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Pathways from childhood socioemotional characteristics and cognitive skills to midlife health behaviours

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ABSTRACT

Objective: This longitudinal study investigated the pathways from childhood socioemotional characteristics and cognitive skills to health behaviours in midlife. **Methods:** Participants in the Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) were followed from age 8 ($n=369$) to age 50 ($n=271$). Outcomes included physical activity, smoking, alcohol consumption and body mass index (BMI) assessed at ages 36, 42 and 50. Predictors were socioemotional characteristics (behavioural activity, negative emotionality, and well-controlled behaviour) and parents' occupational status collected at age 8, cognitive skills (school success at age 14 and the highest education at age 27) and adulthood personality traits (extraversion, neuroticism and conscientiousness). Longitudinal path modelling was used for analyses. **Results:** Well-controlled behaviour and extraversion predicted physical activity in women. Behavioural activity predicted alcohol consumption in women and smoking in men. Negative emotionality was not directly connected to health behaviours. Adulthood neuroticism was associated with smoking in men and with alcohol-related problems in both men and women. There were some indirect paths from childhood socioemotional characteristics to midlife health behaviours through cognitive skills. None of the study variables predicted midlife BMI. **Conclusions**: Childhood socioemotional characteristics have some predictive value on midlife health behaviours, both directly and through cognitive skills.

Introduction

Midlife health behaviours are important predictors of later life health and functional capacity (Artaud et al., 2016; Sabia et al., 2014). Previous research suggests that individual differences in personality are linked to various health behaviours in adulthood (e.g. Turiano et al., 2018), partly through educational attainment (Hampson et al., 2015). Even though personality and educational attainment interlink during life, these

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two factors are rarely studied together beyond childhood and in relation to adult health behaviours. Using data from the ongoing Finnish Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) (Pulkkinen, 2017), collected at several points over a 42-year period, we examined the trajectories of childhood and early adulthood socioemotional characteristics and cognitive skills to measures of health behaviours in early middle age – namely, physical activity, smoking, alcohol use and body mass index (BMI).

Individual differences in behaviour and reaction styles are already apparent in small children. We use the term *socioemotional characteristics* to refer to 'the integral role of emotions and emotion regulation in the process of socialization, involving the interaction of an individual's innate endowments and external influences' (Pulkkinen et al., 2012, p. 1283). These childhood characteristics form a basis for the development of personality traits later in life (Caspi, 2000), which are fivefold: neuroticism, extraversion, conscientiousness, openness (to experience) and agreeableness (McCrae & Costa, 2003). In this study, we focused on three childhood socioemotional characteristics, defined within a two-dimensional model of self-regulation (Pulkkinen, 2017, p. 50): behavioural activity (representing the dimension for activity *vs.* passivity) and well-controlled behaviour and negative emotionality (representing the opposite poles of the dimension for high *vs.* low self-regulation). In adulthood, their closest conceptual counterparts are extraversion, conscientiousness and neuroticism, respectively (Pulkkinen et al., 2012). These personality characteristics, particularly behavioural activity/extraversion and well-controlled behaviour/conscientiousness, have shown some continuity from childhood to adulthood (Caspi, 2000; Hampson & Goldberg, 2006; McCrae et al., 2000; Pulkkinen et al., 2012).

Children who score high in negative emotionality tend more towards aggressive or anxious reactions in new or stressful events (Pulkkinen et al., 2012). Childhood negative emotionality and related traits (e.g. neuroticism) are linked to increased BMI (Pulkki-Råback et al., 2005) and alcohol consumption in adulthood (Hampson et al., 2006; Pitkänen et al., 2008). Aggressive behaviour in childhood was found to associate with smoking and, among men, with heavier alcohol consumption in young adulthood (Pulkkinen, 1983). Childhood neuroticism seems to be unrelated to adulthood physical activity and smoking (Hampson et al., 2007), but adulthood neuroticism has been found to associate with a number of unhealthy behaviours, such as smoking (Malouff et al., 2006; Terracciano & Costa, 2004), heavy alcohol consumption (Malouff et al., 2007), inactivity (Kekäläinen et al., 2020; Sutin et al., 2016; Wilson & Dishman, 2015) and obesity (Gerlach et al., 2015; Sutin et al., 2011).

Children who score high in well-controlled behaviour tend more towards constructive or compliant behaviour in conflict situations (Pulkkinen et al., 2012). These kinds of self-discipline and impulse control can be important characteristics when developing healthy habits (Hampson et al., 2016). Childhood well-controlled behaviour and conscientiousness have been consistently linked to health-promoting behaviours in adulthood (Hampson et al., 2006, 2015, 2016; Pitkänen et al., 2008; Pluess & Bartley, 2015; Tucker et al., 1995). The association of childhood conscientiousness with adulthood health behaviours remained even when adulthood conscientiousness was taken into account (Hampson et al., 2015; Pluess & Bartley, 2015). In adulthood, conscientiousness seems to be the most important personality trait in relation to health and health

behaviours, as it has been found to consistently associate with physical activity, non-smoking, healthy BMI and responsible alcohol consumption (Bogg & Roberts, 2004; Friedman et al., 1995; Hakulinen et al., 2015; Jokela et al., 2013; Malouff et al., 2006, 2007; Terracciano & Costa, 2004; Wilson & Dishman, 2015).

While negative emotionality and neuroticism are linked to health-damaging behaviour, and the opposite is the case for well-controlled behaviour and conscientiousness, behavioural activity and extraversion may predict both health-damaging and health-promoting behaviours. Behavioural activity relates to energetic behaviour and frequent contact with others (Pulkkinen et al., 2012). Studies have consistently found a positive link between physical activity and being extraverted or energetic in childhood (Hampson et al., 2007; Kern et al., 2010; Tucker et al., 1995) as well as in adulthood (Karvonen et al., 2020; Sutin et al., 2016; Wilson & Dishman, 2015). However, the enjoyment of social situations may also increase the likelihood of using alcohol in adulthood, and both childhood behavioural activity (Pitkänen et al., 2008; Tucker et al., 1995) and adulthood extraversion (Hakulinen et al., 2015) have been associated with heavy alcohol use.

The mechanisms underlying the associations between childhood personality and adulthood health behaviours may be related to socioeconomic status (SES), particularly education. Conscientiousness especially was found to positively associate with later education (Judge et al., 1999), and the role of conscientiousness on health behaviours and health was found to be partly mediated by higher educational attainment (Hampson et al., 2015). Higher education, usually completed by early adulthood, provides wide-ranging occupational prospects as well as opportunities for increased income and wealth (Matthews & Gallo, 2011). It is also an accurate measure for individuals outside the labour force (Matthews & Gallo, 2011). Knowledge related to health can be received through education (Adler & Newman, 2002), and it can help in developing cognitive skills (i.e. decision-making) that may explain lifestyle choices (Baker et al., 2011). In general, higher education is associated with better health and health behaviours (Davies et al., 2018), such as non-smoking and a lower risk of obesity (Cheng et al., 2020; Cohen et al., 2013; Gilman et al., 2003). Previous research has found opposing associations between education and occupational physical activity (negative) and leisure-time physical activity (positive) (Beenackers et al., 2012). The relationship between education and alcohol use is more complex, as previous studies suggest that higher education is associated with more frequent alcohol consumption but less frequent binge drinking (Collins, 2016; Rosoff et al., 2021).

In addition to the associations between adulthood education and health behaviours, SES and adult health behaviours are also interlinked over the long run. Higher parental SES early in life has been associated with more frequent participation in leisure-time physical activity (Elhakeem et al., 2015; Juneau et al., 2015), and with a decreased risk of smoking (Puolakka et al., 2018; Tian et al., 2019), obesity (Tamayo et al., 2010), and alcohol-related problems (Barr et al., 2018; Pitkänen et al., 2008) in later adulthood. The relationship between parental SES and adult health behaviours seems to be partially mediated by the individual's own education (Elhakeem et al., 2015; Puolakka et al., 2018; Tian et al., 2019). For example, the individual´s school success in adolescence is a stronger predictor of lower adulthood drinking behaviour (Pitkänen et al., 2008), and the individual's own education and social class are stronger

predictors of lower midlife smoking (Cheng & Furnham, 2016) than parental SES. Moreover, parental SES has been associated with their children's personality development: in adulthood, compared with the children of less-educated parents, the children of more highly educated parents score higher in the personality traits of openness and extraversion and lower in neuroticism (Jonassaint et al., 2011; Sutin et al., 2017).

These complex relationships between childhood personality characteristics, cognitive skills, and adulthood health behaviours are rarely studied together. The purpose of this study was to examine longitudinal paths from childhood socioemotional characteristics and cognitive skills to midlife health behaviours (Figure 1). Because we aimed to study the simultaneous associations of all study variables with midlife health behaviours, we analysed paths from all childhood socioemotional characteristics, parental SES, cognitive skills and adulthood personality traits to midlife health behaviours. We assumed that child socioemotional characteristics are linked to midlife health behaviours through adulthood personality traits. We further expected that parental SES is associated with midlife health behaviours *via* one's own adolescent and adulthood academic achievements. Finally, we hypothesised that child socioemotional characteristics contribute to educational achievement, which in turn is related to health behaviours.

Methods

Participants

The data were drawn from the ongoing JYLS, which began in 1968 (Pulkkinen, 2017). Twelve complete classes of second graders ($N=369$, 196 boys and 173 girls) were randomly selected from the Jyväskylä area in Central Finland. Most of the participants were born in 1959 and were an average of 8 years old. The present analyses utilised five data collection waves, conducted at the age of 14 in 1974 (retention rate 96%), 27 in 1986 (87%), 36 in 1995 (85%), 42 in 2001 (77%) and 50 in 2009 (73%) (Pulkkinen, 2017, p. 18). Sixty percent ($n=222$) of the initial sample have participated in all six data collections from age 8 to age 50, and at least some information from childhood to adulthood is available for 95% of the participants (Metsäpelto et al., 2010; Pulkkinen, 2017, pp. 19–20).

During the data collection waves in childhood, the school authorities approved the data collection. In adulthood, the participants themselves provided the consent. At ages 8 and 14, the main data collection methods were teacher ratings and peer
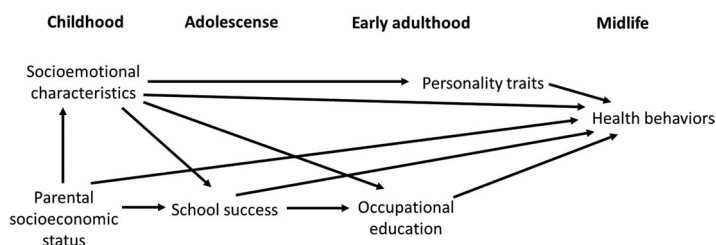

Figure 1. The study framework.

nominations. From age 27 onwards, the main data collection methods were questionnaires and personal interviews. At ages 42 and 50, medical examinations were also conducted, and the Ethical Committee of the Central Finland Health District approved the data collection. For further information on each of the data collection waves, see Pulkkinen (2017). The data and documentation related to the variables are stored in the Finnish Social Science Data Archive (FSD).

Measures

Socioemotional characteristics in childhood, behavioural activity, well-controlled behaviour, and negative emotionality (Pulkkinen et al., 2012) were assessed at age 8. The teacher rated each pupil for different items on a scale from 0 (never observed the characteristic in question in the pupil) to 3 (the characteristic in question is very prominent in the pupil) in relation to children of the same age and sex, and the mean scores for each socioemotional characteristic were computed. *Behavioural activity* was assessed by three items (e.g. 'always busy and plays eagerly with other children' and 'always silent and does not care to be busy'). *Well-controlled behaviour* was assessed by four items designed to measure constructiveness, representing actively coping with a problem ('tries to act reasonably'), positive thinking and active confrontations ('thinks that if one negotiates, everything will be better'), considering others with helpfulness and empathy ('sides with smaller and weaker peers'), and reliability ('is considered a reliable classmate'); three items measured compliance, representing suppression of negative emotions ('never quarrels with others'), regulating emotions with compensatory activities ('dislikes squabbling company and leaves it for something else') and prudence ('is peaceable and patient'); and one item measured emotional stability ('always tries to be friendly to others') (Pulkkinen, 2017, p. 24). *Negative emotionality* was assessed by eight items measuring aggressiveness (e.g. 'hurts another child when angry'); three items measured anxiety (e.g. 'cries easily'); and five items measured low self-control (e.g. 'is inattentive and lacks concentration in his or her work') (Pulkkinen et al., 2012). Cronbach's alphas (a) were 0.77 for behavioural activity, 0.91 for well-controlled behaviour and 0.8 for negative emotionality.

Personality traits in adulthood were assessed at age 33, in 1992, when the NEO Personality Inventory (Costa & McCrae, 1985) was standardised in the non-Indo-European languages. The test is an authorised adaptation of the NEO-PI, in which about one-quarter (181) of the items were substitutes for the original American items (Pulver et al., 1995). The participants were asked to rate whether they agreed with the items on a 5-point response scale, ranging from 0 = strongly disagree to 4 = strongly agree. Mean scores were calculated for all five traits, of which neuroticism (48 items, $a = 0.92$), extraversion (48 items, $a = 0.88$) and conscientiousness (18 items, $a = 0.82$) were used in this study.

Cognitive skills were estimated from school success and occupational education. *School success at age 14* was indicated by the GPA (grade point average) of all subjects evaluated by teachers on the scale from 4 = very poor to 10 = excellent, collected from school archives (Pitkänen et al., 2008). *Occupational education* was evaluated on the basis of the highest occupational educational attainment at age 27. It was categorised

as 1 = no occupational education or short courses only, 2 = vocational school, 3 = vocational college or polytechnic and 4 = university degree (Kokko et al., 2003).

Parents' occupational status when participants were 8 years old was obtained from the teachers and coded, based on the father's (or mother's, if the sole provider) occupation, as 1 = blue-collar, 2 = lower white-collar and 3 = upper white-collar (Pitkänen et al., 2005). For further analysis, two dummy coded variables were produced: medium *vs.* other (1 = lower white-collar, 0 = blue- or upper white-collar) and high *vs.* other (1 = upper white-collar and 0 = blue- or lower white-collar).

Health behaviours

Physical activity was assessed with the question 'How often do you take exercise (including incidental exercise) or pursue sports in your leisure time?' at ages 42 and 50 (Kekäläinen et al., 2019). Answers were given on a 7-point scale ranging from 1 = never to 7 = practically every day. Information about physical activity frequency at age 36 was not available.

Smoking was assessed at ages 36, 42 and 50 with the question 'Do you smoke or have you ever smoked?' Responses ranged from 0 = never to 6 = daily (Kokkonen et al., 2002). The options were recoded to never smoking (= 0), ever smoking (i.e. does not smoke now but have smoked previously) (= 1), sometimes smoking (i.e. does smoke at the moment but not daily) (= 2) and daily smoking (= 3).

Alcohol consumption was evaluated by the annual quantity of and problems related to alcohol consumption (Pulkkinen & Pitkänen, 1994; Pitkänen et al., 2008). *The annual quantity of alcohol consumption* was calculated based on a question measuring both the frequency and quantity of alcohol use: 'How much alcohol do you take at one time? If you have quit, please refer to the situation before you had quit. Circle the most appropriate frequency option on each line.' Quantity options (from 1 = one portion or less to 5 = at least 13 portions, at age 36 and to 7 = 20 or more portions at a time, at ages 42 and 50) were given on the first column, and seven possible frequency options (from 1 = not at all to 7 = 6–7 times a week) were given for each line. The annual quantity of alcohol consumption in grams was calculated by multiplying the number of portions by the frequency of drinking and summing the products from each line together. The sum was multiplied by 12 (one portion = 12 g of alcohol). Because of skewed distribution, cube root transformations of alcohol variables were used in the analyses. Problems related to alcohol consumption were assessed by the Cut down, Annoyed, Guilt and Eye-opener (CAGE) questionnaire, developed for screening alcohol-related problems (Ewing, 1984). The questionnaire includes four questions: 'Have you ever felt the need to Cut down on your drinking?' 'Have you felt Annoyed by criticism of your drinking?' 'Do you feel Guilty about your drinking?' and 'Have you ever had a drink in the morning to get rid of a hangover (an Eye-opener)?' The responses were no (= 0), sometimes (= 1) and often (= 2), and sum scores were calculated (Pitkänen et al., 2008). Cronbach´s alphas were 0.80, 0.84 and 0.82 at ages 36, 42 and 50, respectively.

BMI was calculated from weight and height with the formula weight/height^2. Weight and height were self-reported at age 36 and measured by a study nurse or doctor at ages 42 and 50 (Kinnunen et al., 2012).

Attrition analysis and representativeness of the sample

The retention rates remained high in midlife data collections (85% at age 36, 77% at 42 and 73% at 50). The participants did not participate in every data collection method (i.e. life situation questionnaire, personal interview and health examination), but almost all (99.6–100%) who participated returned the life situation questionnaire in midlife, which included information about health behaviours.

The demographic characteristics of the sample studied at ages 36, 42 and 50 were comparable to those of the respective Finnish cohort born in 1959 regarding, for example, marital status, family type, number of children and employment (Metsäpelto et al., 2010; Pulkkinen, 2017). Participants who participated in personality measures at age 33 and in general at age 50 did not differ from non-participants in childhood socioemotional characteristics, school success, or parental SES (Kinnunen et al., 2012; Pulkkinen, 2017, pp. 19–21). However, participants who were heavy alcohol users at age 42 were less likely than the other participants to participate in the study at age 50 (Pulkkinen, 2017, pp. 19–21), and participants in health examinations at ages 42 and 50 had more well-controlled behaviour at age 8 than non-participants (Kinnunen et al., 2012).

Statistical analysis

For descriptive purposes, bivariate correlations, frequencies, percentages, means and standard deviations of all variables were computed with SPSS Statistics software version 24.0 (IBM Corporation, 2016; Armonk, NY). Path modelling was used to analyse associations between variables. The hypothesised life-course pathways between childhood socioemotional characteristics, parental SES, cognitive skills, adulthood personality traits and health behaviours in midlife (depicted in Figure 1) were tested using likelihood ratio and Wald tests in the Mplus statistical modelling program version 7.3 (Los Angeles, CF) (Muthén & Muthén, 2017), with the maximum likelihood (ML) estimator adapted for data missing at random (MAR). Because the focus was on relationships between personality characteristics and midlife health behaviours and not changes in health behaviours during midlife, averaged scores of health behaviours (physical activity, smoking, alcohol consumption and BMI) were calculated for path models. The p values were not adjusted for multiple testing. The fit of the model was evaluated using likelihood ratio test statistics: the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). The model fit was considered adequate if the following thresholds were met: $p > .05$, CFI ≥ 0.95 and RMSEA ≤ 0.06.

It has been previously shown, from both the present JYLS dataset and the findings of other studies, that women and men have different associations between childhood characteristics and adulthood health behaviours (Hampson et al., 2006; Pitkänen et al., 2008). Therefore, the two-group approach was used to analyse sex differences. A model with the associations shown in Figure 1 set free was compared to models where regression paths, means, variances, and covariances were set to be equal for men and women.

Results

Descriptive results

Descriptive statistics for study variables are presented in Table 1, and frequencies for ordinal variables (education, smoking and physical activity) are presented in the Supplementary material (Table S1). Some of the descriptive results and sex differences have been previously reported, but the sample compositions were somewhat different. At age 8, girls scored higher than boys in well-controlled behaviour, and boys scored higher in negative emotionality (cf. Pulkkinen et al., 2012). Girls had better school success than boys at age 14, and women had more education than men at age 27 (cf. Kokko et al., 2003). Women scored higher on neuroticism at age 33 (cf. Kokko et al., 2013). Men had higher BMI (cf. Kinnunen et al., 2012), increased alcohol consumption, more alcohol-related problems (cf. Pitkänen et al., 2008), and were more likely to be smokers at ages 36, 42 and 50. Women were more physically active at ages 42 and 50 (cf. Karvonen et al., 2020). The correlations between study variables are shown in the Supplementary material 1 (Tables S2 and S3) and detailed descriptive statistics in Supplementary material 2.

Longitudinal path model

Two-group modelling showed that, when all path coefficients were constrained equally for men and women, model fit was not statistically significantly worse when compared to the fit of a model with path coefficients estimated freely for the sexes (χ^2(70) = 82.09, p = .153), indicating that regression paths did not differ between the sexes. However, model fit was statistically significantly worse when equality constraints were also placed on means (χ^2(83) = 227.73, p < .001), variances (χ^2(83) = 132.99, p < .001), covariances (χ^2(89) = 126.92, p = .005) or all of these together (χ^2(115) = 317.56, p < .001). The results are shown from the two-group model in which all parameters were estimated separately for men and women. This model had adequate fit (likelihood ratio test: χ^2(30) = 39.38, p = .117, RMSEA = 0.041 and CFI = 0.989). The standardised direct and total indirect associations with health behaviours in midlife are presented for women in Table 2 and men in Table 3. The same model is presented in Figure 2 as a summarised version with only statistically significant paths. The output for path model is shown in Supplementary material 2.

Several direct associations were found. In women, well-controlled behaviour in childhood was positively associated with physical activity in midlife (β=0.33, p <.001). Increased behavioural activity in childhood predicted increased alcohol consumption in women (β=0.17, p = .042) and smoking in men (β=0.19, p = .007). Of adulthood personality traits, higher extraversion predicted increased physical activity in women (β=0.19, p =.039) and increased alcohol consumption in men (β=0.22, p = .017). In addition, higher neuroticism predicted increased smoking in men (β=0.23, p = .007) and alcohol-related problems in men (β=0.46, p < .001) and women (β=0.21, p = .032). Lower school success in adolescence predicted increased smoking in men (β = −0.34, p < .001) and women (β = −0.37, p < .001). Lower education predicted increased alcohol consumption in men (β = −0.29, p = .003). None of the variables predicted physical activity in men or BMI in men and women.

Table 1. Descriptive statistics for study variables.

	All	Women			Men			Difference
	n	n	M	SD	n	M	SD	$t(df)$, p | $\chi^2(df)$, p^{a}
Age 8								
Behavioural activity	369	173	2.05	0.75	196	2.12	0.67	−0.99 (367), .324
Well-controlled behaviour	369	173	1.54	0.66	196	1.27	0.75	3.64 (367), <.001
Negative emotionality	369	173	0.43	0.37	196	0.70	0.50	−5.80 (367), <.001
Parental SES, n/%	369	173			196			2.88 (3), .237
Low			127	73.41		136	69.39	
Middle			31	17.92		48	24.49	
High			15	8.67		12	6.12	
Age 14								
School success	346	162	7.59	0.82	184	6.90	0.76	0.81 (344), <.001
Age 27								
Education [1–4]	347	164	2.33	1.03	183	2.04	0.93	2.69 (331), .007
Age 33								
Neuroticism	249	126	1.81	0.49	123	1.70	0.48	1.80 (246), .037
Extraversion	249	126	2.28	0.37	123	2.24	0.44	1.19 (246), .236
Conscientiousness	249	126	2.58	0.50	123	2.53	0.51	1.29 (246), .198
Age 36								
Smoking [0–3]	307	148	1.11	1.14	159	1.48	1.25	−2.71 (305), .007
Alcohol consumption, kg/y	305	149	2.15	3.30	156	5.60	7.26	−5.30 (303), <.001
Alcohol-related problems [0–8]	307	148	0.98	1.41	159	2.05	2.00	−5.45 (285), <.001
BMI	279	133	23.23	3.45	146	25.79	3.32	−6.31 (277), <.001
Age 42								
Physical activity [1–7]	277	131	5.15	1.39	146	4.60	1.56	3.08 (275), .002
Smoking [0–3]	284	133	1.15	1.14	151	1.63	1.24	−3.45 (282), .001
Alcohol consumption, kg/y	279	132	2.65	6.32	147	6.87	8.63	−6.61 (277), <.001
Alcohol-related problems [0–8]	275	129	1.27	1.76	146	2.42	2.18	−4.75 (271), <.001
BMI, kg/m^2	241	120	25.20	4.78	121	26.93	4.31	−2.97 (239), .003
Age 50								
Physical activity [1–7]	261	123	5.58	1.40	138	4.86	1.61	3.81 (259), <.001
Smoking [0–3]	265	125	0.86	1.09	140	1.23	1.23	−2.56 (263), .012
Alcohol consumption, kg/y	252	121	3.06	6.10	131	10.01	16.92	−4.61 (277), <.001
Alcohol-related problems [0–8]	261	124	1.10	1.49	137	2.28	2.20	−5.02 (259), <.001
BMI, kg/m^2	227	115	26.80	5.26	112	28.12	4.14	−2.10 (225), .037

Note. [a]Differences between men and women were analysed by independent samples t test or χ^2 difference test (parental SES).
SES: socioeconomic status; BMI: body mass index

There were also some statistically significant indirect associations. In women, childhood behavioural activity had statistically significant negative total indirect associations with smoking ($\beta = -0.08$, $p = .033$) and alcohol problems ($\beta = -0.06$, $p = .044$), but none of the specific indirect associations were statistically significant. In men, increased well-controlled behaviour was indirectly associated with decreased smoking ($\beta = -0.12$, $p = .003$), and this indirect association went through higher school success ($\beta = -0.11$, $p = .005$). In addition, even though the total indirect association between parental SES (high *vs.* other) was not statistically significant, higher parental SES in childhood had an indirect association with lower smoking through school success ($\beta = -0.08$, $p = .008$). Higher parental SES (high *vs.* other: $\beta = -0.12$, $p = .005$ and medium *vs.* other: $\beta = -0.07$, $p = .029$) and higher school success ($\beta = -0.12$, $p = .007$) had statistically significant total indirect associations with lower alcohol consumption. These total indirect associations were explained mainly by the specific indirect associations through education: $\beta = -0.10$, $p = .009$ for high parental SES *vs.* other, $\beta = -0.06$, $p = .021$ for medium parental SES *vs.* other and $\beta = -0.12$, $p = .007$ for school success. For high parental SES *vs.* other, the indirect path through school

Table 2. Standardised direct and total indirect effects on midlife health behaviours in women ($n = 173$).

	Physical activity			Smoking			Alcohol, g/y			Alcohol-related problems			BMI		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Direct effects															
8: Behavioural activity	−0.09	0.09	.313	0.08	0.08	.305	0.17	0.08	.042	0.07	0.08	.364	0.09	0.09	.315
8: Well-controlled behaviour	0.33	.08	<.001	−0.05	0.08	.557	−0.08	0.09	.346	−0.09	0.08	.243	0.07	0.09	.453
8: Negative emotionality	0.11	0.09	.208	0.09	0.08	.251	−0.05	0.09	.593	−0.01	0.08	.897	0.04	0.09	.646
8: Parental SES, medium vs. other	−0.06	0.09	.491	0.00	0.08	.956	0.01	0.08	.888	−0.13	0.08	.104	−0.02	0.09	.746
8: Parental SES, high vs. other	0.03	0.09	.745	−0.06	0.08	.433	−0.12	0.08	.161	−0.10	0.08	.234	0.01	0.09	.928
14: School success	−0.09	0.12	.462	−0.37	0.10	<.001	−0.07	0.11	.514	−0.19	0.11	.071	−0.15	0.11	.180
27: Education	0.17	0.12	.160	−0.10	0.10	.330	−0.08	0.11	.457	−0.06	0.11	.583	−0.08	0.12	.491
33: Extraversion	0.19	0.09	.039	0.00	0.08	.971	−0.13	0.10	.178	−0.16	0.09	.072	−0.00	0.10	.900
33: Neuroticism	0.16	0.11	.113	0.15	0.09	.087	0.02	0.10	.856	0.21	0.10	.032	0.13	0.11	.225
33: Conscientiousness	0.16	0.10	.111	−0.09	0.09	.299	−0.18	0.10	.068	−0.17	0.09	.068	−0.01	0.10	.937
Total indirect effects															
8: Behavioural activity	0.04	0.03	.213	−0.08	0.04	.033	−0.04	0.03	.107	−0.06	0.03	.044	−0.04	0.03	.108
8: Well-controlled behaviour	−0.02	0.03	.412	−0.06	0.04	.127	−0.00	0.03	.940	−0.02	0.03	.455	−0.03	0.03	.286
8: Negative emotionality	−0.01	0.02	.742	0.06	0.04	.101	0.02	0.02	.224	0.04	0.03	.143	0.04	0.03	.139
8: Parental SES, medium vs. other	0.01	0.04	.894	−0.04	0.04	.353	0.02	0.03	.541	−0.01	0.03	.714	−0.01	0.03	.716
8: Parental SES, high vs. other	0.03	0.05	.507	−0.08	0.05	.113	−0.01	0.04	.875	−0.03	0.04	.399	−0.04	0.04	.376
14: School success	0.10	0.07	.165	−0.06	0.06	.332	−0.05	0.06	.459	−0.03	0.06	.584	−0.05	0.07	.492

Note. SES: socioeconomic status; BMI: body mass index

success and education was also statistically significant ($\beta = -0.03$, $p = .032$). High parental SES had also a statistically significant total indirect association with decreased alcohol problems, but none of the specific indirect associations were statistically significant.

Discussion

The purpose of this longitudinal study was to investigate the pathways of socioemotional characteristics and cognitive skills from childhood through early adulthood to health behaviours in early middle age. The main results were that these pathways were interrelated. In addition, family background contributed to the cognitive skills pathways. For *socioemotional characteristics*, it was found that, in women, *well-controlled behaviour*, which represents increased self-regulation in childhood, predicted physical activity in middle age. The direct association was statistically significant, and the path through its early adulthood conceptual counterpart, conscientiousness, was not statistically significant. The corresponding path was not significant in men, but in men, increased well-controlled behaviour indirectly predicted decreased smoking through increased cognitive skills. *Negative emotionality*, which represents decreased self-regulation in childhood, correlated negatively with well-controlled behaviour in childhood, and it had no additional statistically significant contribution to health behaviours in women or men. Its conceptual counterpart, adult neuroticism, predicted alcohol-related problems in men and women and also smoking in men. Within the

Table 3. Standardised direct and total indirect effects on midlife health behaviours in men (*n* = 196).

	Physical activity			Smoking			Alcohol, g/y			Alcohol-related problems			BMI		
	B	SE	*p*	*B*	SE	*p*	*B*	SE	*p*	*B*	SE	*p*	*B*	SE	*p*
Direct effects															
8: Behavioural activity	−0.01	0.08	.879	0.19	0.07	.007	0.02	0.08	.823	0.01	0.07	.908	−0.07	0.08	.354
8: Well-controlled behaviour	−0.16	0.10	.122	0.15	0.09	.085	0.07	0.10	.478	0.07	0.09	.447	−0.07	0.10	.470
8: Negative emotionality	−0.10	0.10	.307	0.04	0.09	.667	−0.02	0.09	.816	0.06	0.09	.456	.01	0.10	.940
8: Parental SES, medium *vs.* other	−0.03	0.08	.737	−0.04	0.07	.577	0.05	0.08	.490	0.02	0.07	.771	−0.07	0.08	.378
8: Parental SES, high *vs.* other	−0.04	0.10	.667	0.11	0.08	.134	0.13	0.08	.107	0.01	0.08	.872	−0.14	0.09	.125
14: School success	0.15	0.10	.125	−0.34	0.09	<.001	0.01	0.09	.882	−0.06	0.09	.509	.02	0.10	.869
27: Education	−0.01	0.11	.946	0.00	0.09	.980	−0.29	0.10	.003	−0.14	0.09	.124	−0.09	0.10	.353
33: Extraversion	0.01	0.10	.906	−0.01	0.09	.885	0.22	0.09	.017	0.14	0.08	.085	.08	0.10	.434
33: Neuroticism	−0.02	0.10	.820	0.23	0.09	.007	0.13	0.09	.156	0.46	0.07	<.001	.06	0.10	.535
33: Conscientiousness	0.03	0.10	.770	−0.16	0.09	.088	−0.00	0.10	.979	−0.10	0.08	.235	−0.11	0.10	.265
Total indirect effects															
8: Behavioural activity	0.01	0.03	.703	−0.02	0.03	.510	0.03	0.04	.468	0.02	0.03	.549	.01	0.03	.694
8: Well-controlled behaviour	0.05	0.03	.111	−0.12	0.04	.003	−0.04	0.04	.312	−0.04	0.03	.166	−0.01	0.03	.701
8: Negative emotionality	−0.02	0.02	.401	0.07	0.04	.066	9.04	0.03	.204	0.08	0.04	.055	.01	0.02	.459
8: Parental SES, medium *vs.* other	0.02	0.03	.487	−0.02	0.04	.550	−0.07	0.03	.029	−0.06	0.03	.054	−0.04	0.03	.214
8: Parental SES, high *vs.* other	0.05	0.04	.274	−0.08	0.05	.092	−0.12	0.04	.005	−0.08	0.04	.036	−0.04	0.04	.373
14: School success	−0.00	0.05	.947	−0.00	0.04	.980	−0.12	0.05	.007	−0.06	0.04	.138	−0.04	0.04	.359

Note. SES: socioeconomic status; BMI: body mass index

two-dimensional framework of socioemotional behaviour, *behavioural activity* in childhood was assessed with a scale score indicating propensity of activity, excluding the following qualitatively described types of activity: well-controlled activity (constructiveness) and low-controlled activity (aggression) (Pulkkinen, 2017). In women, increased behavioural activity directly predicted increased alcohol consumption. In men, behavioural activity predicted smoking directly and its conceptual counterpart, adult extraversion and predicted alcohol consumption. Higher parental SES was associated with decreased alcohol consumption and smoking through the cognitive skills pathway in men. School success was also associated with decreased smoking in men and women.

Regarding the different aspects of health behaviours, the results suggest, first, that childhood well-controlled behaviour and adulthood extraversion predicted midlife *physical activity* in women. This is in line with findings concerning adult dysregulation, suggesting that childhood conscientiousness plays a role in lifespan health behaviours (Hampson et al., 2015) and suggesting a positive association between extraversion and physical activity in middle-aged women (Karvonen et al., 2020; Kekäläinen et al., 2019). It is possible that calm and constructive behaviour in childhood develops into self-discipline and impulse control in adulthood, which are important in turning exercise intentions into actual behaviour. People scoring high in extraversion may seek situations where they can be active (Wilson & Dishman, 2015). However, it was surprising that, unlike in previous research (e.g. Wilson & Dishman, 2015), neither
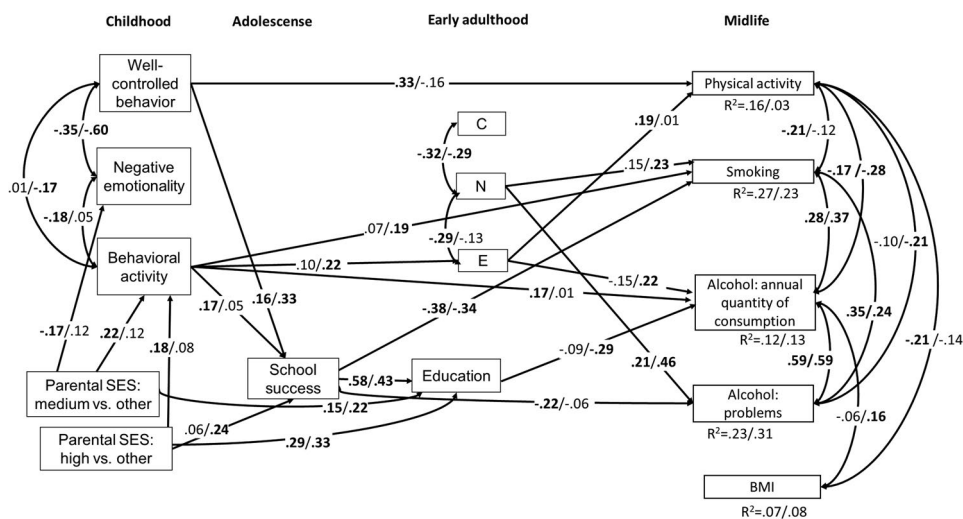
Figure 2. Longitudinal path model for the associations between personality characteristics, cognitive skills and midlife health behaviours. Note. Only significant paths with standardised path coefficients are shown separately for women/men. Coefficients *p* < .05 are in bold. SES: socio-economic status; C: conscientiousness; E: extraversion; N: neuroticism; BMI: body mass index.

conscientiousness nor neuroticism in adulthood were associated with physical activity. In men, the personality characteristics and cognitive skills included in this study explained only 3% of the variance in midlife physical activity. Physical activity might be explained by other individual (e.g. health status and motivation), interpersonal (e.g. social support), and environmental (e.g. sport facilities and the natural environment) characteristics commonly linked to physical activity behaviours (Bauman et al., 2012).

Second, higher scores in behavioural activity in childhood and neuroticism in adulthood were directly associated with *smoking* in men. Previous studies suggested that, in women, higher sociability and, in men, higher cheerfulness in childhood are associated with adulthood smoking (Tucker et al., 1995). These results may indicate the importance of a social component to engage in smoking. However, it was suggested that the positive association between social personality and smoking has diminished as social perceptions of smoking have become more negative over time (Malouff et al., 2006). This may explain why neuroticism was the only adulthood personality trait associated with smoking. The positive association between neuroticism and smoking was in line with previous studies (Cheng & Furnham, 2016; Malouff et al., 2006; Terracciano & Costa, 2004) and may be explained by both the lower impulse control associated with neuroticism and the more complex biological and genetic systems related to serotonin and dopamine (Terracciano & Costa, 2004). Consistent with the literature based on studies with larger sample sizes (Cheng & Furnham, 2016; Malouff et al., 2006; Terracciano & Costa, 2004), conscientiousness correlated negatively with smoking. However, the link was not statistically significant in the path model. Also, school success in adolescence was negatively associated with smoking in both men and women. Because smoking is typically taken up before higher education, school success may be a better predictor of smoking than later

education (Gilman et al., 2003), and also personality in adolescence may be a more important predictor than personality in midlife (Pluess & Bartley, 2015).

Third, higher scores in childhood behavioural activity in women and higher adulthood extraversion in men predicted heavier *alcohol consumption*, and higher neuroticism predicted *alcohol-related problems* in both sexes. Previous studies (Hakulinen et al., 2015; Malouff et al., 2007; Tucker et al., 1995), including results from a study using the same original sample and somewhat different alcohol variables and ages (Pitkänen et al., 2008), suggested that the role of personality characteristics varies between drinking patterns. Our analysis suggests that social behaviour captured by behavioural activity and extraversion were associated with increased drinking, whereas neuroticism was linked to alcohol-related problems. In addition to personality, increased cognitive skills and higher parental SES through cognitive skills predicted lower alcohol consumption and alcohol-related problems, as was previously suggested using somewhat different alcohol variables and ages (Pitkänen et al., 2008). Previous studies suggested that higher education is linked to, for example, increased drinking, taking alcohol with meals and drinking more wine (Rosoff et al., 2021), but fewer alcohol-related problems and decreased binge drinking (Collins, 2016).

Fourth, in contrast to previous findings (Cheng et al., 2020; Cohen et al., 2013; Jokela et al., 2013; Sutin et al., 2011), no evidence was found of associations between socioemotional characteristics, personality, cognitive skills and *BMI* in the longitudinal model. Our longitudinal model explains only 7–8% of the variance in midlife BMI. However, the correlations (Supplementary material 1) showed that education and in women also school success and conscientiousness were linked to lower midlife BMI, and in women neuroticism to higher BMI. It is likely that with a larger sample size some of these associations may have reached statistical significance. It is also possible that other factors not included in the present analyses were related to obesity in this sample. These might include marital status, number of children, psychological distress, locus of control and other health behaviours (Ali & Lindström, 2006; Cheng & Furnham, 2019; Gomersall et al., 2014). In addition, there could be culture- and time-related differences in socio-economic inequalities in BMI and obesity: for example, the inequalities seem to be wider in southern Europe than in Finland (Roskam & Kunst, 2008), and emerge already in childhood among later-born cohorts (i.e. those born in 2001 compared with those born in 1946–1970) (Bann et al., 2018).

The limitations of this study should be considered when interpreting the results. First, this was an exploratory study, and the *p* values were not adjusted for multiple testing. Compared to large population studies (e.g. British cohort studies with $n \approx 17,000$), this relatively small sample may have lacked the statistical power needed to detect all existing associations. For example, many associations that were found in descriptive correlational analyses did not reach statistical significance in the path model when analysed together with all the other variables. The results should be repeated with other samples. Second, the measures of health behaviours had some limitations. Information about physical activity at age 36 was not available, and at ages 42 and 50, physical activity was assessed by a single question asking about the frequency of leisure-time physical activity. The limited question and temporal variety in physical activity levels may explain the lack of associations with physical activity in men. The data did not include questions about nutrition and eating behaviour.

BMI is only a surrogate of obesity and body composition and may be misleading for people with well-developed muscles (Prentice & Jebb, 2001). In addition, a more detailed analysis of smoking (e.g. initiation *vs*. cessation) and alcohol use (e.g. binge drinking) were not the focus of this study. Lastly, there may be multiple other factors than those included in this study that relate to midlife health behaviours across the lifespan. These other factors may explain the low amount of variance observed, particularly for BMI in both men and women and physical activity in men.

This study contributes to our understanding of longitudinal relationships between personality, education, and health behaviours. The unique and major strength of this study is the longitudinal data collected at several points over 42 years with a relatively low attrition rate. However, the fact that participants who were heavy alcohol users at age 42 were less likely than the other participants to participate in the study at age 50 may have attenuated associations. The sample also well represents the Finnish age cohort in the adult data collection phases (Pulkkinen, 2017). Using repeated concurrent measures of health behaviours, we attempted to reduce bias related to retrospective measures (e.g. recall bias) and single measurement points (e.g. effects of extraordinary life situations on results). In addition, this study covered four measures of health behaviours (i.e. physical activity, smoking, alcohol consumption and BMI), which are all important predictors of public health.

Midlife physical activity, smoking, alcohol consumption, and obesity are complex behaviours that are affected by multiple factors over the life course. This study suggests that childhood socioemotional characteristics and cognitive skills can predict some part of the physical activity, smoking, and alcohol-related behaviours in midlife. Considering personality characteristics and cognitive skills may help to identify risk groups for later health-damaging behaviours.

Disclosure statement

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Authors' contributions

Tiia Kekäläinen contributed to conceptualisation, formal analysis, and writing – original draft. Jenni Karvonen contributed to conceptualisation and writing – original draft. Timo Törmäkangas contributed to formal analysis and writing – review & editing. Lea Pulkkinen contributed to data curation, conceptualisation, investigation, methodology, resources, and writing – review & editing. Katja Kokko contributed to conceptualisation, investigation, funding acquisition, supervision, and writing – review & editing.

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