS. A significant inverse association was observed between height and the intellectual activities subcategory of limitations in higher-level functional capacity for all age groups. Among older people aged 70–75 years, for example, the tallest group was 28% less likely to report limitations in intellectual activities compared with the shortest group (PR: 0.72, 95% CI: 0.58–0.90). The remaining subcategories (ie, instrumental self-maintenance and social role limitations) were not associated with height, except social role limitations among people aged 70–74 years.

Discussion

Using data from a large population-based study, we showed that low childhood SSS was significantly associated with limitations in higher-level functional capacity among older people without ADL limitations, especially in the domains of intellectual activities and social roles. These findings were consistent across all studied age groups (ie, 65–69, 70–74, 75–79, and ≥80 years). Furthermore, adulthood height (considered a proxy of childhood nutritional and social environment) was inversely associated with limitations in higher-level functional capacity among older people aged 70–74 years, who experienced the end of World War II when they were aged 5–9 years. The fact that these associations persisted after adjustment for SES attained in adulthood suggests the long-lasting influence of childhood adversity on functional limitations in old age.

The following pathways can possibly explain how low childhood SES and height exert long-term influences on higher-level functional activity limitations in old age: First, low childhood SES may deleteriously affect the development of health maintenance behaviors across the life course. For example, those raised in low SES circumstances may lack role models in terms of intellectual activities or social roles—or what is referred to as the accumulation of "cultural capital." For example, parents in high SES households are more likely to read newspapers and participate in a variety of social roles (37–39). This may explain why low childhood SSS was not associated with self-maintenance instrumental ADL in this study, that is, even those raised in low SES circumstances acquire habits such as the use of public transportation. Second, low childhood SES may trigger a chain of risk that includes low adulthood SES, poor health behaviors, and disease status, which are all associated with limitation in higher-level functional capacities—the so-called "pathways model" in the life-course literature. In our study, adding adult SES, health behaviors, and disease status to the statistical model attenuated the point estimates of PR for limitations in higher-level functional capacity; this suggests that low adult SES, poor health behaviors (such as inactivity), and having a disease (such as coronary heart disease) partially mediated the association between low childhood SES and the outcome.

Our findings are consistent with those of previous studies on childhood SES and disability. Using data from the U.S. Health and Retirement Study, Bowen and González reported that low childhood SES (assessed by parental education and occupation) was associated with ADL, instrumental ADL, late-life disabilities as well as social and behavioral health risks in adult life (7). Furthermore, among midlife populations, childhood SES has been directly linked with functional limitations (ie, grip strength, reaching, walking, and stair climbing) in the 1946 British National Birth Cohort Study (8) and indirectly associated with cognitive function in the UK Whitehall II study (10). Our study adds to this literature by showing that low childhood SSS was directly associated with higher levels of functional (especially, intellectual and social role) limitations.

To the best of our knowledge, this is the first study that has shown an association between height and limitations in higher-level functional capacity. Previous studies reported that short height was associated with mortality or morbidity from stroke and coronary heart disease (40,41), dementia (42), and cognitive function (43,44). Moreover, a recent study showed that height was associated with intelligence and brain gray matter volume (45). Further, the current study was conducted in a non-western setting, suggesting the generalizability of the impact of childhood environment on functional limitation in older age.

The impact of poor childhood nutritional environment on limitations in higher-level functional capacity seems to implicate the presence of a critical period in early childhood, assuming that the period during and immediately after World War II (1937–1945) was associated with the most severe restrictions in nutritional environment (26,27). An important caveat is that we lacked data on the location where participants spent their childhood, although nutrition and clean water likely varied by location. The results are interesting, as those exposed to the War conditions at ages 0–4 years showed no impact on higher functional ability; the reasons for this result are unknown. The 65- to 69-year-old cohort might have had a better environment after World War II, while people aged 70–74 years might have suffered from a poor nutritional environment even when they were aged 0–4 years during and immediately after World War II. Our findings suggest that the prepubertal period is critical for physical and cognitive development, as those who experienced World War II after the prepubertal period (ie, those aged 75–79 and ≥80 years) showed no association between height and functional limitations. The importance of the prepubertal period was also reported in a previous study, although the measured outcome was not height; that study reported that the age of achieving pubertal milestones (assessed as first nocturnal emission, voice breaking, and pubarche) was associated with cognitive functioning among older men (46).

Our study has several limitations. First, childhood SSS was assessed retrospectively because of the study's cross-sectional design; thus, the data are participant to recall bias, and current health status might have affected the assessment of childhood SSS. However, a previous study confirmed the validity of retrospective assessed of childhood SSS using sibling's recall of measures of childhood socioeconomic position (47). Second, in conjunction with the first point, childhood SES was assessed subjectively in this study, although previous studies assessed this variable in terms of parental occupation or education (7,8,10). However, we considered that SSS is a useful indicator that taps aspects of social status beyond objective measures such as educational attainment or occupation. Third, we used only relative childhood SSS, but not other aspects of childhood adversity such as parental death, divorce, or child maltreatment (48). Fourth, adulthood height was self-reported, not measured objectively; this could introduce measurement error. However, we used height as not a continuous but as a categorical variable, which minimizes misclassification. Fifth, our response rate to the survey was 67%, and it is likely that those who had activity limitations as well as those from low childhood SSS backgrounds were less likely to respond to the questionnaire; suggesting that our reported results might underestimate the true underlying associations. Sixth, the AGES cohort excluded persons with ADL limitations from the baseline study sample, which may have led to an underestimation of the impact of height on functional limitations.

In summary, our findings implicate the "long arm" of childhood socioeconomic circumstances on functional capacity at older ages. Policies that mitigate childhood adversity may yield health dividends at a distant point in the future. Conversely, policies to address the prevention of old age disability need to target not just those in midlife, but points that are further "upstream" in the life course.

Supplementary Material

Supplementary material can be found at: http://biomedgerontology.oxfordjournals.org/

Funding

This study was supported in part by Health Labour Sciences Research Grant, Comprehensive Research on Aging and Health (H25-Choju-Shitei-008) 2010-2012 from the Japanese Ministry of Health, Labour and Welfare, Grant-in-Aid for Scientific Research (KAKENHI 23243070) from the Japan Society for the Promotion of Science, and Grant-in-Aid for Scientific Research on Innovative Areas, Ministry of Education, Culture, Sports, Science and Technology KAKENHI (21119003).

Conflict of Interest

None declared.

References

1. Verbrugge LM, Jette AM. The disablement process. *Soc Sci Med*. 1994;38:1–14. doi:10.1016/0277-9536(94)90294-1
2. McGinnis JM, Foege WH. Actual causes of death in the United States. *JAMA*. 1993;270:2207–2212. http://dx.doi.org/10.1001/jama.1993.03510180077038
3. Anderson RT, James MK, Miller ME, Worley AS, Longino CF Jr. The timing of change: patterns in transitions in functional status among elderly persons. *J Gerontol B Psychol Sci Soc Sci*. 1998;53:S17–S27. http://dx.doi.org/10.1093/geronb/53B.1.S17
4. Fried LP, Guralnik JM. Disability in older adults: evidence regarding significance, etiology, and risk. *J Am Geriatr Soc*. 1997;45:92–100.
5. Marmot M, Shipley M, Brunner E, Hemingway H. Relative contribution of early life and adult socioeconomic factors to adult morbidity in the Whitehall II study. *J Epidemiol Community Health*. 2001;55:301–307. http://dx.doi.org/10.1136/jech.55.5.301
6. Nandi A, Glymour MM, Kawachi I, VanderWeele TJ. Using marginal structural models to estimate the direct effect of adverse childhood social conditions on onset of heart disease, diabetes, and stroke. *Epidemiology*. 2012;23:223–232. doi:10.1097/EDE.0b013e31824570bd00001648-201203000-00008 [pii]
7. Bowen ME, González HM. Childhood socioeconomic position and disability in later life: results of the health and retirement study. *Am J Public Health*. 2010;100(suppl 1):S197–S203. doi:AJPH.2009.160986 [pii] 10.2105/AJPH.2009.160986

8. Murray ET, Hardy R, Strand BH, Cooper R, Guralnik JM, Kuh D. Gender and life course occupational social class differences in trajectories of functional limitations in midlife: findings from the 1946 British birth cohort. *J Gerontol A Biol Sci Med Sci*. 2011;66(12):1350–1359. doi:glr139 [pii] 10.1093/gerona/glr139
9. WHO Scientific Group on the Epidemiology of Aging. *The Use of Epidemiology in the Study of the Elderly*. Geneva: World Health Organization (Technical Report Series No. 706); 1984.
10. Singh-Manoux A, Richards M, Marmot M. Socioeconomic position across the lifecourse: how does it relate to cognitive function in midlife? *Ann Epidemiol*. 2005;15:572–578. doi: glr139 [pii] 10.1093/gerona/glr139
11. Lynch J, Smith GD. A life course approach to chronic disease epidemiology. *Annu Rev Public Health*. 2005;26:1–35. http://dx.doi.org/10.1146/annurev.publhealth.26.021304.144505
12. Lawton MP. Assessing the competence of older people. In: Kent DP, Kastenbaum R, Sherwood S, eds. *Research Planning and Action for the Elderly: The Power and Potential of Social Science*. New York: Human Science Press; 1972:122–143.
13. Koyano W, Shibata H, Nakazato K, Haga H, Suyama Y. Measurement of competence: reliability and validity of the TMIG Index of Competence. *Arch Gerontol Geriatr*. 1991;13:103–116. doi:0167-4943(91)90053-S [pii]
14. World Health Organization. *Active Ageing: A Policy Framework*. Geneva: World Health Organization; 2002. http://whqlibdoc.who.int/hq/2002/who_nmh_nph_02.8.pdf.
15. Notkola V, Punsar S, Karvonen MJ, Haapakoski J. Socio-economic conditions in childhood and mortality and morbidity caused by coronary heart disease in adulthood in rural Finland. *Soc Sci Med*. 1985;21:517–523. http://dx.doi.org/10.1016/0277-9536(85)90035-8
16. Kaplan GA, Salonen JT. Socioeconomic conditions in childhood and ischaemic heart disease during middle age. *BMJ*. 1990;301:1121–1123. http://dx.doi.org/10.1136/bmj.301.6761.1121
17. Gliksman MD, Kawachi I, Hunter D, et al. Childhood socioeconomic status and risk of cardiovascular disease in middle aged US women: a prospective study. *J Epidemiol Community Health*. 1995;49:10–15. http://dx.doi.org/10.1136/jech.49.1.10
18. Davey Smith G, Egger M. Meta-analysis: unresolved issues and future developments. *BMJ*. 1998;316:221–225. http://dx.doi.org/10.1136/bmj.316.7126.221
19. Loucks EB, Lynch JW, Pilote L, et al. Life-course socioeconomic position and incidence of coronary heart disease: the Framingham Offspring Study. *Am J Epidemiol*. 2009;169:829–836. doi:kwn403 [pii] 10.1093/aje/kwn403
20. Claussen B, Davey Smith G, Thelle D. Impact of childhood and adulthood socioeconomic position on cause specific mortality: the Oslo Mortality Study. *J Epidemiol Community Health*. 2003;57:40–45.
21. Wamala SP, Lynch J, Kaplan GA. Women's exposure to early and later life socioeconomic disadvantage and coronary heart disease risk: the Stockholm Female Coronary Risk Study. *Int J Epidemiol*. 2001;30:275–284. http://dx.doi.org/10.1093/ije/30.2.275
22. Subramanyam MA, Diez-Roux AV, Hickson DA, et al. Subjective social status and psychosocial and metabolic risk factors for cardiovascular disease among African Americans in the Jackson Heart Study. *Soc Sci Med*. 2012;74:1146–1154. doi:10.1016/j.socscimed.2011.12.042S0277-9536(12)00089-5 [pii]
23. Silventoinen K. Determinants of variation in adult body height. *J Biosoc Sci*. 2003;35:263–285. http://dx.doi.org/10.1017/S0021932003002633
24. Peck MN, Lundberg O. Short stature as an effect of economic and social conditions in childhood. *Soc Sci Med*. 1995;41:733–738. http://dx.doi.org/10.1016/0277-9536(94)00379-8
25. Batty GD, Shipley MJ, Gunnell D, et al. Height, wealth, and health: an overview with new data from three longitudinal studies. *Econ Hum Biol*. 2009;7:137–152. doi:10.1016/j.ehb.2009.06.004
26. Yoshimura T, Tohya T, Onoda C, Okamura H. Poor nutrition in prepubertal Japanese children at the end of World War II suppressed bone development. *Maturitas*. 2005;52:32–34. doi:10.1016/j.maturitas.2004.12.002
27. Oiso T. Changing food patterns in Japan. *Prog Clin Biol Res*. 1981;77:527–538.
28. Wada T, Ishine M, Sakagami T, et al. Depression in Japanese community-dwelling elderly–prevalence and association with ADL and QOL. *Arch Gerontol Geriatr*. 2004;39:15–23. doi:10.1016/j.archger.2003.12.003S0167494303001493 [pii]
29. Ishizaki T, Watanabe S, Suzuki T, Shibata H, Haga H. Predictors for functional decline among nondisabled older Japanese living in a community during a 3-year follow-up. *J Am Geriatr Soc*. 2000;48:1424–1429.
30. Fujiwara Y, Shinkai S, Kumagai S, et al. Longitudinal changes in higher-level functional capacity of an older population living in a Japanese urban community. *Arch Gerontol Geriatr*. 2003;36:141–153. doi:S016749430200081X [pii]
31. Lipowicz A, Koziel S, Hulanicka B, Kowalisko A. Socioeconomic status during childhood and health status in adulthood: the Wroclaw growth study. *J Biosoc Sci*. 2007;39:481–491. doi:10.1017/S0021932006001799
32. Wada K, Tamakoshi K, Tsunekawa T, et al. Validity of self-reported height and weight in a Japanese workplace population. *Int J Obes (Lond)*. 2005;29:1093–1099. doi:10.1038/sj.ijo.0803012
33. Ng SP, Korda R, Clements M, et al. Validity of self-reported height and weight and derived body mass index in middle-aged and elderly individuals in Australia. *Aust N Z J Public Health*. 2011;35:557–563. doi:10.1111/j.1753-6405.2011.00742.x
34. Ministry of Health Labor and Welfare. *National Health and Nutrition Survey in Japan*, 2012. http://www.mhlw.go.jp/bunya/kenkou/kenkou_eiyou_chousa.html. Accessed January 9, 2013.
35. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA*. 1998;280:1690–1691. doi:jsc80400 [pii]
36. Barros AJ, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol*. 2003;3:21. doi:10.1186/1471-2288-3-21 1471-2288-3-21 [pii]
37. Abel T. Cultural capital and social inequality in health. *J Epidemiol Community Health*. 2008;62:e13. http://dx.doi.org/10.1136/jech.2007.066159
38. Bourdieu P. *Distinction: A Social Critique of the Judgement of Taste*. Oxford: Taylor & Francis Ltd; 2010.
39. Pampel FC, Krueger PM, Denney JT. Socioeconomic Disparities in Health Behaviors. *Annu Rev Sociol*. 2010;36:349–370. doi:10.1146/annurev.soc.012809.102529
40. Wannamethee SG, Shaper AG, Whincup PH, Walker M. Adult height, stroke, and coronary heart disease. *Am J Epidemiol*. 1998;148:1069–1076. http://dx.doi.org/10.1093/oxfordjournals.aje.a009584
41. Silventoinen K, Zdravkovic S, Skytthe A, et al.; GenomEUtwin Project. Association between height and coronary heart disease mortality: a prospective study of 35,000 twin pairs. *Am J Epidemiol*. 2006;163:615–621. doi:kwj081 [pii] 10.1093/aje/kwj081
42. Beeri MS, Davidson M, Silverman JM, Noy S, Schmeidler J, Goldbourt U. Relationship between body height and dementia. *Am J Geriatr Psychiatry*. 2005;13:116–123. doi:13/2/116 [pii] 10.1176/appi.ajgp.13.2.116
43. Weinstein G, Goldbourt U, Tanne D. Body height and late-life cognition among patients with atherothrombotic disease. *Alzheimer Dis Assoc Disord*. 2013;27:145–152. doi: 10.1097/WAD.0b013e31825ca9ef
44. Abbott RD, White LR, Ross GW, et al. Height as a marker of childhood development and late-life cognitive function: the Honolulu-Asia Aging Study. *Pediatrics*. 1998;102(3 Pt 1):602–609.

45. Taki Y, Hashizume H, Sassa Y, et al. Correlation among body height, intelligence, and brain gray matter volume in healthy children. *Neuroimage*. 2012;59:1023–1027. 10.1016/j.neuroimage.2011.08.092 S1053-8119(11)01025-1 [pii]
46. Heys M, Jiang C, Cheng KK, et al. Does the age of achieving pubertal landmarks predict cognition in older men? Guangzhou Biobank Cohort Study. *Ann Epidemiol*. 2010;20:948–954. doi:10.1016/j.annepidem.2010.06.011 S1047-2797(10)00161-4 [pii]
47. Ward MM. Concordance of sibling's recall of measures of childhood socioeconomic position. *BMC Med Res Methodol*. 2011;11:147. doi:10.1186/1471-2288-11-147 1471-2288-11-147 [pii]
48. Cuijpers P, Smit F, Unger F, Stikkelbroek Y, Ten Have M, de Graaf R. The disease burden of childhood adversities in adults: a population-based study. *Child Abuse Negl*. 2011;35:937–945. doi:10.1016/j.chiabu.2011.06.005