Associations between childhood reading problems and affective symptoms across the life course: Evidence from the 1946 British Birth Cohort

Data statement: Data is available upon application to MRC Unit for Lifelong Health and Ageing at UCL.

Word count: 2728

Abstract

Background: Little is known about long-term outcomes of reading problems in childhood on affective symptoms across the life course. The aim of this research was to test longitudinal associations between reading problems in childhood and affective symptoms from adolescence to early old age.

Methods: Data were from the National Survey of Health and Development (British 1946 birth cohort). A measure of reading problems was available at age 11. Affective symptoms were assessed at ages 13, 15, 35, 43, 53, 60-64 and 69. Path analyses tested longitudinal associations between reading problems and affective symptoms from adolescence to early old age. Linear regressions tested associations between reading problems in childhood and accumulation of affective symptoms across the life course (age 13 to 69). Models were adjusted for sex, education, conduct problems, and socioeconomic position in childhood and adulthood.

Results: After full adjustment, reading problems were significantly associated with higher affective symptoms in adolescence (ages 13 and 15) but not affective symptoms in adulthood (ages 36, 43, 53, 60-64, and 69). Reading problems were not associated with accumulation of affective symptoms across the life course.

Limitations: Attrition was limitation of this study, due to the long follow-up period. In order to account for missing data, full information maximum likelihood (FIML) was used.

Conclusions: Childhood reading problems are associated with higher affective symptoms in adolescence, but this does not persist into adulthood. These results highlight an important period in adolescence when reading problems may exert a particularly strong effect on affective symptoms.

Introduction

Reading problems in childhood are commonly comorbid with mental health problems, including externalising symptoms (Bennett et al., 2003) and internalising symptoms (Maughan and Carroll, 2006). Research has shown that children with reading problems are at increased risk of emotional problems. Indeed, one study reported that approximately 9.9% of children with a reading problem also show symptoms of anxiety disorder, a figure that is significantly higher than for children without a reading problem (3.9%) (Carroll et al., 2005). Cross-sectional associations have been observed showing higher rates of depressive symptoms, including self-blame, low energy and suicidal ideation in children with reading problems compared to those without (Boetsch et al., 1996; Mammarella et al., 2016; Willcutt and Pennington, 2000).

There is limited research which has tested this association using a longitudinal design. One such study provided evidence that severe and persistent reading problems were associated with depressed mood in a sample of boys between the ages 7-10 at initial assessment, though not for those who had already entered into adolescence (Maughan et al., 2003). However, evidence testing longitudinal associations between reading problems and mental health is scarce and the limited research available uses only relatively short follow-up periods. As such, it is currently unknown whether associations between reading problems and affective symptoms persist across the life course into older age.

Consequently, this research aimed to test longitudinal associations between reading problems in childhood and affective symptoms from adolescence to early old age, using a follow-up period of nearly six decades, while adjusting for conduct problems in adolescence. It is known that externalising problems co-occur frequently with both affective symptoms (Polier et al., 2012) and reading problems (Carroll et al., 2005). As such, it is important to include externalising

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symptoms in models to ensure that associations observed between reading problems and

affective symptoms are not simply due to comorbid externalising problems.

<div align="center">**Methods**</div>

Participants

Data were from the National Survey of Health and Development (NSHD; the British 1946 birth cohort), a population-based sample initially consisting of 5362 men and women born in England Scotland and Wales during one week of 1946. Cohort members have been followed up 24 times up to the most recent data collection in 2015, when participants were aged 69 (Kuh et al., 2016). Ethical approval for this sweep was obtained from NRES Queen Square REC and Scotland A REC.

Measures

Affective symptoms

Affective symptoms have been measured at seven time points over the life course in NSHD at ages 13, 15, 36, 43, 53, 60-64, and 69 (Kuh et al., 2016, 2011; Wadsworth et al., 2006). In adolescence (ages 13 and 15), mental health was assessed by the cohort member's teacher using a forerunner of the Rutter A scale, from which measures of affective symptoms were derived. In adulthood, mental health was assessed directly from the cohort member using the Present State Examination (PSE) at age 36, the Psychiatric Symptom Frequency scale (PSF) at age 43, and the General Health Questionnaire (GHQ) at ages 53, 60-64, and 69. The use of sum scores to capture affective symptoms has been criticised in recent years, because sum scores rely on the assumption that all items on a depression questionnaire are equivalent and interchangeable indicators of depression severity (Fried and Nesse, 2015). It is now believed that assigning an equal weight to all items on a depression scale regardless of loading value may obfuscate valuable information in depression research. For this reason, latent scores of affective symptoms

were generated from the available measures and used at all ages instead of sum scores. Latent factor scores of affective symptoms for each age up to 53 were derived previously (Colman et al., 2007) and latent factor scores were also generated for ages 60-64 and 69 for this analysis using confirmatory factor analysis (see below).

To derive a score of accumulation, cut-off scores were used to generate a binary measure of affective symptoms at each available time-point to indicate whether symptoms reached clinical thresholds for potentially diagnosable affective problems. In line with previous research in NSHD (James et al., 2018), cut-off scores used differed depending on the instrument administered. At ages 13 and 15, the cut-off used was the $\geq 91^{st}$ percentile of the latent scores derived from the teacher rated forerunner of the Rutter A scale (Colman et al., 2007). At age 36, the standard Index of Definition ≥ 5 on the Present State Examination was used. At age 43, the cut-off used was a score of ≥ 23 on the Psychiatric Symptom Frequency scale. At ages 53, 60-64 and 69, the standard cut-off of score of ≥ 5 on the General Health Questionnaire was used. The measure of accumulation was derived by summing the number of time points cohort members met the threshold across all available waves, creating a score ranging from 0-7. Due to small frequencies in groups reaching cut-off scores repeatedly across testing waves, this measure was recoded into three categories: 1. Never reached threshold; 2. Reached threshold at one time point; 3. Reached threshold at two or more time points.

Reading Problems

A measure of reading problems was previously derived at age 11 (Gaysina et al., 2010). Specifically, cohort members completed a test of general cognitive ability and a reading test. The general cognitive ability test was comprised of 80 verbal and non-verbal reasoning questions, and the reading test was composed of 50 words of increasing difficulty which cohort members

were asked to pronounce. Cohort members were classified as having a reading problem if they obtained a score 1.5 SD below the mean on the reading test, in addition to a score at least 70% of the maximum on the test of general cognitive ability (Gaysina et al., 2010).

Covariates

Sex, education, adolescent conduct problems, and socioeconomic position in childhood and adulthood were used as covariates. Education was captured by the highest level of educational qualification by age 26, coded into three categories: 1. None; 2. Vocational or ordinary ('O' level); 3. A Level or higher. Conduct problems were assessed at ages 13 and 15 using the teacher rated forerunner of the Rutter A scale. Items for conduct problems included unpunctuality, restlessness, truancy, daydreaming, indiscipline, disobedience and lying. Factor analysis was conducted previously to generate a summary measure of conduct problems. The scores were coded into three categories: absent, mild, or severe conduct problems. This was based on validated percentile cuts (0-75%: Absent, 76-93%: Mild, 94% and higher: Severe) (Colman et al., 2009; Ghodsian et al., 1980; Rodgers, 1990). Social class of the cohort member's father was used to represent socioeconomic position in childhood when the cohort member was 4, 11, or 15. Social class of the cohort member at age 53 or earlier if this was missing was used to represent socioeconomic position in adulthood. Both measures were coded into six categories according to the UK Registrar General: 1. Professional; 2. Intermediate; 3. Skilled non-manual; 4. Skilled manual; 5. Partly skilled; 6. Unskilled.

Statistical analyses

Missingness in the data was explored and the sample with missing data was compared to the sample with complete data on key variables using chi square and t-tests as appropriate. In

subsequent analyses, full information maximum likelihood (FIML) was used to account for missing data (Enders, 2001a, 2001b; Enders and Bandalos, 2001).

Latent scores of affective symptoms at all ages up to 53 were derived previously in NSHD (Colman et al., 2007). Confirmatory factor analysis (CFA) was used to derive latent factor scores of affective symptoms at ages 60-64 and 69. This model fit to the data well (χ^2 (1483) = 4523.80, p < .001; CFI = 0.926; TLI = 0.923; RMSEA = 0.029), and as such the latent scores were used in subsequent analyses. Path models were used to test associations between reading problems in childhood and latent scores of affective symptoms at each age. Path models were used rather than multiple regression to account for multiple outcome variables within model and so model fit could be tested and evaluated (Streiner, 2005). Model fit was assessed using standard fit indices: chi-square; comparative fit index (CFI); Tucker-Lewis index (TLI); and root mean square error of approximation (RMSEA) (Hooper et al., 2008). Linear regressions were used to test associations between reading problems in childhood and accumulation of affective symptoms from age 13 to 69.

Interaction terms between sex and reading problems were tested at the 10% level. Interaction terms were not significant (Table S1), and as such sex was used as a covariate, rather than a stratifying variable. All models were initially run unadjusted, and then fully adjusted for sex, adolescent conduct problems, education and socioeconomic position in childhood and in adulthood. Analyses were run in Mplus (Muthén and Muthén, 2017), and RStudio.

Results

Demographic information and missing data analysis

The sample with missing data (N = 4356) had significantly higher affective symptoms at ages 13, 15, 36, and 43 than the sample with complete data (N = 1006), but not at ages 53, 60-64 or 69 (Table 1). The sample with missing data were also significantly more likely to have a reading problem in childhood, have conduct problems, have less education, and be from a lower socioeconomic position in childhood and adulthood than the sample with complete data. However, the sample with missing data did not differ significantly from the sample with complete data on sex or the number of time points with case-level affective symptoms. Due to these differences, missing data was handled using full information maximum likelihood (FIML), resulting in an analytic sample of 3363 people. Demographic information for the analytic sample included in fully adjusted models (N = 3336) is described in Table 2.

Associations between childhood reading problems and affective symptoms in adolescence and adulthood

The unadjusted and fully adjusted path models were both a good fit to the data (Unadjusted: N = 3965; χ^2 (2) = 3.97, p = .14; CFI = 0.999; TLI = 0.991; RMSEA = 0.016. Adjusted: N = 3336; χ^2 (3) = 3.82, p = .28; CFI = 1.000; TLI = 0.994; RMSEA = 0.009). Reading problems at age 11 were significantly associated with higher affective symptoms in adolescence (at ages 13 and 15), but not in adulthood (at ages 36, 43, 53, 60-64 and 69) (Table 3). These findings remained consistent after full adjustment for sex, education, adolescent conduct problems and socioeconomic position in childhood and adulthood.

Associations between reading problems in childhood and accumulation of affective symptoms from adolescence to early old age

Linear regression models were fit to model associations between reading problems in childhood and accumulation of affective symptoms from adolescence to early old age (represented by the number of time points with case-level affective symptoms between ages 13 and 69). Results from regression models revealed that in both unadjusted and fully adjusted models, reading problems at age 11 were not significantly associated with the accumulation of affective symptoms (Table 4).

Discussion

Summary of findings

These results reveal that reading problems at age 11 are associated with higher affective symptoms in adolescence, but this does not persist into adulthood. Additionally, childhood reading problems are not associated with accumulation of affective symptoms over time from adolescence through to early old age.

This builds on previous research which shows that internalising and externalising symptoms are commonly comorbid with reading disability in children (Carroll et al., 2005; Maughan and Carroll, 2006). Specifically, children with reading problems report significantly more symptoms of generalised and social anxiety (Mammarella et al., 2016), higher depressive and withdrawal symptoms (Dahle et al., 2011; Mammarella et al., 2016) , and higher rates of conduct disorders (Carroll et al., 2005). Results from this study complement and further extend existing literature by testing associations between reading problems and affective symptoms over a considerably longer period of time than considered in previous research (over nearly six decades). Specifically, results from this study show that associations between reading problems and affective symptoms are only evident in childhood and adolescence, but not later in the life course (age 36 through 69).

There are at least four plausible hypotheses as to why associations between reading problems at age 11 and affective symptoms at ages 13 and 15 may be observed; 1. Shared risk; 2. Confounding; 3. Reverse causality; 4. Indirect pathway. The shared risk hypothesis states that associations may arise due to shared underlying risk factors, such as genetic or socio-behavioural risk (e.g. socioeconomic position). The confounding hypothesis is that associations may be

observed due to other variables or comorbidities present in childhood, for example conduct problems (Bennett et al., 2003; Carroll et al., 2005). However, observed associations between childhood reading problems and adolescent affective symptoms remained evident even when adolescent conduct problems were also included in the models, which suggests that these associations are not solely attributable to comorbid externalising symptoms. The reverse causality hypothesis states that associations may operate in the opposite direction, whereby the presence of affective symptoms in childhood may lead to increased risk of developing reading problems. For example, people with higher affective symptoms may be less likely to engage with education, which in turn may lead to higher rates of reading problems. It is also plausible that associations between reading problems and affective symptoms may be bidirectional. Unfortunately, there were no measures of affective symptoms available prior to the assessment of reading problems in this dataset, meaning that bi-directionality cannot be tested. The indirect pathway hypothesis is that there may be an effect of childhood reading problems on adolescent affective symptoms operating through various social or behavioural mechanisms. For example, one potential pathway is through self-esteem. Specifically, research has shown that reading problems in childhood are associated with lower self-esteem, which may be a consequence of subjective awareness of poorer academic performance compared with peers (Humphrey and Mullins, 2002). This lowered self-esteem may in turn increase vulnerability for experiencing subsequent affective problems.

Findings from this study show that affective symptoms associated with childhood reading problems are evident in adolescence but for affective symptoms at least this does not appear to persist into adulthood. As described above, self-esteem is one potential mechanism of the association between reading problems and adolescent affective symptoms. However, research

has shown that childhood literacy is not associated with lower global self-esteem in adulthood (Maughan and Hagell, 1996). As such, it is plausible that reading problems are associated with poorer self-esteem in childhood and adolescence given that the development of literacy skills is a core part of the school curriculum. However, as people transition into adulthood and leave school, reading ability may become less central to self-esteem. This could potentially explain why associations between reading problems and affective symptoms are specific to childhood and adolescence, and do not persist into adulthood.

Strengths and limitations

The strengths of this study are the use of a large population-based birth cohort with a follow up period across nearly seven decades. Additionally, prospective measures were available for childhood reading problems and for affective symptoms across the life course.

However, there are several limitations which should be acknowledged and considered when interpreting results. Furthermore, different instruments were used to capture affective symptoms over time. Additionally, affective symptoms in adolescence were teacher rated, whereas all adult measures were rated by the cohort member themselves. This may mean that measures of affective symptoms may not be comparable over time. In order to account for this in part, latent scores and respective clinical cut-offs were used to make measures more comparable over time. Furthermore, there were no measures of affective symptoms earlier than age 13, meaning we could not eliminate the possibility of reverse causality where affective symptoms in childhood may contribute to development of reading problems. Finally, attrition was an issue in this cohort, and missing data analyses revealed that the sample with complete data differed from the sample with missing data on key variables, including on educational attainment and

socioeconomic position. In order to account for missing data and loss to follow up, full information maximum likelihood (FIML) was used for analyses.

Future research and conclusions

In conclusion, this research shows that reading problems in childhood are associated with higher affective symptoms in adolescence, but not in adulthood (age 36 to 69). Childhood reading problems are not associated with accumulation of affective symptoms from adolescence to early old age (13 to 69). Future research should focus on testing whether intervention to improve literacy in childhood can also help to reduce levels of affective symptoms in adolescence.

References

Bennett, K.J., Brown, K.S., Boyle, M., Racine, Y., Offord, D., 2003. Does low reading achievement at school entry cause conduct problems? Soc. Sci. Med. 56, 2443–2448. https://doi.org/10.1016/S0277-9536(02)00247-2

Boetsch, E.A., Green, P.A., Pennington, B.F., 1996. Psychosocial correlates of dyslexia across the life span. Dev. Psychopathol. 8, 539–562.

Carroll, J.M., Maughan, B., Goodman, R., Meltzer, H., 2005. Literacy difficulties and psychiatric disorders: Evidence for comorbidity. J. Child Psychol. Psychiatry 46, 524–532.

Colman, I., Murray, J., Abbott, R.A., Maughan, B., Kuh, D., Croudace, T.J., Jones, P.B., 2009. Outcomes of conduct problems in adolescence: 40 year follow-up of national cohort. BMJ 338, a2981.

Colman, I., Ploubidis, G.B., Wadsworth, M.E.J., Jones, P.B., Croudace, T.J., 2007. A Longitudinal Typology of Symptoms of Depression and Anxiety Over the Life Course. Biol. Psychiatry 62, 1265–1271. https://doi.org/10.1016/j.biopsych.2007.05.012

Dahle, A.E., Knivsberg, A., Andreassen, A.B., 2011. Coexisting problem behaviour in severe dyslexia. J. Res. Spec. Educ. Needs 11, 162–170.

Enders, C., 2001a. A primer on maximum likelihood algorithms available for use with missing data. Struct. Equ. Model. 1, 128–141. https://doi.org/10.1207/S15328007SEM0801

Enders, C., 2001b. The performance of the full information maximum likelihood estimator in multiple regression models with missing data. Educ. Psychol. Meas. 61, 713–740. https://doi.org/10.1177/00131640121971482

Enders, C., Bandalos, D., 2001. The relative performance of full information maximum

    likelihood estimation for missing data in structural equation models. Struct. Equ. Model. 8,

    430–457. https://doi.org/10.1207/S15328007SEM0803_5

Fried, E.I., Nesse, R.M., 2015. Depression sum-scores don't add up: why analyzing specific

    depression symptoms is essential. BMC Med. https://doi.org/10.1186/s12916-015-0325-4

Gaysina, D., Maughan, B., Richards, M., 2010. Association of reading problems with speech and

    motor development: Results from a British 1946 birth cohort. Dev. Med. Child Neurol. 52,

    680–681. https://doi.org/10.1111/j.1469-8749.2010.03649.x

Ghodsian, M., Fogelman, K., Lambert, L., Tibbenham, A., 1980. Changes in behaviour ratings of

    a national sample of children. Br. J. Soc. Clin. Psychol. 19, 247–256.

Hooper, D., Coughlan, J., Mullen, M.R., 2008. Structural equation modelling: Guidelines for

    determining model fit. Electron. J. Bus. Res. Methods 6, 53–60.

    https://doi.org/10.21427/D79B73

Humphrey, N., Mullins, P.M., 2002. Self-concept and self-esteem in developmental dyslexia. J.

    Res. Spec. Educ. Needs 2, no-no.

James, S., Davis, D., O'Hare, C., Sharma, N., John, A., Gaysina, D., Hardy, R., Kuh, D.,

    Richards, M., 2018. Lifetime affective problems and later-life cognitive state: over 50 years

    of follow-up in a British Birth Cohort Study. J. Affect. Disord. 241, 348–355.

    https://doi.org/10.1016/j.jad.2018.07.078

Kuh, D., Pierce, M., Adams, J., Deanfield, J., Ekelund, U., Friberg, P., Ghosh, A.K., Harwood,

    N., Hughes, A., Macfarlane, P.W., Mishra, G., Pellerin, D., Wong, A., Stephen, A.M.,

Richards, M., Hardy, R., 2011. Cohort Profile: Updating the cohort profile for the MRC National Survey of Health and Development: A new clinic-based data collection for ageing research. Int. J. Epidemiol. 40. https://doi.org/10.1093/ije/dyq231

Kuh, D., Wong, A., Shah, I., Moore, A., Popham, M., Curran, P., Davis, D., Sharma, N., Richards, M., Stafford, M., Hardy, R., Cooper, R., 2016. The MRC National Survey of Health and Development reaches age 70: maintaining participation at older ages in a birth cohort study. Eur. J. Epidemiol. 31, 1135–1147. https://doi.org/10.1007/s10654-016-0217-8

Mammarella, I.C., Ghisi, M., Bomba, M., Bottesi, G., Caviola, S., Broggi, F., Nacinovich, R., 2016. Anxiety and depression in children with nonverbal learning disabilities, reading disabilities, or typical development. J. Learn. Disabil. 49, 130–139.

Maughan, B., Carroll, J., 2006. Literacy and mental disorders. Curr. Opin. Psychiatry 19, 350–354.

Maughan, B., Hagell, A., 1996. Poor readers in adulthood: Psychosocial functioning. Dev. Psychopathol. 8, 457–476.

Maughan, B., Rowe, R., Loeber, R., Stouthamer-Loeber, M., 2003. Reading problems and depressed mood. J. Abnorm. Child Psychol. 31, 219–229.

Muthén, L., Muthén, B., 2017. Mplus user's guide (eight edition)[Computer software manual]. Los Angeles, CA.

Polier, G.G., Vloet, T.D., Herpertz-Dahlmann, B., Laurens, K.R., Hodgins, S., 2012. Comorbidity of conduct disorder symptoms and internalising problems in children: investigating a community and a clinical sample. Eur. Child Adolesc. Psychiatry 21, 31–38.

Rodgers, B., 1990. Behaviour and personality in childhood as predictors of adult psychiatric

    disorder. J. Child Psychol. Psychiatry 31, 393–414.

Streiner, D.L., 2005. Finding our way: an introduction to path analysis. Can. J. Psychiatry 50,

    115–122.

Wadsworth, M., Kuh, D., Richards, M., Hardy, R., 2006. Cohort profile: The 1946 National

    Birth Cohort (MRC National Survey of Health and Development). Int. J. Epidemiol. 35, 49–

    54. https://doi.org/10.1093/ije/dyi201

Willcutt, E.G., Pennington, B.F., 2000. Psychiatric comorbidity in children and adolescents with

    reading disability. J. Child Psychol. Psychiatry Allied Discip. 41, 1039–1048.

Tables & Figures

Table 1: Missing data analysis.

Table 2: Demographic information for analytic sample (N=3336).

Table 3: Associations between reading problems at age 11 and affective symptoms from age 13 to 69.

Table 4: Associations between reading problems at age 11 and number of time points with case-level affective symptoms (accumulation).

Table 1: Missing data analysis.

	Mean (SD) or N (%)		Difference
	Sample with missing data (N=4356)	Sample with complete data (N=1006)	
Affective symptoms			
Age 13	0.01 (0.55)	-0.06 (0.51)	$t(1961.1) = 3.62, p < .001$
Age 15	0.02 (0.58)	-0.07 (0.51)	$t(2025.7) = 4.64, p < .001$
Age 36	0.29 (0.87)	0.19 (0.81)	$t(2041.8) = 3.28, p = .001$
Age 43	0.05 (0.66)	-0.03 (0.63)	$t(2037.5) = 3.63, p < .001$
Age 53	0.20 (0.50)	0.17 (0.49)	$t(2096.6) = 1.39, p = .16$
Age 60-64	0.13 (0.56)	0.11 (0.59)	$t(2098.9) = 1.01, p = .31$
Age 69	0.16 (0.58)	0.14 (0.61)	$t(2067.7) = 0.94, p = .35$
Number of time points with case-level affective symptoms			
0	56 (56.57)	533 (52.98)	
1	29 (29.29)	289 (28.73)	$\chi^2(2) = 1.09, p = .58$
≥2	14 (14.14)	184 (18.29)	
Conduct problems			
Absent	2367 (73.40)	795 (79.03)	
Mild	607 (18.82)	164 (16.30)	$\chi^2(2) = 16.46, p < .001$
Severe	251 (7.78)	47 (4.67)	
Reading Problems			
Yes	279 (9.43)	54 (5.37)	$\chi^2(1) = 15.57, p < .001$
No	2680 (90.57)	952 (94.63)	
Sex			
Male	2303 (52.87)	512 (50.89)	$\chi^2(1) = 1.20, p = .27$
Female	2053 (47.13)	494 (49.11)	
Educational attainment			
None	1467 (42.82)	298 (29.62)	$\chi^2(2) = 61.82, p < .001$

Vocational or GCSE	918 (26.80)	298 (29.62)	
A Level or higher	1041 (30.39)	410 (40.76)	
Childhood socioeconomic position			
Professional	214 (5.84)	76 (7.55)	
Intermediate	702 (19.14)	205 (20.38)	
Skilled Non-Manual	552 (15.05)	177 (17.59)	
Skiled Manual	1225 (33.41)	329 (32.70)	$\chi^2 (5) = 17.48, p = .004$
Partly Skilled	710 (19.36)	172 (17.10)	
Unskilled	264 (7.20)	47 (4.67)	
Adulthood socioeconomic position			
Professional	194 (6.07)	88 (8.75)	
Intermediate	997 (31.21)	410 (40.76)	
Skilled Non-Manual	747 (23.39)	233 (23.16)	
Skiled Manual	666 (20.85)	148 (14.71)	$\chi^2 (5) = 59.37, p < .001$
Partly Skilled	445 (13.93)	93 (9.24)	
Unskilled	145 (4.54)	34 (3.38)	

Table 2: Demographic information for analytic sample (N=3336).

	Mean (SD)	N (%)
Affective symptoms		
Age 13	-0.03 (0.54)	-
Age 15	-0.02 (0.55)	-
Age 36	0.24 (0.84)	-
Age 43	0.01 (0.65)	-
Age 53	0.19 (0.50)	-
Age 60-64	0.12 (0.57)	-
Age 69	0.14 (0.59)	-
Conduct problems age 13-15		
Absent	-	2546 (76.32)
Mild	-	575 (17.24)
Severe	-	215 (6.45)
Number of time points with case-level affective symptoms		
0	-	534 (52.98)
1	-	289 (28.67)
≥ 2	-	185 (18.35)
Reading Problems		
Yes	-	283 (8.48)
No	-	3053 (91.52)
Sex		
Male	-	1677 (50.27)
Female	-	1659 (49.73)
Educational attainment		
None	-	1291 (38.70)
Vocational or GCSE	-	926 (27.76)
A Level or higher	-	1119 (33.54)
Childhood socioeconomic position		
Professional	-	198 (5.94)
Intermediate	-	633 (18.98)
Skilled Non-Manual	-	518 (15.53)
Skiled Manual	-	1113 (33.36)
Partly Skilled	-	666 (19.96)
Unskilled	-	208 (6.24)
Adulthood socioeconomic position		
Professional	-	211 (6.33)
Intermediate	-	1128 (33.81)
Skilled Non-Manual	-	787 (23.59)
Skiled Manual	-	648 (19.42)
Partly Skilled	-	421 (12.62)
Unskilled	-	141 (4.23)

Table 3: Associations between reading problems at age 11 and affective symptoms from age 13 to 69.

	Age 13	Age 15	Age 36	Age 43	Age 53	Age 60-64	Age 69
				Affective symptoms			
Unadjusted model: χ^2 (2) = 3.97, p = .14; CFI = 0.999; TLI = 0.991; RMSEA = 0.016							
Reading problems	0.10 (0.02), <.001*	0.08 (0.02), <.001	0.01 (0.02), .63	0.01 (0.02), .54	-0.01 (0.02), .67	0.04 (0.02), .06	0.04 (0.02), .11
Fully adjusted model: χ^2 (3) = 3.82, p = .28; CFI = 1.000; TLI = 0.994; RMSEA = 0.009							
Reading problems	0.09 (0.02), <.001	0.05 (0.02), .01	-0.01 (0.02), .75	0.02 (0.02), .28	-0.01 (0.02), .69	0.03 (0.03), .29	0.02 (0.03), .50

* Output is presented as β (SE), *p*

** Coded where lower values represent higher socioeconomic position

Table 4: Associations between reading problems at age 11 and number of time points with case-level affective symptoms (accumulation).

	Accumulation of affective symptoms
Unadjusted model	
Reading problems	0.05 (0.04), *.22**
Fully adjusted model	
Reading problems	0.04 (0.04), *.27*
Sex	0.21 (0.03), *<.001*
Education	-0.01 (0.04), *.76*
Childhood socioeconomic position**	0.003 (0.03), *.93*
Adulthood socioeconomic position**	0.03 (0.04), *.45*
Conduct problems	0.02 (0.03), *.48*

* Output is presented as β (SE), *p*

** Coded where lower values represent higher socioeconomic position