

This is a preprint of an article published in *Addiction*.

Fergusson DM, Horwood LJ, Boden JM., Jenkin G. Childhood social disadvantage and smoking in adulthood: Results of a 25-year longitudinal study. *Addiction*, 2007; 102: 475-482.

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Childhood social disadvantage and smoking in adulthood: Results of a 25-year longitudinal study

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Abstract

Aim: To examine the associations between exposure to socioeconomic disadvantage in childhood and smoking in adulthood.

Design: A 25-year longitudinal study of the health, development, and adjustment of a birth cohort of 1,265 New Zealand children.

Measurements: Assessments of childhood socioeconomic disadvantage, smoking in adulthood, and potential mediating pathways, including: parental education, family socioeconomic status, family living standards, and family income; smoking frequency and nicotine dependence at age 25; child IQ, educational achievement by age 18 years, conduct problems ages 14-16, parental smoking 0-16 years, and peer smoking at 16 years.

Findings: Smoking at age 25 was significantly ($p < .0001$) correlated with increasing childhood socioeconomic disadvantage. Further, indicators of childhood socioeconomic disadvantage were significantly ($p < .0001$) correlated with the intervening variables of childhood intelligence, school achievement, conduct problems, and exposure to parental and peer smoking; which in turn were significantly ($p < .0001$) correlated with measures of smoking at age 25. Structural equation modelling suggested that the linkages between the latent factor of childhood disadvantage and later smoking were largely explained by a series of pathways involving cognitive/educational factors, adolescent behavioural adjustment, and exposure to parental and peer smoking.

Conclusions: The current study suggested that smoking in adulthood is influenced by childhood socioeconomic disadvantage via the mediating pathways of cognitive/educational factors, adolescent behaviour, and parental and peer smoking.

Keywords: cigarette smoking; socioeconomic status; education; IQ; parental smoking; peer smoking; conduct problems

It has been well-documented that social stratification is related to health outcomes, with individuals of disadvantaged socioeconomic background being at greater risk of mortality and morbidity (1-3). One factor that mediates linkages between socioeconomic disadvantage and health is the higher rate of cigarette smoking amongst socially disadvantaged groups (4-6). These observations in turn raise questions about the factors that lead to increased risks of cigarette smoking amongst socially disadvantaged groups. Research evidence suggests a number of pathways that may mediate between exposure to social disadvantage in childhood and the development of smoking.

First, it may be suggested that these associations are mediated by the greater exposure of children from disadvantaged families to role models who smoke. In particular, it is clear that children from socially-disadvantaged families have increased exposure to both parental and peer smoking (7-9), with both of these factors being linked to the development of cigarette smoking (8, 10-14).

Second, it may be suggested that the association is mediated via cognitive and educational factors. It has been well-documented that children from disadvantaged families demonstrate lower levels of cognitive ability and school achievement (15-17). In turn, these factors are related to increased risks of later cigarette smoking (14, 18-21).

Finally, it may be suggested that the associations are mediated by behavioural factors that increase the likelihood that children from disadvantaged families will take up cigarette smoking. Research indicates that that children from disadvantaged families are at increased risk of conduct problems and related behaviours (22-24). In turn, these behaviours have been shown to be related to later cigarette smoking (14, 25-28).

It is likely that these mediating processes act accumulatively to influence the likelihood that children from disadvantaged families will become regular cigarette smokers. However, there is

only limited longitudinal research that has examined the pathways linking exposure to childhood social disadvantage to later cigarette smoking. In particular, Jenkin (14) has reported the findings of a longitudinal study examining the pathways linking early socioeconomic status to later smoking. That study concluded that parental and peer smoking, educational attainment, and deviant behaviour mediated the link between childhood socioeconomic disadvantage and later smoking; however, the study used only a single indicator of childhood socioeconomic disadvantage (family socioeconomic status at birth).

Against this background, the current paper examines this issue by presenting the findings of a longitudinal study of the development of cigarette smoking in a birth cohort of 1000 children studied to the age of 25. The aims of this research were: (1) to document the linkages between exposure to socioeconomic disadvantage in childhood (0- 10 yrs) and the development of cigarette smoking by age 25; and (2) to examine the extent to which linkages between childhood socioeconomic disadvantage and later smoking were mediated via: (a) cognitive factors including intelligence and educational attainment; (b) exposure to parental and peer smoking; and (c) behavioural adjustment in childhood.

Method

The data were gathered during the course of the Christchurch Health and Development Study, a cohort of 1265 children born in Christchurch (New Zealand) in mid-1977 that has been followed from birth to age 25 years. Assessments have been conducted at birth, 4 months, 1 year and annual intervals to age 16, and at 18, 21 and 25 years, with information gathered from a combination of sources including: interviews with parents or a significant other; self report; psychometric testing; teacher report; and medical and other official record data (29, 30). All information collected during the course of the study has been obtained only with the signed consent of research participants, and all phases of data collection have been subject to ethical approval by the regional Ethics Committee.

The present analysis is based on the sample of 994 participants who had complete data on measures of childhood socioeconomic disadvantage and smoking at age 25. This sample represented 79% of the initial cohort of 1265 children. The following measures were used in the present analysis.

Cigarette Smoking (25 Years)

At age 25 participants were questioned about cigarette smoking. Sample members who reported being current smokers (having a cigarette in the past month) were further questioned about their frequency of smoking. Custom-written survey items were used to assess Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) symptom criteria for nicotine dependence. These items spanned a series of symptoms relating to: being unable to go a day without a cigarette; feeling dependent on or addicted to cigarettes; feeling tense or irritable without a cigarette; needing a cigarette first thing in the morning; having headaches or other physical symptoms without a cigarette; smoking more than was intended; increasing cigarette consumption to maintain the effect; wanting to quit or cut down on smoking; unsuccessful attempts to quit or cut down; having health problems as a consequence of smoking or being advised by a doctor to give up smoking for health reasons. This information was used to classify participants on two measures of smoking behaviour at age 25: (a) the frequency of current smoking classified in 4 levels (non-smoker; <10 cigs/day; 10-19 cigs/day; 20+ cigs/day); (b) a count of the number of reported symptoms of DSM-IV nicotine dependence.

Measures of Childhood Socioeconomic Disadvantage

Family socioeconomic status (birth). Family socioeconomic status at the time of the child's birth was assessed using the Elley and Irving (31) revised socioeconomic index for New Zealand. This index classified SES into 6 levels on the basis of paternal occupation, ranging from 1 = professional occupations to 6 = unskilled occupations.

Parental education levels (birth). Maternal and paternal education at the time of the survey child's birth were separately classified according to a 3 level classification reflecting the highest level of educational attainment. This classification was: 1 = parent had tertiary qualifications (university degree, tertiary technical diploma, or similar); 2 = parent had high school qualifications; 3 = parent had no educational qualifications.

Family living standards (0-10 years). At each assessment from age 1 to age 10 years a global assessment of the quality of the material living standards of the family was obtained by means of an interviewer rating. Ratings were made on a 5-point scale ranging from 1 = family obviously affluent to 5 = family obviously poor or very poor. In the present analysis, interviewer ratings were averaged over the 10 year period to provide a global measure of the typical family living standards experienced by the child during this period.

Averaged family income decile (0-10 years). At each assessment from age 1 to age 10 years, parents were questioned about their income from all sources over the previous 12 months, including income from salary/wages, self-employment, welfare payments, investments and other sources. This information was used to obtain an estimate of the family's gross income for each year of the study. For the purposes of the present analysis, families were first classified into deciles of family income for each year, with a rank of 1 indicating the family was in the highest decile and a rank of 10 the lowest decile of family income for a given year. The decile scores were then averaged over the 10 year period to provide a global measure of the average rank level of family income for each family over the period from the child's birth to age 10 years.

Mediating Factors

A range of measures was selected from the database of the study to investigate their role in mediating the association between childhood socioeconomic disadvantage and smoking in young adulthood.

Adolescent conduct problems (14-16 years). At each assessment from age 14 to 16 years, parent and self reports were obtained reflecting the extent to which the young person was reported to exhibit a range of oppositional and conduct disordered behaviours. Parental reports were obtained using selected items from the Revised Behavior Problem Checklist (32). Self reports were obtained using custom written survey items designed to assess Diagnostic and Statistical Manual of Mental Disorders III-Revised symptom criteria for conduct and oppositional defiant disorder.

Confirmatory factor models fitted to the data showed that in each case the selected items could be scaled on a uni-dimensional scale reflecting the extent of parent-reported and self-reported conduct problems. For the purposes of the present analysis the parent and self report conduct problems scores were summed for each year and then averaged over the 3 year period to provide a robust measure of the extent of adolescent behaviour problems. The reliability of the combined score, assessed using coefficient α , was .97.

Child cognitive ability (8-9 years). Child cognitive ability was assessed at ages 8 and 9 using the Revised Wechsler Intelligence Scale for Children (WISC-R: 33). Total scores were computed on the basis of results on four verbal and four performance subscales. The split-half reliabilities of these scores were .93 at age 8 and .95 at age 9. For the purposes of these analyses the observed WISC-R total intelligence scores at age 8 and 9 were combined by averaging over the two administrations.

Educational achievement. At ages 18 and 21 years, participants were questioned about aspects of their educational history including levels of achievement in the following high school qualifications: (a) School Certificate, a national series of examinations that was typically undertaken by most students at the end of their third year of high school (Year 11); (b) Sixth Form Certificate, a qualification awarded for satisfactory completion of the sixth form (Year 12); (c) Higher School Certificate, a qualification awarded for completion of a recognized course of study at seventh form level (Year 13); (e) University Bursary, an award granted to students who attained a recognized level of achievement in university bursary examinations. This information was used to classify participants on a 5-level measure reflecting the highest level of high school attainment. This classification was: 1 = no high school qualifications; 2 = attained at least one pass grade in School Certificate examinations; 3 = attained Sixth Form Certificate; 4 = gained Higher School Certificate; 5 = gained University Bursary.

Parental smoking (0-16 years). As part of the parental interview at each year from when participants were aged 1-16 years, information was obtained on the frequency of maternal and paternal cigarette smoking. Using these data, a measure of the extent of exposure to parental smoking during childhood was constructed on the basis of a count of the number of years up to age 16 in which either parent was reported to be a smoker.

Peer smoking (16 years). As part of questioning about cigarette smoking at age 16 years, participants were asked to report about smoking by peers and in particular, how many of their friends smoked. Ratings were made on a 3-point scale (none/some/most).

Model Fitting

The structural model (described in Results) of the linkages between childhood socioeconomic disadvantage and smoking in young adulthood was fitted to the correlation matrix of the observed

measures of disadvantage, smoking and mediating factors using the LISREL 8 modelling package (34). Model fitting was conducted using asymptotic distribution free methods of weighted least squares estimation (35). Weighted least squares provides a robust alternative to maximum-likelihood estimation when the observed data show significant departure from a multivariate normal distribution. Model goodness of fit was assessed on the basis of the following fit indices: (a) the model chi squared statistic; (b) the root mean squared error of approximation (RMSEA); (c) the standardised root mean squared residual correlation (SRMR); (d) the adjusted goodness of fit index (AGFI). In well-fitting models the RMSEA should be $<.05$; the SRMR should be close to zero and the AGFI close to 1 (34). To examine the stability of the model to stratification by gender or ethnicity, the modelling was extended to a multi-group modelling situation in which the model was fitted simultaneously to the variance/covariance matrix for each population subgroup and chi-squared tests of equality of model parameters across sub-groups were conducted.

Results

Correlations Between Indicators of Socioeconomic Disadvantage, Intervening Variables and Later Cigarette Smoking.

Table 1 shows the matrix product moment correlations between: a) the indicators of childhood socioeconomic disadvantage; b) the intervening variables of childhood intelligence; educational achievement at school leaving; conduct problems at age 14-16; exposure to parental and peer smoking; and c) the frequency of cigarette smoking and symptoms of nicotine dependence at 25.

The Table shows that, in all cases:

1. The indicators of childhood socioeconomic disadvantage were significantly ($p < .0001$) correlated with measures of smoking at age 25, including smoking frequency and nicotine dependence, indicating that increasing childhood disadvantage was associated with increasing rates of smoking in adulthood.

2. Measures of smoking at age 25 were significantly ($p < .0001$) correlated with the intervening variables, indicating that higher rates of smoking were associated with lower intelligence scores and poorer school performance, higher rates of adolescent conduct problems and increasing exposure to parental and peer smoking.
3. The indicators of childhood socioeconomic disadvantage were significantly ($p < .0001$) correlated with the intervening variables indicating that, in general, increasing childhood disadvantage was associated with lower intelligence scores and poorer school achievement, increasing rates of adolescent conduct problems and increasing exposure to parental and peer smoking.

TABLE 1 ABOUT HERE

Fitted Path Model

The results in Table 1 clearly suggest a causal model in which the linkages between childhood socioeconomic disadvantage and later smoking were mediated via a series of intervening processes involving: a) cognitive/educational factors; b) behavioural adjustment in adolescence; and c) exposure to role models who smoked. These ideas are expressed in the block recursive path model shown in Figure 1. The model assumes:

- a) That the five measures of socioeconomic disadvantage are indicators of a latent variable reflecting the individual's level of exposure to socioeconomic disadvantage during childhood.
- b) The measures of daily smoking and nicotine dependence are indicators of a latent variable reflecting the extent of cigarette smoking at age 25.

- c) The linkages between the latent factors of childhood socioeconomic disadvantage and later smoking are mediated by a series of intervening variables describing cognitive/educational factors; adolescent conduct problems; and exposure to parental and peer smoking role models.
- d) The model also assumes linkages between the disturbance terms of the mediating variables (IQ, educational achievement, conduct problems, parent/peer smoking), reflecting the components of the correlations between these variables that are not explained by their associations with the latent measure of socioeconomic disadvantage. To simplify the model presentation these disturbance correlations are represented in the model by the dotted line linking the disturbances of the 5 mediating variables.

FIGURE 1 ABOUT HERE

This model was fitted to the matrix of correlations in Table 1 using methods of weighted least squares estimation (34) to take into account the fact that the observed data did not have a multivariate normal distribution. The fitted model, incorporating additional parameters reflecting correlations between the error terms of the indicators of the latent measure of socioeconomic disadvantage, showed a generally acceptable fit to the observed data ($\chi^2(2) = 76.5$, $p < .0001$; RMSEA = .034; SRMR = .024; AGFI = .99). Figure 1 shows the standardised parameters from the final fitted model. Examination of the model leads to the following conclusions:

1. The five indicators of childhood disadvantage load on a single latent factor that represents exposure to childhood socioeconomic disadvantage. These correlations ranged between .59-.74, suggesting that all measures were of generally similar validity as indicators of disadvantage.

2. The observed measures of smoking frequency and nicotine dependence symptoms both have very high factor loadings (.93) suggesting that these measures provide highly reliable indicators of the participants' latent (non-observed) level of smoking at age 25.

3. The linkages between the latent factor of childhood socioeconomic disadvantage and later smoking are almost entirely explained by a series of intervening pathways involving the cognitive/educational factors; adolescent behavioural adjustment; and exposure to parental and peer smoking. The fitted model implies that the higher rates of cigarette smoking amongst young adults from socioeconomically disadvantaged backgrounds arise from a series of childhood and adolescent factors that increase the likelihood of later smoking. These factors include: lower (measured) intelligence; poorer school achievement; higher rates of adolescent conduct problems; and greater exposure to peer and parent smoking.

From the fitted path model it becomes possible to estimate the contributions of various intervening pathways to the correlation between socioeconomic disadvantage and later smoking. This decomposition is shown in Table 2 which partitions the total estimated correlation between the latent measures of childhood socioeconomic disadvantage and smoking in young adulthood into components reflecting mediation via childhood cognitive/educational factors; via adolescent behavioural adjustment; and via exposure to parental/peer smoking. The Table shows that the total correlation between socioeconomic disadvantage and later smoking was .27. Of this correlation, .15 (56%) was mediated via cognitive/educational factors, .03 (11%) via adolescent adjustment and .07 (26%) via exposure to parent and peer smoking, leaving a residual unexplained correlation of only .02.

TABLE 2 ABOUT HERE

Sensitivity Analysis

To examine the sensitivity of the findings to possible alternative model representations, a series of additional analyses was conducted. These analyses examined changes to: (a) the age at which smoking was assessed; (b) the choice of intervening variables; and (c) model stratification by gender and ethnicity. Despite extensive exploration of the database to fit a wide range of models, these supplementary analyses led to the same conclusions as those of the original fitted path model. Furthermore, an identical model structure and conclusions were arrived at when the data were stratified by gender or ethnicity.

Discussion

In this paper we have used data gathered over the course of a 25-year longitudinal study to explore the pathways that may link exposure to childhood socioeconomic disadvantage to later smoking.

The findings of the study were as follows:

The correlation between smoking and childhood socioeconomic disadvantage

In the present study a range of measures of childhood disadvantage was used that spanned socioeconomic status, parental educational levels, family living standards, and family income. All of these indicator measures were found to be correlated with later smoking, with correlations ranging from .14 to .21 and a median value of .17. However, when the indicator variables were combined to produce a latent variable estimate, the estimated correlation increased to .27. This result suggests that the use of single indicator measures of socioeconomic disadvantage may lead to an under-estimation of the association between cigarette smoking and exposure to childhood socioeconomic disadvantage.

Pathways from socioeconomic disadvantage to later smoking

Subsequent analysis using structural equation models suggested that the correlation between childhood socioeconomic disadvantage and later smoking was explained by the accumulative effects of three general pathways that linked childhood socioeconomic disadvantage to later smoking. First, childhood socioeconomic disadvantage was associated with lower measured IQ scores and lower educational achievement, with these pathways explaining over 50% of the correlation between childhood socioeconomic disadvantage and later smoking. Second, childhood disadvantage was associated with increased rates of conduct problems in adolescence that were in turn associated with increased risks of smoking, with this pathway accounting for about 11% of the correlation between socioeconomic disadvantage and later smoking. Third, childhood disadvantage was associated with greater exposure to both parental and peer smoking, with both of these factors being in turn associated with increased risks of later smoking. This pathway accounted for more than a quarter of the correlation between childhood social background and later smoking.

Supplementary analyses suggested that these conclusions were robust, and did not depend on the choice of socioeconomic indicators, or the age at which smoking was assessed. The results of the study suggest that the correlation between childhood socioeconomic disadvantage and later smoking arose from an accumulation of disadvantageous conditions that were more common in children from disadvantaged backgrounds.

The pathways identified in the present study are in general agreement with a number of findings in the previous literature that link intelligence and educational achievement (14, 18-21), conduct problems (14, 25-28), and parental and peer smoking (8, 10-14), to later smoking. In addition, the links between these specific pathways and childhood socioeconomic disadvantage are in general agreement with models that have been constructed to examine the associations between early socioeconomic status and later health outcomes (6, 36-38).

Limitations

The first limitation of the study is that it is clear that the development and maintenance of smoking behaviour is a complex outcome that is likely to unfold over time in a complex manner. The current study used structural equation modelling techniques that took into account multiple indicators of socioeconomic position, a number of potential mediating factors, and multiple indicators of smoking. This raises the question of the adequacy of the statistical models and methods in capturing the complexity of the processes involved with the development of cigarette smoking. It is likely that, given this complexity, the statistical models we have employed give only an approximation to the true (but non-observed) state of affairs.

Second, the variables included in the analyses are based on report data that have been provided by the participants. As such these variables may be subject to various errors of measurement that may compromise the estimation of model parameters.

Third, because the study has been based on a particular birth cohort studied at a particular time and location (Christchurch, New Zealand), it is unclear to what extent the results may be generalised to other cultures, and to other cohorts.

Conclusions

Notwithstanding the above limitations, the results of the current study suggested that smoking in adulthood is influenced by socioeconomic disadvantage via the following pathways: by intelligence and educational achievement, by conduct problems and deviant behaviour, and by parent and peer smoking. It is clear that cigarette smoking in adulthood is the result of a complex interplay of a number of factors, including lower educational achievement, poorer adjustment, and the presence of smokers in one's environment. Efforts to reduce the prevalence of smoking in the population

should therefore focus both on the individual behavioural factors leading to a greater risk of smoking, and on the social factors that contribute to inequalities in socioeconomic position.

Acknowledgements: This research was funded by grants from the Health Research Council of New Zealand, the National Child Health Research Foundation, the Canterbury Medical Research Foundation and the New Zealand Lottery Grants Board.

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Table 1. Matrix of product moment correlations between measures of cigarette smoking, child cognitive and behavioural factors, parental/peer smoking and measures of family socioeconomic disadvantage.

Measure		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Smoking frequency (25 years)	Y1	1.00											
Nicotine dependence symptoms (25 years)	Y2	.85	1.00										
Child IQ (8-9 years)	Y3	-.21	-.19	1.00									
School achievement	Y4	-.37	-.36	.59	1.00								
Adolescent conduct problems (14-16 years)	Y5	.26	.26	-.31	-.44	1.00							
Parental smoking (0-16 years)	Y6	.17	.18	-.24	-.31	.21	1.00						
Peer smoking (16 years)	Y7	.28	.28	-.18	-.29	.30	.14	1.00					
Family socio-economic status (birth)	Y8	.19	.16	-.35	-.41	.21	.37	.18	1.00				
Paternal education (birth)	Y9	.17	.16	-.32	-.42	.18	.33	.13	.60	1.00			
Maternal education (birth)	Y10	.16	.15	-.38	-.37	.23	.28	.16	.39	.43	1.00		
Average family living standard (0-10 years)	Y11	.18	.21	-.35	-.41	.28	.34	.07	.50	.39	.44	1.00	
Averaged family income decile (0-10 years)	Y12	.14	.17	-.34	-.40	.26	.28	.10	.50	.36	.44	.64	1.00

Note: ¹ All measures of socio-economic disadvantage have been scored such that higher scores imply greater disadvantage.

² All correlations are significantly different from zero ($p < .001$).

Table 2. Decomposition of correlation between childhood socioeconomic disadvantage and smoking at age 25.

	Component of Correlation
Total correlation	.27
Component mediated by:	
Cognitive/educational factors	.15
Adolescent conduct problems	.03
Parent/peer smoking	.07
Unexplained correlation	.02

Figure 1. Fitted path model of childhood socioeconomic disadvantage, smoking at age 25 and mediating factors.

