Chapter 4

Socioeconomic inequalities in a 16-year longitudinal measurement of Successful Ageing

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Abstract

Background

This study examines to what extent education, occupation, and income are associated with the multidimensional process of Successful Aging, encompassing trajectories of physical, mental, and social functioning in old age.

Methods

We employed 16-year longitudinal data from 2,095 participants aged 55-85 at baseline in the Dutch, nationally representative Longitudinal Aging Study Amsterdam. For nine indicators of Successful Aging, separate Latent Class Growth models were used to identify subgroups of older adults with a 'successful' trajectory. A 'Successful Aging Index' expressed the number of indicators for which individual respondents had a successful trajectory (range 0-9). Using multivariate regression models we investigated associations between socioeconomic position and the Successful Aging Index, and with separate indicators of Successful Aging.

Results

Higher education, occupational skill level, and income were independently associated with higher numbers of successful trajectories. Education (β=0.09) was a slightly stronger correlate of Successful Aging than income (β=0.08). Analyses of separate indicators of Successful Aging showed that cognitive functioning, functional limitations, and emotional support given were associated with all three components of socioeconomic position, while other indicators were associated with only one (e.g. life satisfaction) or none (e.g. social loneliness). For some indicators of Successful Aging, socioeconomic inequalities were not only present at baseline, but also increased or decreased during follow-up.

Conclusion

Education, occupation, and income represent distinct socioeconomic life course factors that each contribute in a specific way to inequalities in Successful Aging. Physical and cognitive functioning were associated more strongly with socioeconomic position than social and emotional functioning.

Introduction

An extensive body of research has demonstrated that higher socioeconomic position (SEP) is associated with better outcomes in specific aspects of health and functioning in old age (1–4). However, the effects of SEP on health and functioning are generally assumed to be nonspecific, simultaneously influencing multiple health outcomes within the same individuals (5–7). Few studies have examined the extent to which socioeconomic inequalities in specific aspects of functioning translate into inequalities across a broad range of indicators of health and wellbeing measured within the same study sample. The concept of successful aging (SA; 8) is particularly suited to conduct such studies, since it entails aggregate measures of physical, cognitive, and psychosocial functioning of older individuals. Research on SA aims to identify groups of older adults that maintain high levels of physical and mental functioning, and remain socially engaged (9). Because of this holistic approach, measures of SA can be used to investigate socioeconomic disparities in the overall process of aging.

While some studies have investigated the links between SEP and SA, two crucial issues remain to be addressed by empirical research. First, aging is a dynamic process, which can only be accurately measured by evaluating long-term trajectories of functioning (8,10,11). Moreover, socioeconomic inequalities in functioning may result from cumulative advantages and disadvantages that unfold throughout the course of life (12). For instance, studies on health trajectories in adulthood (6) and on specific domains of successful aging (13) show that lower SEP is linked to earlier and faster decline in physical and mental functioning over the life-course. The current study extends the literature on SA by examining to what extent SEP is associated with longitudinal trajectories of functioning across all domains of SA in older adults.

Second, it is generally understood that apart from sharing a common influence on health and well-being, education, occupation, and income are at the heart of partly distinct causal pathways that may differentially influence specific aspects of health and well-being in old age (2,14,15). For example, higher education may be directly linked to better cognitive functioning across the life span, but also indirectly to better physical health through its associations with favorable health behaviors (16). Higher occupations may be linked to better social functioning through their association with larger and more diverse social networks (17), and at the same time to reduced cognitive decline through higher complexity of activities at work (18). Low income may be linked to worse psychological functioning through financial stress (19), and may simultaneously be linked to physical disability (4) through higher (perceived) barriers to the use of health care facilities (20). Therefore, this study extends previous studies on early life determinants of SA (21–23) by including three components of SEP; education, occupation, and income. We expect that each of these components is independently associated with the composite measure of SA, and that underlying these general inequalities in SA, each component of SEP is associated with partly different indicators of functioning included in the composite measure.

The aim of this study is to investigate to what extent education, occupation, and income are associated with the multidimensional and longitudinal process of SA. Additionally, we unpack these potential associations by analyzing associations between three components of SEP and each single indicator of SA. For each indicator of SA, we also establish whether SEP is linked to observed initial levels of functioning only, or additionally to subsequent developments in functioning over time.

Methods

Data and study sample

We employed data from the Dutch nationally representative Longitudinal Aging Study Amsterdam (LASA). The aim of LASA is "to study the determinants, trajectories and consequences of physical, cognitive, emotional and social functioning in relation to ageing" (24, p.868). The baseline sample of LASA consisted of 3,107 respondents aged 55-85, with oversampling of the oldest old and men. Information on the several domains of functioning was acquired during interviews at home, by written questionnaires, and in medical interviews. Follow-up interviews were performed in 1995-1996 (*n*=2,545), 1998-1999 (*n*=2,076), 2001-2002 (*n*=1,691), 2005-2006 (*n*=1,257), and 2008-2009 (*n*=985). At each wave on average 81% of the respondents were re-interviewed, 12% had died, and 8% had withdrawn from the study for other reasons. Respondents provided informed consent and the LASA study was approved by the Medical Ethics Board of the VU University Medical Center, the Netherlands. More detailed information about the LASA study can be found elsewhere (24).

We use a Successful Aging-index (SA-index), which was developed in an earlier study (25). The SA-index was based on baseline data and five follow-up measurements, conducted until 2008-2009. We excluded respondents who did not participate in any follow-up measurement from the sample. The SA-index was only calculated for respondents who had sufficient data for at least eight indicators of SA (*n*=2,185). Furthermore, we excluded respondents with missing data for one or more socioeconomic indicators, which could not be inferred from follow-up measurements (*N*=90). The final analyses were based on data from 2,095 respondents (mean age 69.1 years, SD 8.5).

Measurements

Successful Aging-index

SA was based on nine indicators of physical, cognitive, emotional, and social functioning (Table 1). Following leading viewpoints from the SA literature, this selection of indicators covers aspects of physical health and cognitive functioning, as well as aspects of mental health and social participation. The SA-index reflects the number of indicators for which

individual respondents showed a relatively favorable 16-year development. We provide a summary description of how the SA-index was calculated. Details can be found elsewhere (25).

For each separate indicator of SA, Latent Class Growth Analysis (LCGA) in Mplus version 6.0 (26) was applied to identify subgroups of respondents with similar trajectories. Missing data on follow-up measurements was handled by the Full Information Maximum Likelihood procedure (26). Linear, quadratic, and cubic slopes were fitted to the data, to assess which of these functions fitted the data best. Because the aging process exhibits fundamental differences between men and women (27,28), the analyses were stratified for gender. The optimal number of latent classes varied from two to five among the indicators. Trajectories that were characterized by high and stable functioning, limited deterioration, or substantial recovery after low initial functioning were evaluated as 'successful' trajectories. Detailed results of the LCGA analyses can be found in Chapter 3.

For each indicator of SA, respondents were assigned a 1 (having a successful trajectory) or 0 (not having a successful trajectory), according to the class with the highest posterior probability for a respondent. The SA-index was calculated by counting the number of indicators for which respondents had a successful trajectory (range 0-9). A higher score on this index thus represents a higher number of successful aspects of functioning in any combination. Scores of respondents with missing data for one indicator of SA (*n*=126) were divided by 8 and then multiplied by 9.

Socioeconomic Position

Education was initially classified in nine categories. For descriptive analyses we recoded this to five categories: elementary not completed; elementary; lower vocational; general intermediate, intermediate vocational or general secondary; and higher vocational, college or university. For the multivariate models we used the original nine categories expressed in years of education (range 5-18).

Occupational level was assessed by asking the current and longest previous profession of the respondents. The profession was categorized into four skill levels according to the SBC92 (Standard Classification of Occupations 1992) coding scheme. These levels represent the standing of and required skills for the profession (33). Examples are cleaning staff and cashiers (elementary level), cement and concrete workers (low skilled), plumbers, electricians and clerks (medium skilled), and managers, teachers, and scientists (high or scientific). If information on the longest job was missing (*n*=50) we used the skill level of the current job. 277 respondents (12.7%) reported that they never had a paid job. We included these respondents as a fifth category. In the multivariate models, elementary skill level was used as the reference category.

Information on net monthly household income was asked in 13 categories, ranging from less than €454 to €2268 or more. In order to make individual income comparable among all

Table 1 . Description of the nine indicators of successful aging

Indicator	Measurement instrument	Item(s)	Item range	Range
Functional Limitations	6 items asking whether respondent could perform specific daily activities	Can you walk up and down a staircase of 15 steps without resting? ...use own or public transportation? ...cut your own toenails? ...dress and undress yourself? ...sit down and stand up from a chair? ...walk outside during five minutes without stopping?	1 (no) - 5 (yes, without difficulty)	6 - 30
Self-rated health	1 item	How is your health in general?	1 (poor) - 5 (excellent)	1 - 5
Cognitive functioning	20-item Mini Mental State Examination (MMSE (29))	Examples: Spell "WORLD" backwards Repeat, remember, and recall the names of three objects	Varies between assignments	0 - 30
Depressive symptoms	20-item Center for Epidemiologic Studies Depression Scale (CES-D (30))	examples: During the past week: ...I felt hopeful about the future ...my appetite was poor ...I felt sad	0 (less than 1 day) - 3 (5-7 days)	0 - 60
Satisfaction with life	1 item	Lately, how satisfied have you been with your life in general?	1 (very dissatisfied) - 5 (very satisfied)	1 - 5
Social Loneliness	5-item subscale of De Jong Gierveld Loneliness Scale (31)	There's always someone I can talk to about my day-to-day problems There are plenty of people I can lean on when I have problems There are many people I can trust completely There are enough people I feel close to I can call on my friends whenever I need them	0 (no) - 1 (more or less/yes)	0 - 5
Emotional support given to others	frequency of providing emotional support to nine most important network members, except partner (32)	How often in the past year did you talk to X about his or her personal experiences and feelings?	0 (never) - 4 (often)	0 - 36
Instrumental support given to others	frequency of providing instrumental support to nine most important network members, except partner (32)	How often in the past year did you help X with daily tasks in and around the house?	0 (never) - 4 (often)	0 - 36
Social activity	frequency of participation in several types of organizations	For example: association for the elderly, political party, church, sports club, neighborhood organization	0 (never) - 8 (daily)	0 - 30

respondents, we took the median value of each income category and multiplied this by 0.7 for respondents who indicated that their partner contributed to the monthly income (34). When baseline data was missing (*n*=232), we used income from the first subsequent measurement that was available (1995-1996: *n*=192; 1998-1999: *n*=28; 2001-2002: *n*=12).

Income values from the subsequent waves were adjusted for inflation, which was on average 2.7% per year for the 1992-2001 period (35). Sensitivity analyses indicated that substituting missing income information at baseline with follow-up information did not influence the direction and magnitude of the results, and increased precision of the regression coefficients. For descriptive analyses we divided income into quintiles. For the multivariate analyses we used the median values for each category (corrected for inflation and presence of partner income), and expressed this in hundreds of euros (range 1.59 – 24.39).

Statistical Analyses

First, we calculated gross associations of SEP with SA by regressing the SA-index (range 0-9) on one component of SEP at a time, adjusting for baseline age and sex only. Subsequently, we followed the most likely order of the acquisition of SEP across the life-course by adding occupation to education in a second model, and then adding income to both education and occupation in a third model. We assessed the magnitude of overlap in the associations between each component of SEP and SA by calculating the relative change in regression coefficients after adding each component of SEP in consecutive models. Second, we employed nine logistic regression analyses that assessed the associations between SEP and each single indicator included in the SA-index. In these models, all SEP components were simultaneously added to investigate net associations with SA. Third, in eighteen linear models we regressed individual intercept and slope values for each separate SA-indicator on SEP. These analyses aimed to assess whether socioeconomic inequalities were present in the baseline measurement and/or changed throughout follow-up.

Results

Descriptive results

On average, respondents had successful trajectories for 5.5 out of nine indicators of successful aging (Table 2). Women had 0.6 successful trajectories less than men. The oldest age group was successful in approximately two indicators less than the youngest. Means for the educational and income groups showed consistent positive gradients in the number of successful trajectories with higher education and income. Occupational skill level also showed a positive gradient with SA, but respondents who never had a paid job had on average 0.3 higher SA scores than those with elementary occupational skill level.

Table 2. Characteristics of 2,095 Older Adults, the Netherlands, 1992-2008

Variable		valid n	M(SD)/%	Mean SA (SD)	p- val.
Age in 1992	continuous	2095	69.1 (8.5)		
	55-65 years	721		6.43 (1.73)	
	65-75 years	709		5.44 (2.00)	
	75-85 years	665		4.34 (1.79)	<.001
Gender	female	1103	52.6	5.19 (2.04)	
	male	992	47.4	5.75 (1.96)	<.001
Successful Aging Index score		2095	5.5 (2.02)		
	0 successful trajectories[b)]	15	0.7		
	1	65	3.1		
	2	111	5.3		
	3	187	8.9		
	4	280	13.4		
	5	359	17.1		
	6	360	17.2		
	7	364	17.4		
	8	274	13.1		
	9 successful trajectories	80	3.8		
% with a 'successful' trajectory for[b)]:					
	Functional limitations	2092 [c)]	60.9		
	Self-rated health	2095	65.3		
	Cognitive functioning	2094	73.7		
	Depressive symptoms	2093	64.7		
	Satisfaction with Life	1998	87.6		
	Social loneliness	2095	78.4		
	Emotional support given	2095	67.4		
	Instrumental support given	2095	28.2		
	Social activity	2085	21.5		
Indicators of socioeconomic position					
Education	no. years (5-18)	2095	8.9 (3.29)		
	Elementary not completed	201	9.6	4.98 (1.99)	
	Elementary	650	31.0	4.85 (2.02)	
	Low	439	21.0	5.70 (2.04)	
	Intermediate	559	26.7	5.88 (1.88)	
	High	246	11.7	6.08 (1.84)	<.001
Occupational skill level		2095			
	Elementary	158	7.6	4.60 (2.12)	
	Low	648	30.9	5.26 (2.02)	
	Medium	725	34.6	5.83 (1.91)	
	High	298	14.2	5.91 (1.95)	
	Never had a paid job	266	12.7	4.92 (2.03)	<.001
Income [d)]	continuous (€159 – 2439)	2095	926 (452)		
	First quintile (<€ 600)	423	20.2	4.77 (2.11)	
	Second quintile (600-700)	425	20.2	4.99 (1.96)	
	Third quintile (700-900)	427	20.4	5.38 (1.98)	
	Fourth quintile (900-1250)	410	19.6	5.94 (1.90)	
	Fifth quintile (>€ 1250)	410	19.6	6.25 (1.76)	<.001

[a)] Scores for respondents with eight valid indicators (n=126) were rescaled to 0-9

[b)] Based on the highest posterior class probability

[c)] Number of respondents per indicator may vary since respondents with one or two missing indicator(s) were also included

[d)] Based on baseline information (1992). Missing values were replaced by information from subsequent measurements and corrected for inflation. Income for respondents whose partner contributed were multiplied by 0.7

Table 3. Associations between Education, Occupation, and Income and the SA-index for 2,095 Older Adults, the Netherlands, 1992-2008

	Model 1a		Model 1b		Model 1c		Model 2		Model 3	
	B		B		B		B	Beta	B	Beta
	95% CI	beta	95% C.I.	beta	95% C.I.	beta	95% C.I.	Δ [a)]	95% C.I.	Δ
Covariates										
Age (years)	-0.10	-0.41	-0.10	-0.41	-0.10	-0.40	-0.10	-0.40	-0.09	-0.39
	-0.11, -0.09		-0.11, -0.09		-0.11, -0.09		-0.11, -0.09		-0.10, -0.08	
Gender	-0.40		-0.31		-0.41		-0.29		-0.25	
(1=female)	-0.56, -0.24		-0.48, -0.13		-0.58, -0.25		-0.46, -0.12		-0.42, -0.07	
SEP components										
Education	0.09	0.14					0.07	0.12	0.06	0.09
(years)	0.06, 0.11						0.04, 0.10	-14.3%	0.02, 0.09	-35.7%
Occupational skill level (ref = elementary)										
low			0.55				0.50		0.49	
			0.24, 0.87				0.19, 0.81	-9.1%	0.18, 0.80	-10.9%
medium			0.92				0.75		0.72	
			0.60, 1.24				0.43, 1.08	-19.5%	0.39, 1.04	-21.7%
high			1.08				0.63		0.52	
			0.73, 1.44				0.23, 1.03	-41.7%	0.12, 0.92	-51.9%
never had a paid job			0.52				0.49		0.48	
			0.16, 0.87				0.14, 0.85	-5.8%	0.12, 0.83	-7.7%
Income (per 100 euro)					0.06	0.13			0.04	0.08
					0.04, 0.08				0.02, 0.06	-38.5%

[a)] Δ shows the relative change in the regression coefficient compared to Model 1

Correlations between the SEP components ranged from 0.43 (occupation and income) to 0.57 (education and occupation; correlation matrix in the supplement to this chapter). Correlations between the components of SEP and the SA-index were *r*=0.22 (education), *r*=0.19 (occupation), and *r*=0.24 (income). Correlations between the indicators of SA were low to moderate, ranging from 0.04 (cognitive functioning and satisfaction with life) to 0.34 (depressive symptoms and self-rated health).

SEP and the SA-index

We found positive gross associations (adjusted for age and sex only) between education, income, and occupational skill level and the SA-index (Table 3; models 1a-c). Never having had a job was also positively associated with SA compared to elementary skill level. Model 2 showed that, adjusting for education, age and sex, higher occupational skill level was independently associated with higher SA. In comparison with model 1a, adding occupation to the model attenuated the association between education and SA by 14.3%. Model 3 showed that, adjusted for education, occupation, age and sex, income also had an independent and positive association with SA. Adding income to the model containing education and occupation attenuated the association between education and SA by an additional 21.4%. In model 3, all components of SEP retained an independent and positive association with SA. Standardized coefficients suggested that education was a slightly stronger predictor of SA than income.

SEP and Single Indicators of Successful Aging

In order to investigate variations between SEP indicators in associations with specific aspects of aging, we examined the associations between SEP and each separate indicator of SA (Table 4). Higher education was associated with higher odds of having a successful trajectory in functional limitations, cognitive functioning, and emotional support given. Higher income was associated with higher odds of successful aging in functional limitations, self-rated health, cognitive functioning, emotional support given, and satisfaction with life.

Regarding occupation, for functional limitations and depressive symptoms only the respondents with low and medium skill levels had higher odds of successful aging compared to respondents with elementary skill level. For self-rated health there was a clear positive gradient, but, adjusting for education and income, respondents who never had a paid job had the highest odds of success compared to elementary skill level. A positive gradient with higher skill level was found for cognitive functioning, but respondents who never had a paid job did not differ from elementary occupational skill level in odds of successful aging for this indicator. For emotional support given, respondents with low occupation, and those who never had a paid job, had higher odds of success compared to those with elementary

Table 4. Associations between Education, Occupation, and Income and Nine Indicators of Successful Aging for 2,095 Older Adults, the Netherlands, 1992-2008[1)]

	Functional limitations OR (CI)	Self-Rated health OR (CI)	Cognitive function OR (CI)	Depress. symptom OR (CI)	Satisfact. with Life OR (CI)	Social loneliness OR (CI)	Emotional support OR (CI)	Instrum. support OR (CI)	Social activity OR (CI)
Education (years)	1.05	1.02	1.13	1.03	1.01	0.98	1.10	1.04	0.97
	1.00, 1.09	0.98, 1.06	1.08, 1.18	0.99, 1.07	0.96, 1.07	0.94, 1.02	1.05, 1.14	1.00, 1.09	0.93, 1.02
Occupational skill level (ref=elementary)									
Low	1.64	1.42	1.40	1.50	1.00	0.97	1.63	0.90	1.33
	1.10, 2.45	1.00, 2.02	0.93, 2.11	1.05, 2.14	0.61, 1.66	0.63, 1.47	1.13, 2.34	0.58, 1.40	0.84, 2.09
Medium	1.89	1.50	2.00	1.68	1.33	1.10	1.68	1.04	1.52
	1.24, 2.88	1.04, 2.18	1.28, 3.11	1.15, 2.45	0.77 2.28	0.70, 1.71	1.14, 2.46	0.66, 1.63	0.95, 2.44
High	1.59	1.65	1.93	1.30	0.83	1.00	1.49	0.90	1.69
	0.93, 2.71	1.02, 2.66	1.07, 3.48	0.81, 2.10	0.42, 1.64	0.58, 1.74	0.91, 2.43	0.52, 1.57	0.95, 3.02
Never had a job	1.37	1.85	0.95	1.34	1.20	1.05	1.62	1.02	1.50
	0.87, 2.15	1.23, 2.77	0.61, 1.50	0.89, 2.01	0.67, 2.14	0.65, 1.69	1.08, 2.45	0.98, 1.04	0.91, 2.49
Income (100 €)	1.04	1.03	1.07	1.02	1.04	1.01	1.03	1.01	0.99
	1.01, 1.07	1.01, 1.06	1.03, 1.11	0.99, 1.04	1.00, 1.08	0.98, 1.04	1.01, 1.06	0.98, 1.04	0.96, 1.01

[1)] All logistic regression analyses were adjusted for age and sex. Components of SEP were also mutually adjusted. Outcome is whether respondent had a 'successful' trajectory of functioning for the indicator of Successful Aging. OR = Odds Ratio; CI = 95% Confidence Interval

Table 5. Associations between three components of SEP and Individual Intercept (I) and Slope (S) Values for nine indicators of Successful Aging in 2,095 Older Adults, the Netherlands, 1992-2008 [a)]

	Functional limitations		Self-Rated health		Cognitive functioning		Depressive symptoms		Satisfaction with Life		Social loneliness		Emotional support		Instrumental support		Social activity	
	I	S[b)]	I	S	I	S	I	S	I	S	I	S	I	S	I	S	I	S
Mean intercept and linear slope[c)]	27.96	-0.38	3.66	-0.02	27.25	-0.14	7.68	0.17	4.08	-0.01	0.93	0.03	21.19	0.05	13.56	0.05	2.64	-0.04
Education (years)	0.05	0.01	0.01	-0.00	0.06*	0.01*	-0.06	-0.00	-0.00	0.00	-0.00	0.00	0.18*	-0.00	0.11*	-0.01	-0.03	0.00
Occupational skill level (ref=elementary)																		
Low	0.79*	0.03	0.11*	0.00	0.34*	0.08*	-1.2*	0.00	-0.03	0.01	0.02	0.01	1.02*	-0.00	-0.13	0.03	0.28	-0.00
Medium	0.85*	0.06	0.12*	0.00	0.50*	0.11*	-1.5*	-0.01	0.01	0.01	-0.04	0.01	1.17*	-0.00	-0.23	0.07	0.46*	-0.0*
High	0.60	0.08	0.12	0.00	0.41*	0.09*	-1.1*	-0.01	-0.02	0.01	0.07	0.00	0.87	-0.00	-0.63	0.10	0.53*	-0.01*
Never had a job	0.38	-0.03	0.16*	0.00	-0.11	-0.01	-1.1*	0.00	-0.01	0.01	0.00	0.00	0.96*	-0.00	0.17	-0.01	0.40	-0.01
Income (100 €)	0.04*	0.00	0.01*	+0.0*	0.03*	0.01*	-0.03	-0.00	0.01*	0.00	-0.00	0.00	0.06*	-0.0*	0.03	-0.00	-0.01	0.00

[a)] Reported are b-coefficients. Models were adjusted for age, sex and all SEP components. Coefficients marked with * are significant at the p<0.05-level (two-tailed)

[b)] Slope values are reflecting yearly rate of change. E.g. a coefficient of income and the cognitive functioning slope of 0.01 means that given the average decrease of 0.14 per year, with each 100 euro increase in income, cognitive functioning deteriorates by 0.01 less per year, adjusted for all other variables in the model

[c)] All slope coefficients significantly differed from zero at p<.001, except for satisfaction with life at p<.01

occupations. The relatively low OR's for high occupational skill level were only observed after adjustment for education and income.

SEP and individual intercepts and slopes for each successful aging indicator

The first two analyses indicate socioeconomic inequalities in 'successful' trajectories, as derived from the Latent Class models. Based on individual intercept and slope values, we now address the question to what extent socioeconomic inequalities in functioning were already completely established at baseline, or continued to develop during follow-up. We found that socioeconomic inequalities were largely already existent at baseline, and in a few instances increased or decreased throughout follow-up (Table 5). For cognitive functioning we found an average decline of 0.14 per year ($p<.001$). Therefore, the positive associations between education, occupational skill level and income with the slope indicate that cognitive decline was less strong with higher SEP, and an increase in inequalities over time. Decline in self-rated health was less strong with higher income. Furthermore, on average, emotional support given increased by 0.05 per year ($p<.001$). Despite initial advantages in emotional support with higher SEP, the negative association between income and the slope indicates less increase in emotional support over time with higher SEP, and thus a slight decrease in inequalities over time. For social activity, initial levels were higher with higher occupational skill level, but there was also a slightly stronger decline over time, also indicating convergence in levels of social activity over time among occupational groups.

Discussion

This study investigated whether higher SEP is associated with higher levels of Successful Aging, using a measurement of SA based on 16-year trajectories in nine indicators of physical, cognitive, emotional, and social functioning in old age. The impact of education, occupation, and income on SA partly overlapped, indicated by substantial decreases in the magnitude of the associations between each SEP component and SA after adjusting for the other indicators. Correlations and standardized regression coefficients indicated that education was most strongly associated with SA, followed by income and occupation. The relative dominance of education in functional inequalities in old age is in line with earlier research (36), and might be explained by the broad consequences of formal education for (health) behaviors, choices, social interaction, as well as its influence on occupational opportunities and income throughout the life course.

The inclusion of nine indicators of SA provided a unique opportunity to empirically test the notion that education, occupation, and income partly represent specific pathways towards inequalities in overall health and functioning in old age (14,15,36). Our main findings that each SEP component retained an independent association with the SA-index supported this

notion. Additional results further specified these findings, showing that education, occupation, and income were associated with multiple but partly different indicators of SA. Each indicator of SEP was associated with higher odds of SA in Functional Limitations, Cognitive Functioning, and Emotional Support Given. Education was uniquely associated with SA in Instrumental Support, occupational skill level was uniquely associated with SA in Depressive Symptoms, and income was uniquely associated with SA in Satisfaction with Life. Clearly, these results highlight the importance of previous calls to not use indicators of SEP interchangeably in social epidemiology (14), but to consider their specific effects on outcomes of interest in the context of one-another.

In contrast to physical and cognitive aspects of SA, we found no socioeconomic inequalities in social loneliness and social activity. For loneliness, an explanation may be that while older adults with lower SEP tend to have smaller social networks, they do not necessarily have less 'close' network members (17). As a result, the experienced discrepancy between available and desired social relationships, which implies loneliness (31), may not be associated with SEP. The absence of inequalities in social activity is largely in line with previous studies on SA that also found inequalities in social participation to be small compared to cognitive or physical functioning (23,37). In an explorative analysis, we observed that older adults with higher SEP relatively often participated in trade unions and political parties, while those with lower SEP relatively often participated in organizations for helping the elderly and neighborhood organizations. Older adults with lower SEP participate at similar rates, but in different types of organizations.

In our final analysis we found that for most indicators of SA, socioeconomic inequalities were established earlier in life, i.e. they were existent at the start of the study, and remained stable throughout old age. However, some aspects also showed increasing SEP inequalities during old age, most notably cognitive functioning. For emotional support given and social activity, we found some evidence for a decrease in inequalities over the course of old age. While it is important to note that on the basis of our analyses, we cannot draw conclusions about whether socioeconomic conditions caused initial inequalities in health and functioning or vice versa (38), these findings suggest that SEP continues to play a role in the dynamics of ageing until high ages.

Public policies in Western increasingly promote Successful Aging or related concepts such as Active Aging (39). Our results show that policies aimed at reducing socioeconomic inequalities in SA may be advised to focus on prevention of excessive declines in cognitive and physical functioning among those with lower SEP. Early-life (e.g. focused on education) as well as later-life (e.g. focused on work circumstances in low-skilled jobs) approaches have scope to create equal opportunities for SA across socioeconomic groups.

Because of the longitudinal study design, we included a relatively healthy and socioeconomically advantaged sample. Selection bias may therefore have influenced the results. However, attrition between baseline and the first follow-up measurement was mostly

due to death (74%), which is a natural process occurring in the source population as well. A comparison of mortality rates between the LASA-sample and the Dutch population found very small differences, exceeding 1% only within the age group 80-85 (40). Additionally, sophisticated methods of handling missing data on follow-up measurements were used in the computation of the SA-trajectories. Therefore, a maximum of variability in functioning over time and SEP was retained within the sample, despite mortality attrition.

A further point of discussion refers to the calculation of the SA-index. It may be argued that summing class probabilities for the successful classes rather than summing rounded probabilities ('successful' or not) would account for the uncertainty in class membership, and therefore provide more accurate regression estimates. We used the rounded probabilities because of easier interpretability of SA-index scores (number of successful trajectories) and consequently better interpretability of regression coefficients. Sensitivity analyses using the SA-index based on summed posterior probabilities showed a slightly stronger association of education, and a slightly weaker association of occupational skill level with SA, but without altering conclusions with regards to statistical significance.

This study aimed to investigate socioeconomic inequalities in individual aging. Through being multidimensional and based on trajectories of functioning in aging individuals rather than on functioning at one point in time, we are confident that using the SA-Index suited this purpose well. We were able to examine socioeconomic inequalities in multiple aspects of health and functioning within the same study sample. We demonstrated that having few socioeconomic resources entails multiple elevated risks to health and wellbeing within the same individuals. However, we also demonstrated that these risks not necessarily accumulate across all domains of functioning considered central to human aging. Psychosocial aspects of functioning seem to be remarkably robust against the disadvantages associated with low SEP.

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Supplement to Chapter 4

Correlation matrix

Based on all respondents with a valid score on the Successful Aging Index (n=2,185)

Correlations among the Successful Aging Index-score, components of SEP, and nine separate indicators included in the SA-Index (n=2,185) [a)]

		SA	Edu	Occ	Inc	Age	Sex								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Successful Aging Index-score														
2	Education in years	.22*													
3	Occupational skill level[b)]	.19*	.57*												
4	Income	.24*	.51*	.43*											
5	Age	-.43*	-.13*	-.04	-.20*										
6	Sex (1=female, 0=male)	-.14*	-.24*	-.34*	-.27*	.02									
7	SA: Functional limitations	.61*	.18*	.14*	.20*	-.44*	-.15*								
8	SA: Self-rated health	.52*	.10*	.13*	.12*	-.06*	-.11*	.32*							
9	SA: Cognitive functioning	.48*	.24*	.17*	.23*	-.39*	-.04	.30*	.04*						
10	SA: Depressive symptoms	.60*	.10*	.10*	.11*	-.16*	-.12*	.29*	.34*	.15*					
11	SA: Satisfaction with life	.41*	.04	.04	.07*	-.03	-.05*	.12*	.22*	.04	.29*				
12	SA: Social loneliness	.48*	.00	.02	.04	-.13*	-.04	.11*	.10*	.07*	.27*	.17*			
13	SA: Emotional support given	.53*	.17*	.12*	.15*	-.18*	-.02	.16*	.08*	.21*	.11*	.08*	.27*		
14	SA:Instrumental support given	.53*	.13*	.09*	.15*	-.34*	-.14*	.24*	.12*	.17*	.17*	.08*	.20*	.33*	
15	SA: Social Activity	.34*	-.02	.01	-.02	-.13*	.06*	.08*	.06*	.09*	.09*	.07*	.06*	.11*	.05*

a) * = significant at the p<.05-level (2-tailed). Variables 7-15 are dichotomous, where 1 expresses most successful latent class membership

b) respondents who never had a paid job are omitted (n=266)