Childhood predictors of later psychiatric hospital treatment: findings from the Finnish 1981 birth cohort study

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TITLE

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ABSTRACT

Psychiatric hospital treatment (PHT) is expensive and indicates a severe disorder. Investigation of the early identification of this small patient group has though been hindered by small samples or unsatisfactory assessment in childhood. The present study aims to study the predictive association between psychopathology at age eight using multi-informant assessment and later PHT. A nationwide birth cohort of Finnish children (n=5346) was assessed at age eight to obtain information about psychopathology using the Rutter parent and teacher reports and self-reports of depressive symptoms. The main outcome was admission to any hospital with a primary diagnosis of any psychiatric disorder according to the Finnish National Hospital Discharge Register between age 13 and 24. Between age 13 and 24, 6.2% of the males and 4.1% of the females had been admitted for PHT. Among males, PHT was independently predicted by non-intact family and adult reports of conduct and of emotional symptoms, while among females by self-reported depressive symptoms. However, the combination of conduct and emotional problems was the strongest predictor for PHT in both sexes. Admission due to psychosis among males was associated with childhood conduct, attention and emotional problems, but with emotional problems among females. Psychopathology at age eight can be seen as a long-lasting increased risk of severe psychiatric disorders requiring hospital treatment in adolescence or early adulthood. Attention should be paid to self-reports among females and of comorbid conduct and emotional problems in both sexes in the early identification of this patient group.

Keywords: Epidemiology, Child Psychiatry, Health services, Comorbidity, Cohort studies

INTRODUCTION

Psychiatric hospital treatment (PHT) is the most expensive mental health care treatment [24] and indicates a severe psychiatric disorder [5]. PHT becomes more common in adolescence [29] and is associated with psychotic, affective [29] and comorbid disorders, high rates of aggressive behavior [14], suicidality [26] and an elevated risk of death before middle age [4]. In order to prevent these severe disorders and reduce the high health costs, it is important to early identify those at highest risk.

Clinical case-control longitudinal studies have shown that children with a psychiatric diagnosis are at risk of PHT in adulthood [21, 41]. However, the only large-scale prospective birth cohort study examining childhood predictors for later PHT with a follow-up extending to adulthood is the UK National Child Development Study (UKNCDS) [8]. The study included 131 inpatients and 1385 randomly selected controls. Among males, teacher reports of externalizing and internalizing behaviors both at age seven and age eleven predicted hospital treatment of psychosis or neurotic disorders before the age of 28. Conversely among females, problems at age seven did not substantially increase the likelihood of PHT, whereas problems at age eleven increased the likelihood.

Previous studies regarding childhood predictors for later PHT are scarce and several issues have been overlooked. First, the scarcity of gender-specific studies in this field is understandable, since PHT is a rather rare phenomenon, and the number of subjects has not exceeded 1000 participants in most psychiatric birth cohort studies including information both about childhood psychopathology and adult psychiatric outcomes. Second, childhood comorbid conduct and emotional problems increase the risk of several adult adverse outcomes [10, 12, 21, 36, 37], but its impact on later PHT remains unclear. Third, in the UKNCDS, childhood mental health problems relied only on teacher reports at baseline [8]. However, information about childhood problems should be based on standardized tools from several informants to get a comprehensive view of the child's problems [7].

The current study aims to fill the previously described gaps in the literature by examining in an explorative manner the predictive associations between childhood psychiatric problems at age eight (externalizing, internalizing, combinations of them, parent/teacher versus child self-reports) and the timing of PHT and separate

diagnostic groups between age 13 and 24. We used a nationwide birth cohort, consisting of one tenth of all eight-year-olds born in Finland in 1981, and linked it 16 years later to the Finnish National Hospital Discharge Register [13, 28, 37, 38]. Because of the sex differences in disorder prevalence through childhood and adolescence [32, 34] and the differing developmental pathways in the sexes [15, 32], we performed all analyses separately for males and females.

MATERIAL AND METHODS

Participants

This investigation is part of the nationwide "Finnish 1981 Birth Cohort Study". The Joint Commission on Ethics of Turku University and Turku University Central Hospital has approved the research plan. Informed consent was obtained from the children's parents at baseline. The combination of information from questionnaires and registry data was analyzed in such a way that the subject could not be identified.

The methodology of the study has been reported in detail previously [1, 36, 37]. The original representative study sample was drawn from the Finnish-speaking population of Finnish children born during 1981 (n=60,007). The first assessment was conducted in October and November 1989. Of the selected 8-9-year-old 6017 children, 5813 (96.6%) took part in the study in 1989. The sample was controlled for demographic and socio-economic factors in the general population and it has good generalizability [1]. At follow-up, we identified the subjects in our cohort by linking their unique identification number with the Hospital Register Data. Subjects were excluded if their unique personal identification codes were lost or could not be linked with the Hospital Discharge Register, or if they had died or moved between 1989 and 1993. Of the 5813 children studied in 1989, information about inpatient hospital service use between 1994 and 2005 was obtained for 5346 subjects (91.9%; 2710 males (M) and 2636 females (F)).

Methods

Mental health problems at age eight

Psychiatric symptoms at age eight were assessed using information collected from three different sources: parents, teachers, and children. The parents and the teachers completed the Rutter's parent questionnaire [33] and the teacher-questionnaire [31], respectively. Both scales are validated [23] and have been widely used in child psychiatric research [1]. The parent questionnaire consists of 31 and the teacher questionnaire of 26 items on a scale ranging between 0 and 2 points, giving a maximum total score of 62 and 52 points respectively. In addition to the total score scale, there are three subscales. The conduct scale has questions about stealing, lying, aggression, defiance; the attention-hyperactivity scale has concerns about restlessness, distractibility, inattention; and the emotional scale addresses shyness, withdrawal and anxiety. The children themselves filled in the Children's Depression Inventory (CDI), which measures depressive symptoms [22]. The CDI has shown good validity for assessing depressive symptoms among children [39]. It has 27 items on a scale ranging between 0 and 2 points, but the question concerning suicide was excluded from our version, because it was thought that it could upset the children [37]. In sum, our version had a maximum score of 52 points. The agreement between informants and the sex specific scores of the subscales have been reported previously [2].

First, to assess possible caseness, the children were divided into screen positive and negative groups. The total scores of the parent and teacher reports (M: n=2638; F: n=2554) were cut off at 13 and 9 points, respectively, which correspond to the 85th percentile: these are commonly used, and validated to detect mental disorders [23]. Parent and teacher reports were combined using an "or rule" [17, 44], i.e. subjects were classed as screen positive if either the parent report or the teacher report or both reports were above the cutoff score (M: 29.6%; F: 12.6%). The proportions of screen positive and screen negative subjects have been described in detail in a prior report [2].

Second, to study specific types of psychopathology, four scales were used: the pooled conduct, attention-hyperactivity and emotional scales and the self-reported depressive scale [36, 37]. The scores from the parent and teacher conduct, attention-hyperactivity and emotional subscales were summed together to generate the three pooled scales (parent conduct scores + teacher conduct scores = pooled conduct score etc.), while the depressive scale was based on the child self-report alone. These scales were studied as both linear variables to achieve statistical power and as categorical variables to facilitate the interpretation of the results for screening purposes. In line with previous reports using categorical variables [36, 37], we used sex-specific cutoff scores at the 90th percentile based on the distribution in the population-based sample at baseline.

Third, to analyze how combinations of psychopathology affect the outcome, the pooled categorical conduct, attention-hyperactivity, emotional and depressive scales were combined (M: n=2544; F: n=2471). Sixteen different combinations of symptoms were formed by the four categorical scales. The 16 groups were collapsed into six clinically meaningful groups in line with previous reports [36, 37]: 1. The Reference group was negative (below the 90th percentile) on all four scales (M: 69.9%; F: 70.6%); 2. The Conduct-emotional group was conduct-positive and emotional-positive or CDI-positive, indicating a high level of symptoms in both conduct and emotional domains (M: 4.3%; F: 3.5%); 3. The Conduct-only group was positive on the conduct scale, but negative on both the emotional scale and the CDI (M: 5.7%; F: 7.8%); 4. The Attention-Hyperactivity group was positive on the attention-hyperactivity scale, but without conduct problems (M: 4.0%; F: 5.6%); 5. The Emotional-only group was positive on the emotional scale or the CDI, but negative on conduct and attention-hyperactivity scales (M: 9.6%; F: 6.7%); 6. The Invisible group had high levels of self-reported depressive symptoms, but was screen negative on all three scales based on adult reports (M: 6.5%; F: 5.7%).

Additional data at age eight was collected on: (1) parental education level: father's or mother's completion of at least 12 years of education (in Finland compulsory education consists of 9-year comprehensive school after which education can be continued in vocational school or in upper secondary school concentrating on theoretical subjects); (2) family structure: families were classified as intact (two-biological-parent families) or non-intact (other family structure).

The outcome

Information about psychiatric hospital treatment between 1.1.1994 and 31.12.2005 was based on the National Hospital Register in Finland, which is extensively documented in psychiatric research [19, 28, 37, 38]. The register covers the diagnosis and the day of admission in all general, mental and private hospital inpatient care units in Finland. If a patient needs observation for more than 12 hours, the patient is admitted to a inpatient treatment [37].

The outcome of psychiatric hospital treatment was defined as having a primary diagnosis of a psychiatric disorder in the hospital discharge register between 1994 and 2005. All patients treated according to the register

were included in the study. The diagnostic codes were registered according to ICD-9 in years 1994-1995 and ICD-10 in 1996-2005. Diagnostic codes of specific diagnoses and diagnostic groups were classified according to the transcription of ICD-10 and ICD-9 codes to DSM-IV-TR diagnoses [3]. The association with childhood variables was analyzed for having any psychiatric diagnosis and additionally separately analyzed for the four diagnostic groups with most subjects: psychosis, mood disorders (non-psychotic), anxiety disorders, and substance-related disorders. Subjects could belong to several diagnostic groups, because some subjects were diagnosed with different diagnoses at different admissions. Subjects who had not been treated for a psychiatric disorder according to the register data between 1994 and 2005 were used as a reference group in all statistical analyses.

Statistical Analysis

Associations of psychiatric symptoms with incidence of PHT and the four diagnostic groups between ages 13 and 24 years were analyzed using Cox's proportional hazards regression analysis [16]. The time from age 13 to the first hospital admission with a certain type of diagnosis before age 24 was the observed time for an endpoint event in the analyses. For those who did not have any hospital treatment before age 24, the time from age 13 to age 24 was recorded as the event time, and it was handled as a censored time observation. The strength of the associations was quantified using hazard ratios (HR) with 95% confidence intervals (95%CI). The Kaplan-Meier curves in the figures were Nelson (empirical) cumulative hazard function estimates. Statistical computations were done with SAS System for Windows, release 9.1/2006.

RESULTS

Psychiatric Hospital Treatment between Age 13 and 24

During the follow-up, 168 (6.2%) males and 108 (4.1%) females had been admitted for psychiatric treatment. The mean age at their first admission was 19.1 (SD 2.4) for males and 18.8 (SD 3.7) for females. A detailed table of the number of subjects who had been admitted for different specific psychiatric diagnoses, is available from the corresponding author upon request. The most common psychiatric reason (diagnostic group) for being admitted to hospital treatment among males was substance-related disorders (1.8%, n=48), while among females

it was non-psychotic mood disorders (1.9%, n=50). Males (1.5%, n=40) were more often than females (.8%, n=22) admitted for psychotic disorders (Fisher's exact test, subjects without the studied diagnosis were used as reference group, p=.030). More males than females were admitted for non-affective psychoses (1.3%, n=35 vs. .5%, n=13, p=.002), and two of its six sub-diagnoses: schizophrenia (.6%, n=15 vs. .2%, n=4, p=.019) and psychotic disorder not otherwise specified (.8%, n=22 vs. .2%, n=5, p=.002). No sex differences were seen among affective psychoses (.4%, n=10 vs. .4%, n=11, p=.83).

Some subjects had several admissions with different primary diagnoses. The rate of overlapping of different diagnostic groups during the follow-up is available from the corresponding author upon request. Among males, diagnostic groups overlapped with each other between 4.2% and 30.0%, while among females, the groups overlapped between 8.0% and 40.9%.

Predictors at Age eight for Psychiatric Hospital Treatment

Screen positive at age eight: As shown in Figures a and b, the probability of surviving without PHT decreased more for the screen-positive group than for the screen-negative group throughout the follow-up period in both sexes. However, among males, there was an increase in subjects being admitted for the first time for PHT during the follow-up between the age of 18 and 22 in both the screen-positive and screen-negative groups. Of all males admitted for PHT, 51.5% were screen positive at age eight (sensitivity, n=84 of total 163 subjects with complete childhood data, positive predictive value (PPV)=10.7%), while the sensitivity among females was 27.1% (n=29 of total 107, PPV=9.0%). Additionally, in both sexes, screen-positive status predicted mood disorders (M: n=21, sensitivity=53.9%, PPV=2.7%, HR 2.81, 95%CI 1.50-5.27, p=.001; F: n=15, sensitivity=30.6%, PPV=4.7%, HR 3.16, 95%CI 1.72-5.81, p<.001), anxiety disorders (M: n=19, sensitivity=52.8%, PPV=2.4, HR 2.67, 95%CI 1.39-5.14, p=.003; F: n=6, sensitivity=42.7%, PPV=1.9%, HR 5.32, 95%CI 1.85-15.32, p=.002) and substance-related disorders (M: n=29, sensitivity=60.4%, PPV=3.7%, HR 3.67, 95%CI 2.06-6.54, p<.001; F: n=9, sensitivity=37.5%, PPV=2.8%, HR 4.28, 95%CI 1.87-9.77, p<.001). Psychosis was predicted only among males (n=22, sensitivity=56.4%, PPV=2.8%, HR 3.13, 95%CI 1.66-5.89, p<.001).

Psychopathology types and family variables: Table 1 shows the predictive associations between family variables and the categorical psychopathology scales at age eight and later PHT, according to the univariate and

multivariate analyses. When the two family variables and the four psychopathology scales were included in multivariate models (a model including the categorical scales (Table 1) and another model including the linear scales), PHT, among males, was independently predicted by non-intact family structure ($p<.001$ for both categorical and linear regressions, given in this order), the conduct scale ($p=.03$ and $p=.006$), the emotional scale ($p=.01$ and $p=.002$) and the self-reported depressive symptoms in the linear regression ($p=.008$). Among females, PHT was independently predicted by the self-reported depressive scale ($p=.02$ for both regressions) and the emotional scale in the linear regression ($p=.04$).

Because of the small number of subjects, linear instead of categorical psychopathology scales were primarily used to analyze the predictive association between childhood psychopathology and specific diagnostic groups (Table 2). Psychosis was independently predicted by the conduct scale among males. Mood disorders were independently predicted by the emotional scale and the self-reported depressive symptoms in both sexes. Anxiety disorders were independently predicted by the emotional scale among males. Substance-related disorders were independently predicted by non-intact family structure and the conduct scale in both sexes.

Because of the particular importance of early identification of children at risk of psychotic disorders we further examined associations between categorical measures of psychopathology at age eight and later psychotic disorder. Out of 40 males admitted for a psychotic disorder, 32.5% scored above the 90th percentile on the conduct scale (HR 4.35, 95%CI 2.25-8.43, $p<.001$), 28.2% on the emotional scale (HR 2.84, 95%CI 1.41-5.70, $p=.003$) and 22.5% on the hyperkinetic scale (HR 2.84, 95%CI 1.35-5.96, $p=.006$). Among 22 females with psychosis, 27.3% scored above the 90th percentile on the emotional scale (HR 3.44, 95%CI 1.35-8.79, $p=.01$). The same associations were significant, when the psychopathology measures were analyzed as linear variables in the univariate analysis (Table 2).

Combinations of psychopathology: The conduct, attention-hyperactivity, emotional and self-reported depressive psychopathology scales were combined to disentangle the predictive value of pure versus comorbid problems and of adult- versus self-reports. The proportions of subjects with different combinations of psychopathology who had later been treated for a psychiatric disorder are shown in Figure c and d, including the univariate predictive associations for PHT. The strongest predictive association for PHT was found for the comorbid conduct-emotional groups, as 20.9% of the males and 11.5% (PPV) of the females belonging to this

group had been treated for a psychiatric disorder during the follow-up period, while the corresponding figures for the reference groups were 3.9% for males and 3.2% for females. Among males, also the attention-hyperactivity group, the conduct group and the emotional group predicted PHT. In additional analysis when the effects of the interactions between the psychopathology types, family structure and parental education level were analyzed on the main outcome PHT, no significant interactions were found.

DISCUSSION

The results of this nationwide population-based study have several findings with implications for the early identification of subjects with psychiatric disorders requiring hospital treatment. Among females, self-reported depressive symptoms at age eight had a strong predictive association with psychiatric outcome, while among males, conduct problems most strongly predicted psychiatric outcomes. However, it was the combination of conduct and emotional problems among both males and females which mainly increased the risk of later PHT.

One out of two males and one out of four females admitted for PHT by the age of 24 were "screen-positives" at age eight, according to either parent or teacher reports indicating possible psychiatric caseness. Accordingly, previous studies have shown that childhood psychopathology predicts especially intensive psychiatric treatment [20, 41]. Furthermore, psychiatric problems at age eight increase the risk for later PHT more in males than females, which is in line with the findings from the UKNCDS [8].

When we analyzed combinations of psychopathology scales, the greatest likelihood for PHT was found for children with combined conduct and emotional problems. About 21% of males and 12 % of females with concurrent conduct and emotional problems at age eight were admitted for PHT by age 24, compared to 4% (M) and 3% (F) of the reference group. Previous longitudinal studies have shown that childhood internalizing and externalizing problems are associated with adverse psychiatric outcomes in adulthood [10, 21, 37], including our previous report of males with military call-up data [36]. A novel finding in the present study is that the long-term prognosis concerning severe adult disorders requiring PHT, is poorest also among females with comorbid externalizing and internalizing problems in childhood, not only among males.

The developmental gender differences in relation to later psychotic illness have not received the attention this important topic deserves. Intriguingly, among females, only emotional problems had a predictive association with psychosis in early adulthood, while among males, conduct problems was the associated precursor. This is in line with the few existing studies including gender-specific information on childhood psychopathology [8, 27]. To date, most of the longitudinal birth cohort studies have not reported separate estimates concerning childhood psychopathology for males and females [6, 18, 20, 36]. In previous studies, some gender differences have been indicated: neurodevelopmental deficits are more profound among preschizophrenic males than females [43]. Also a life-course-persistent psychopathological deviance has been indicated to associate with psychosis among males, while females often have a later onset of symptoms [43].

Concerning other diagnostic groups treated in hospitals and their impact on childhood psychopathology, the results are largely in line with previous reports. Both mood and anxiety disorders treated in hospitals were predicted by similar problems in childhood [20, 36]. Though attention problems predicted PHT and several diagnoses among males in the univariate analyses, no statistically significant associations were found in the multivariate analyses. This further supports findings from previous longitudinal population based studies were attention problems have been adjusted for other childhood problems [30]. Substance-related disorders were predicted by conduct problems [9, 36], and non-intact family structure in both sexes [42]. However, a non-intact family may not be seen as a risk per se, but, for example, through the often associated family problems like disadvantageous child-rearing practices, financial problems and psychiatric problems among parents [11].

Generally, it is considered that children's self-reports of psychopathology, especially depressive symptoms, become more important the older the children get [35, 40]. In the present study, self-reports were gathered already at the age of eight, which is earlier than in other psychiatric birth cohort studies with outcomes in adulthood [36]. A novel finding is that self-reports of depressive symptoms at age eight show independent predictive associations with later PHT among females, while adult reports remain significant among males. If replicated, this finding indicates that especially girls' depressive symptoms are often not noticed by adults, though it is an important warning sign for possible later adverse outcomes. Also the self-identification of depressive symptoms

The strengths of the sample include the fact that it is nationwide, a follow-up rate of 91%, and the use of a nationwide well-documented register [28, 37, 38]. However, several limitations should be considered when interpreting the results of this study. First, interviews were not used to assess childhood psychopathology. Some individual and environmental factors, like family factors, could possibly have affected the level of psychopathology reported in the questionnaires, which could have been corrected with a clinical judgement. Conversely, the use of brief reports made it possible to obtain a large sample with high a participation rate (97%). Second, though former studies concerning psychotic disorders have shown that the hospital discharge register is diagnostically valid and very accurate in detecting psychoses [28], we do not have data on the diagnostic validity of, e.g., anxiety disorders. However, all Finnish inpatient units are legally obliged to report all discharges to the register, and 97.6% of all registered psychiatric diagnoses are identical with the ones in medical records [19]. Third, admission to PHT depends not only on the severity of the disorder, but also on help-seeking patterns and on the health care system. Yet, the legal principles of outpatient and inpatient treatment in mental health are from 1990, and the rate of psychiatric inpatient treatment has remained the same between 1994 and 2007 (6.0 discharges in general and mental hospitals per 1000 adult population [25]).

Given the burden of severe psychiatric disorders and intensive psychiatric treatment on individuals and society, early identification of these patients is a major challenge for mental health services. Based on our results, we recommend different screening strategies for males and females, when identifying children at risk of later psychiatric disorders requiring PHT. Among males, conduct problems, while among females, anxiety and self-reported depressive problems, have the strongest association with PHT. However, comorbid conduct and emotional problems carry the highest risk of later PHT in both sexes. Moreover, information from multiple sources is emphasized and especially girls' reports of their own internal distress should not be overlooked in screening or clinical assessment.

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REFERENCES

1. Almqvist F, Ikäheimo K, Kumpulainen K et al (1999) Design and subjects of a Finnish epidemiological study on psychiatric disorders in childhood. Eur Child Adolesc Psychiatry 8 Suppl 4:3-6

2. Almqvist F, Kumpulainen K, Ikäheimo K et al (1999) Behavioural and emotional symptoms in 8-9-year-old children. Eur Child Adolesc Psychiatry 8 Suppl 4:7-16

3. American Psychiatric Association (2000) Appendix H. DSM-IV classification with ICD-10 codes. In: American Psychiatric Association (ed) Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR). American Psychiatric Association, Washington, DC, pp 829--841

4. Best KM, Hauser ST, Gralinski-Bakker JH, Allen JP, Crowell J (2004) Adolescent psychiatric hospitalization and mortality, distress levels, and educational attainment: Follow-up after 11 and 20 years. Arch Pediatr Adolesc Med 158:749-752

5. Blanz B, Schmidt MH (2000) Preconditions and outcome of inpatient treatment in child and adolescent psychiatry. J Child Psychol Psychiatry 41:703-712

6. Cannon M, Caspi A, Moffitt TE, Harrington H, Taylor A, Murray RM, Poulton R (2002) Evidence for early-childhood, pan-developmental impairment specific to schizophreniform disorder: Results from a longitudinal birth cohort. Arch Gen Psychiatry 59:449-456

7. Costello EJ, Egger H, Angold A (2005) 10-year research update review: The epidemiology of child and adolescent psychiatric disorders: I. methods and public health burden. J Am Acad Child Adolesc Psychiatry 44:972-986

8. Done DJ, Crow TJ, Johnstone EC, Sacker A (1994) Childhood antecedents of schizophrenia and affective illness: Social adjustment at ages 7 and 11. BMJ 309:699-703

9. Elkins IJ, McGue M, Iacono WG (2007) Prospective effects of attention-deficit/hyperactivity disorder, conduct disorder, and sex on adolescent substance use and abuse. Arch Gen Psychiatry 64:1145-1152

10. Ensminger ME, Juon HS, Fothergill KE (2002) Childhood and adolescent antecedents of substance use in adulthood. Addiction 97:833-844

11. Fergusson DM, Boden JM, Horwood LJ (2007) Exposure to single parenthood in childhood and later mental health, educational, economic, and criminal behavior outcomes. Arch Gen Psychiatry 64:1089-1095

12. Foley DL, Goldston DB, Costello EJ, Angold A (2006) Proximal psychiatric risk factors for suicidality in youth: The great smoky mountains study. Arch Gen Psychiatry 63:1017-1024

13. Gissler M, Haukka J (2004) Finnish health and social welfare registers in epidemiological research. Norsk Epidemiologi 14:113-120

14. Gowers SG, Rowlands L (2005) Inpatient services. Curr Opin Psychiatry 18:445-448

15. Hankin BL, Abramson LY (2001) Development of gender differences in depression: An elaborated cognitive vulnerability-transactional stress theory. Psychol Bull 127:773-796

16. Hoshmer DW, Lemenshow S: Applied Survival Analysis, Regression Modeling of Time to Event Data. New York, John Wiley & Sons, Inc., 1999

17. Jensen PS, Rubio-Stipec M, Canino G, Bird HR, Dulcan MK, Schwab-Stone ME, Lahey BB (1999) Parent and child contributions to diagnosis of mental disorder: Are both informants always necessary? J Am Acad Child Adolesc Psychiatry 38:1569-1579

18. Jones P, Rodgers B, Murray R, Marmot M (1994) Child development risk factors for adult schizophrenia in the British 1946 birth cohort. Lancet 344:1398-1402

19. Keskimäki I, Aro S (1991) Accuracy of data on diagnoses, procedures and accidents in the Finnish hospital discharge register. Int J Health Sci 2:15-21

20. Kim-Cohen J, Caspi A, Moffitt TE, Harrington H, Milne BJ, Poulton R (2003) Prior juvenile diagnoses in adults with mental disorder: Developmental follow-back of a prospective-longitudinal cohort. Arch Gen Psychiatry 60:709-717

21. Knapp M, McCrone P, Fombonne E, Beecham J, Wostear G (2002) The Maudsley long-term follow-up of child and adolescent depression: 3. Impact of comorbid conduct disorder on service use and costs in adulthood. Br J Psychiatry 180:19-23

22. Kovacs M: Children's Depression Inventory, CDI, Manual. Ontario, Multi-Health Systems Inc., 1992

23. Kresanov K, Tuominen J, Piha J, Almqvist F (1998) Validity of child psychiatric screening methods. Eur Child Adolesc Psychiatry 7:85-95

24. Mechanic D, McAlpine DD, Olfson M (1998) Changing patterns of psychiatric inpatient care in the united states, 1988-1994. Arch Gen Psychiatry 55:785-791

25. Official Statistics of Finland/ Stakes (2008) Psykiatrian erikoisalan laitoshoito 2007 - tilastotiedote 36/2008. http://www.stakes.fi/tilastot/tilastotiedotteet/2008/Tt36_08.pdf. Accessed 04/20 2009

26. Olfson M, Gameroff MJ, Marcus SC, Greenberg T, Shaffer D (2005) National trends in hospitalization of youth with intentional self-inflicted injuries. Am J Psychiatry 162:1328-1335

27. Olin SS, John RS, Mednick SA (1995) Assessing the predictive value of teacher reports in a high risk sample for schizophrenia: A ROC analysis. Schizophr Res 16:53-66

28. Peräla
ä J, Suvisaari J, Saarni SI et al (2007) Lifetime prevalence of psychotic and bipolar I disorders in a general population. Arch Gen Psychiatry 64:19-28

29. Pottick K, Hansell S, Gutterman E, White HR (1995) Factors associated with inpatient and outpatient treatment for children and adolescents with serious mental illness. J Am Acad Child Adolesc Psychiatry 34:425-433

30. Reef J, Diamantopoulou S, van Meurs I, Verhulst F, van der Ende J (2009) Child to adult continuities of psychopathology: A 24-year follow-up. Acta Psychiatr Scand 120:230-238

31. Rutter M (1967) A children's behaviour questionnaire for completion by teachers: Preliminary findings. J Child Psychol Psychiatry 8:1-11

32. Rutter M, Caspi A, Moffitt TE (2003) Using sex differences in psychopathology to study causal mechanisms: Unifying issues and research strategies. J Child Psychol Psychiatry 44:1092-1115

33. Rutter M, Tizard J, Whitmore K (eds) (1970) Education, health and behaviour. Longman, London.

34. Simonoff E, Pickles A, Meyer JM et al (1997) The Virginia twin study of adolescent behavioral development. Influences of age, sex, and impairment on rates of disorder. Arch Gen Psychiatry 54:801-808

35. Sourander A, Helstelä L, Helenius H (1999) Parent-adolescent agreement on emotional and behavioral problems. Soc Psychiatry Psychiatr Epidemiol 34:657-663

36. Sourander A, Jensen P, Davies M et al (2007) Who is at greatest risk of adverse long-term outcomes? The Finnish from a boy to a man study. J Am Acad Child Adolesc Psychiatry 46:1148-1161

37. Sourander A, Klomek AB, Niemelä S et al (2009) Childhood predictors of completed and severe suicide attempts: Findings from the Finnish 1981 birth cohort study. Arch Gen Psychiatry 66:398-406

38. Tiihonen J, Haukka J, Henriksson M et al (2005) Premorbid intellectual functioning in bipolar disorder and schizophrenia: Results from a cohort study of male conscripts. Am J Psychiatry 162:1904-1910

39. Timbremont B, Braet C, Dreessen L (2004) Assessing depression in youth: Relation between the children's depression inventory and a structured interview. J Clin Child Adolesc Psychol 33:149-157

40. Verhulst FC, Dekker MC, van der Ende J (1997) Parent, teacher and self-reports as predictors of signs of disturbance in adolescents: Whose information carries the most weight? Acta Psychiatr Scand 96:75-81

41. Weissman MM, Wolk S, Wickramaratne P et al (1999) Children with prepubertal-onset major depressive disorder and anxiety grown up. Arch Gen Psychiatry 56:794-801

42. Weitoft GR, Hjern A, Haglund B, Rosen M (2003) Mortality, severe morbidity, and injury in children living with single parents in Sweden: A population-based study. Lancet 361:289-295

43. Welham J, Isohanni M, Jones P, McGrath J (2009) The antecedents of schizophrenia: A review of birth cohort studies. Schizophr Bull 35:603-623

44. Youngstrom EA, Findling RL, Calabrese JR (2003) Who are the comorbid adolescents? Agreement between psychiatric diagnosis, youth, parent, and teacher report. J Abnorm Child Psychol 31:231-245

Table 1. Predictive associations between family structure and psychopathology scales at age eight, and psychiatric hospital treatment between age 13 and 24. The univariate and multivariate analyses were done with Cox's regression analysis.[a]

	Males						Females					
	Total	Psychiatric hospital treatment[b]					Total	Psychiatric hospital treatment[b]				
			Univariate analysis		Multivariate analysis				Univariate analysis		Multivariate analysis	
	No.	% (No.)	HR (95% CI)	p-value	HR (95% CI)	p-value	No.	% (No.)	HR (95% CI)	p-value	HR (95% CI)	p-value
Family structure												
Two biological parents	2181	4.8 (105)					2158	3.7 (80)				
Other	435	12.4 (54)	**2.71 (1.95-3.76)**	**<.001**	**1.98 (1.37-2.85)**	**<.001**	408	6.4 (26)	**1.75 (1.12-2.72)**	**.01**	1.50 (0.94-2.39)	.09
Parental education level												
Upper secondary	924	4.7 (43)					904	3.0 (27)				
Lower	1663	6.6 (110)	**1.44 (1.01-2.05)**	**.04**	1.18 (0.82-1.69)	.38	1633	4.8 (79)	**1.63 (1.05-2.53)**	**.03**	1.51 (0.95-2.38)	.08
Conduct scale												
<90th percentile	2337	5.1 (120)					2251	3.7 (84)				
≥90th percentile	264	15.9 (42)	**3.26 (2.29-4.63)**	**<.001**	**1.70 (1.04-2.79)**	**.03**	297	7.4 (22)	**2.04 (1.28-3.27)**	**.003**	1.65 (0.96-2.83)	.07
Attention scale												
<90th percentile	2338	5.3 (123)					2257	3.9 (87)				
≥90th percentile	247	15.0 (37)	**3.02 (2.09-4.36)**	**<.001**	1.52 (0.92-2.52)	.10	268	6.0 (16)	1.58 (0.92-2.68)	.10	1.07 (0.59-1.95)	.82
Emotional scale												
<90th percentile	2274	5.3 (121)					2277	3.9 (88)				
≥90th percentile	321	12.5 (40)	**2.47 (1.72-3.52)**	**<.001**	**1.66 (1.11-2.50)**	**.01**	251	6.8 (17)	**1.79 (1.06-3.01)**	**.03**	1.53 (0.88-2.65)	.13
Self-report of depressive symptoms												
<90th percentile	2338	5.5 (128)					2296	3.7 (84)				
≥90th percentile	311	11.3 (35)	**2.13 (1.47-3.10)**	**<.001**	1.45 (0.94-2.23)	.09	278	7.9 (22)	**2.22 (1.39-3.55)**	**<.001**	**1.83 (1.10-3.03)**	**.02**

Abbreviations: HR, hazard ratio; CI, confidence interval.

[a] Bold face indicates a statistically significant association at p<.05.

[b] Subjects who had not been admitted for psychiatric hospital treatment between age 13 and 25 were used as reference group in Cox's regression analysis.

Table 2. Predictive associations between family structure and psychopathology scales at age eight, and psychiatric hospital treatment of different diagnostic groups between age 13 and 24. The univariate and multivariate analyses were done with Cox's regression analysis.[a]

Table 2. Predictive associations between family structure and psychopathology scales at age eight, and psychiatric hospital treatment of different diagnostic groups between age 13 and 24. The univariate and multivariate analyses were done with Cox's regression analysis.[a]

	Males					Females				
		Univariate analysis		Multivariate analysis			Univariate analysis		Multivariate analysis	
	% (No.)	HR (95% CI)	p-value	HR (95% CI)	p-value	% (No.)	HR (95% CI)	p-value	HR (95% CI)	p-value
Psychosis[b]										
Family structure										
Two biological parents	1.1 (23)					0.7 (16)				
Other	3.0 (13)	**2.89 (1.46-5.70)**	**.002**	1.81 (0.84-3.90)	.13	1.5 (6)	1.99 (0.78-5.09)	.15	1.97 (0.76-5.13)	.17
Parental education level										
Upper secondary	1.6 (15)					0.8 (7)				
Lower	1.3 (21)	0.78 (0.40-1.51)	.46	0.54 (0.27-1.08)	.08	0.9 (15)	1.18 (0.48-2.90)	.71	1.28 (0.50-3.33)	.61
Linear psychopathology scales[c]										
Conduct scale	(2601)	**1.74 (1.41-2.14)**	**<.001**	**1.96 (1.38-2.79)**	**<.001**	(2548)	1.18 (0.87-1.62)	.29	1.19 (0.79-1.80)	.41
Attention scale	(2585)	**1.47 (1.15-1.88)**	**.002**	0.86 (0.57-1.29)	.46	(2525)	1.00 (0.66-1.52)	.99	0.80 (0.46-1.38)	.42
Emotional scale	(2595)	**1.49 (1.17-1.89)**	**.001**	1.21 (0.88-1.66)	.24	(2528)	**1.47 (1.07-2.02)**	**.02**	1.41 (0.997-2.00)	.05
Self-report of depressive symptoms	(2658)	1.11 (0.83-1.48)	.47	0.81 (0.56-1.18)	.27	(2574)	1.25 (0.88-1.79)	.21	1.15 (0.78-1.70)	.49
Mood disorders[b]										
Family structure										
Two biological parents	1.3 (28)					1.8 (39)				
Other	2.8 (12)	**2.18 (1.11-4.29)**	**.02**	1.68 (0.80-3.53)	.17	2.5 (10)	1.36 (0.68-2.72)	.39	1.23 (0.61-2.51)	.56
Parental education level										
Upper secondary	1.6 (15)					1.4 (13)				
Lower	1.4 (23)	**0.85 (0.45-1.63)**	**.63**	0.71 (0.36-1.41)	.33	2.2 (36)	1.53 (0.81-2.89)	.19	1.40 (0.72-2.72)	.32
Linear psychopathology scales[c]										
Conduct scale	(2601)	1.40 (1.10-1.79)	.007	1.40 (0.97-2.03)	.07	(2548)	**1.29 (1.08-1.54)**	**.005**	1.17 (0.91-1.50)	.21
Attention scale	(2585)	1.22 (0.92-1.61)	.17	0.80 (0.53-1.22)	.31	(2525)	1.23 (0.99-1.52)	.06	1.01 (0.75-1.36)	.95
Emotional scale	(2595)	**1.57 (1.25-1.97)**	**<.001**	**1.44 (1.12-1.86)**	**.005**	(2528)	**1.41 (1.13-1.77)**	**.002**	**1.24 (0.97-1.58)**	**.09**
Self-report of depressive symptoms	(2658)	**1.51 (1.20-1.89)**	**<.001**	**1.35 (1.05-1.74)**	**.02**	(2574)	**1.42 (1.14-1.76)**	**.002**	**1.29 (1.02-1.64)**	**.03**

Table 2 continued.

	Males					Females				
		Univariate analysis		Multivariate analysis			Univariate analysis		Multivariate analysis	
	% (No.)	HR (95% CI)	p-value	HR (95% CI)	p-value	% (No.)	HR (95% CI)	p-value	HR (95% CI)	p-value
Anxiety disorders[b]										
Family structure										
Two biological parents	1.3 (28)					0.5 (10)				
Other	1.6 (7)	1.26 (0.55-2.89)	.58	0.97 (0.41-2.31)	.95	0.98 (4)	2.12 (0.67-6.77)	.20	1.70 (0.52-5.56)	.38
Parental education level										
Upper secondary	1.1 (10)					0.6 (5)				
Lower	1.5 (25)	1.39 (0.67-2.90)	.38	1.15 (0.54-2.44)	.71	0.6 (9)	0.99 (0.33-2.97)	.99	0.77 (0.25-2.35)	.64
Linear psychopathology scales[c]										
Conduct scale	(2601)	**1.34 (1.03-1.75)**	**.03**	0.96 (0.63-1.45)	.83	(2548)	**1.43 (1.10-1.84)**	**.007**	1.12 (0.76-1.65)	.56
Attention scale	(2585)	**1.43 (1.09-1.87)**	**.01**	1.33 (0.89-1.98)	.16	(2525)	**1.54 (1.18-2.01)**	**.002**	1.38 (0.94-2.04)	.10
Emotional scale	(2595)	**1.57 (1.23-2.02)**	**<.001**	**1.42 (1.08-1.87)**	**.01**	(2528)	1.15 (0.71-1.86)	.56	0.97 (0.58-1.62)	.91
Self-report of depressive symptoms	(2658)	1.27 (0.96-1.67)	.09	1.10 (0.81-1.50)	.54	(2574)	**1.49 (1.03-2.16)**	**.04**	1.30 (0.88-1.91)	.18
Substance-related disorders[b]										
Family structure										
Two biological parents	1.2 (27)					0.6 (12)				
Other	4.8 (21)	**4.01 (2.27-7.09)**	**<.001**	**2.40 (1.25-4.60)**	**.009**	2.9 (12)	**5.33 (2.39-11.86)**	**<.001**	**4.30 (1.88-9.83)**	**<.001**
Parental education level										
Upper secondary	1.1 (10)					0.7 (6)				
Lower	2.0 (34)	1.90 (0.94-3.85)	.07	1.34 (0.65-2.76)	.42	1.1 (18)	1.66 (0.66-4.18)	.28	1.36 (0.53-3.46)	.53
Linear psychopathology scales[c]										
Conduct scale	(2601)	**1.84 (1.52-2.22)**	**<.001**	**1.47 (1.08-2.01)**	**.01**	(2548)	**1.43 (1.17-1.74)**	**<.001**	**1.51 (1.11-2.06)**	**.01**
Attention scale	(2585)	**1.75 (1.42-2.17)**	**<.001**	0.98 (0.69-1.40)	.93	(2525)	1.23 (0.91-1.65)	.17	0.82 (0.52-1.30)	.40
Emotional scale	(2595)	**1.44 (1.16-1.80)**	**.001**	1.16 (0.89-1.51)	.27	(2528)	1.27 (0.90-1.80)	.18	1.15 (0.78-1.69)	.48
Self-report of depressive symptoms	(2658)	**1.51 (1.21-1.88)**	**<.001**	1.22 (0.94-1.59)	.13	(2574)	1.25 (0.90-1.75)	.18	0.95 (0.64-1.41)	.82

Abbreviations: HR, hazard ratio; CI, confidence interval.

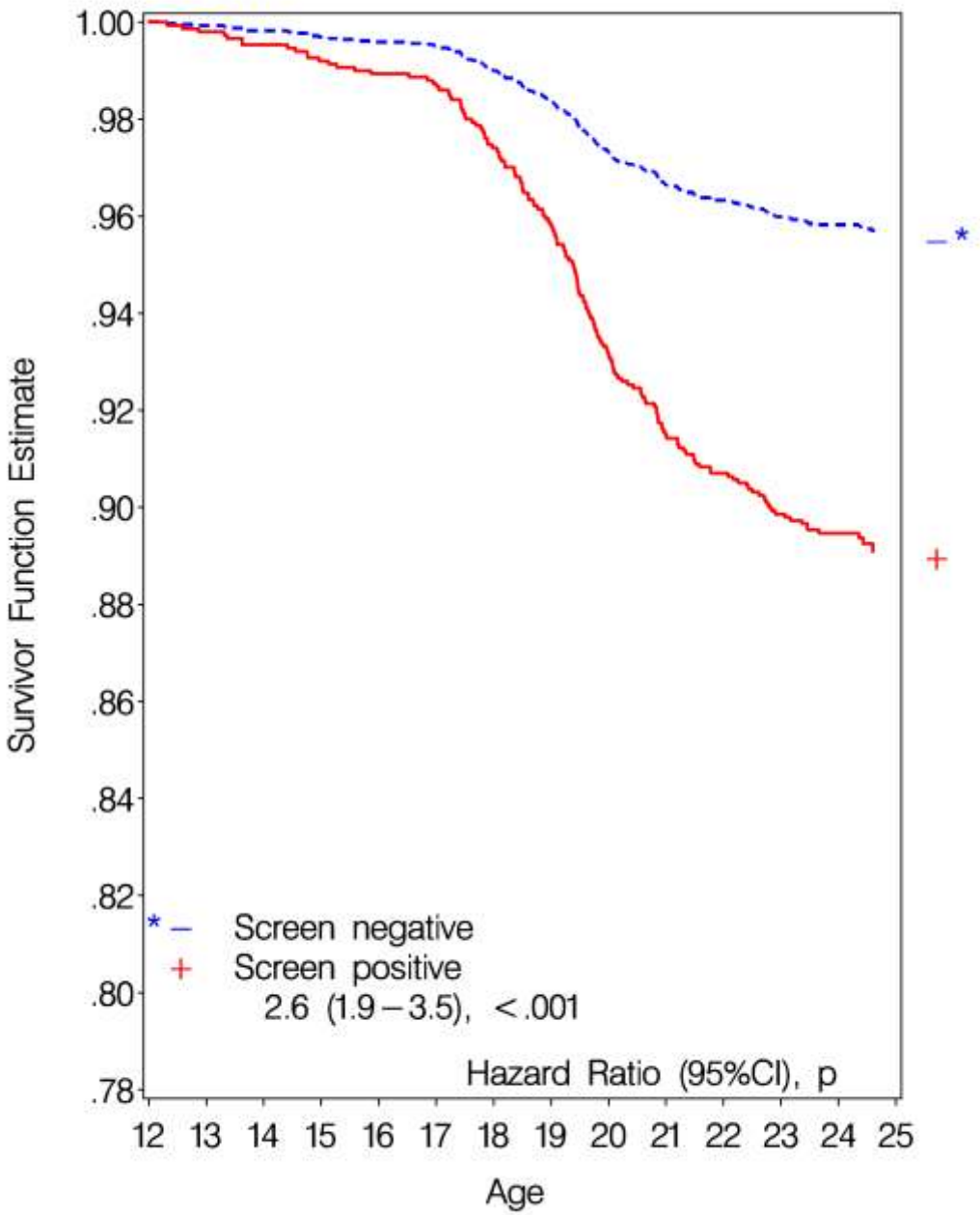
[a] Bold face indicates a statistically significant association at p<.05.

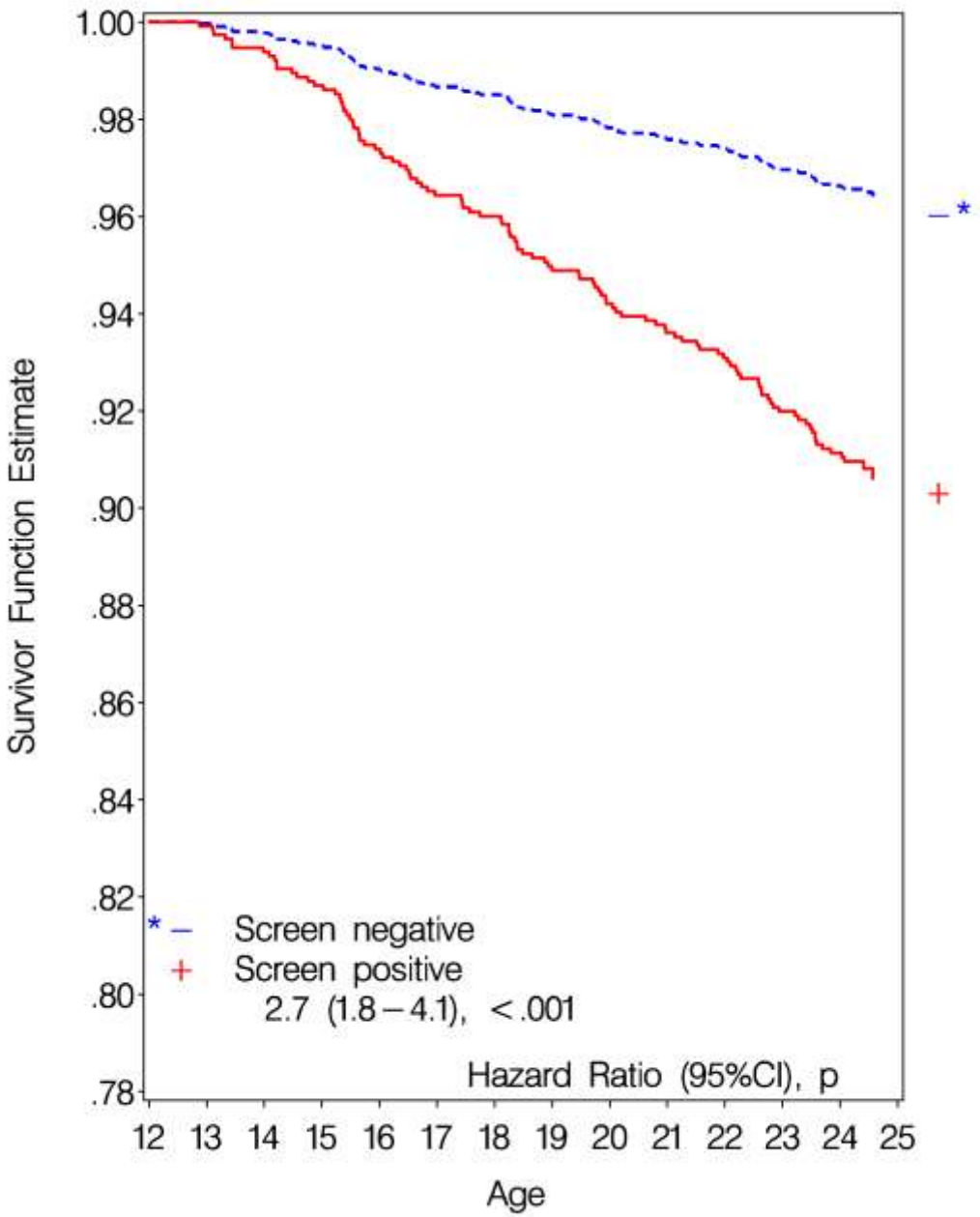
[b] Subjects who had not been admitted for psychiatric hospital treatment between age 13 and 25 were used as reference group in Cox's regression analysis.

[c] Hazard ratios and confidence intervals of the linear variables are calculated for one standard deviation change.

Figure legend

Fig. 1 Estimated survival curves for surviving without psychiatric hospital treatment between age 13 and 24 by screening status among males (Fig a, n=2638, 29.6% screen positive) and females (Fig b, n=2554, 12.6% screen positive) and by different combinations of psychopathology among males (Fig c, n=2544) and females (Fig d, n=2471). The psychopathology combinations: reference (males (M): 69.9%, females (F): 70.6%), conduct-emotional (M: 4.3%; F: 3.5%), conduct-only (M: 5.7%; F: 7.8%), attention (M: 4.0%; F: 5.6%), emotional-only (M: 9.6%; F: 6.7%) and invisible status (M: 6.5%; F: 5.7%). Reported hazard ratios (HR) with confidence intervals (95%CI) are done with univariate Cox's regression analysis.


1.00
.98
.96
.94
.92
.90
.88
.86
.84
.82
.80
.78
Survivor Function Estimate
* – Screen negative
+ Screen positive
2.6 (1.9 – 3.5), < .001
Hazard Ratio (95%CI), p
12 13 14 15 16 17 18 19 20 21 22 23 24 25
Age


1.00
.98
.96
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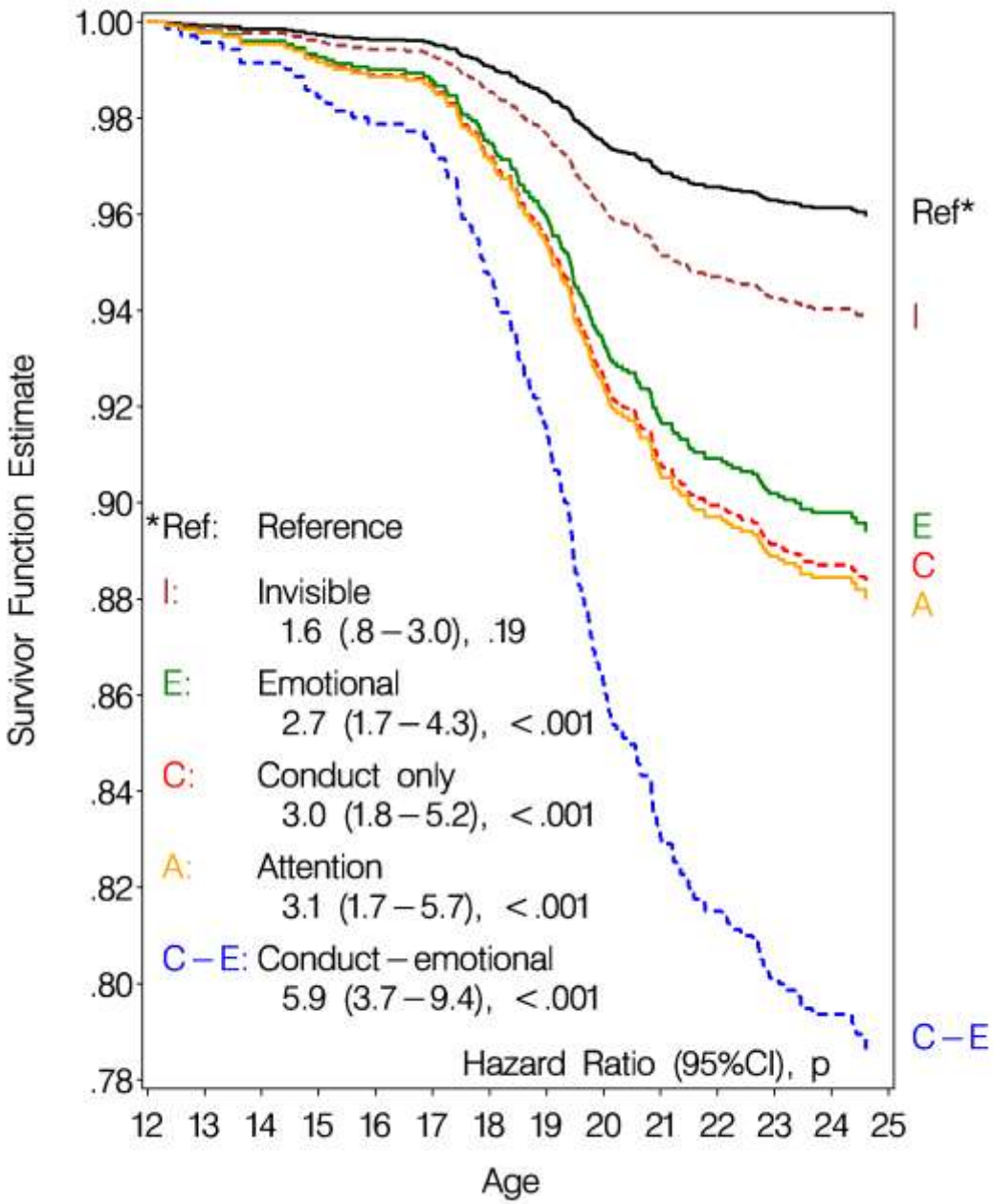
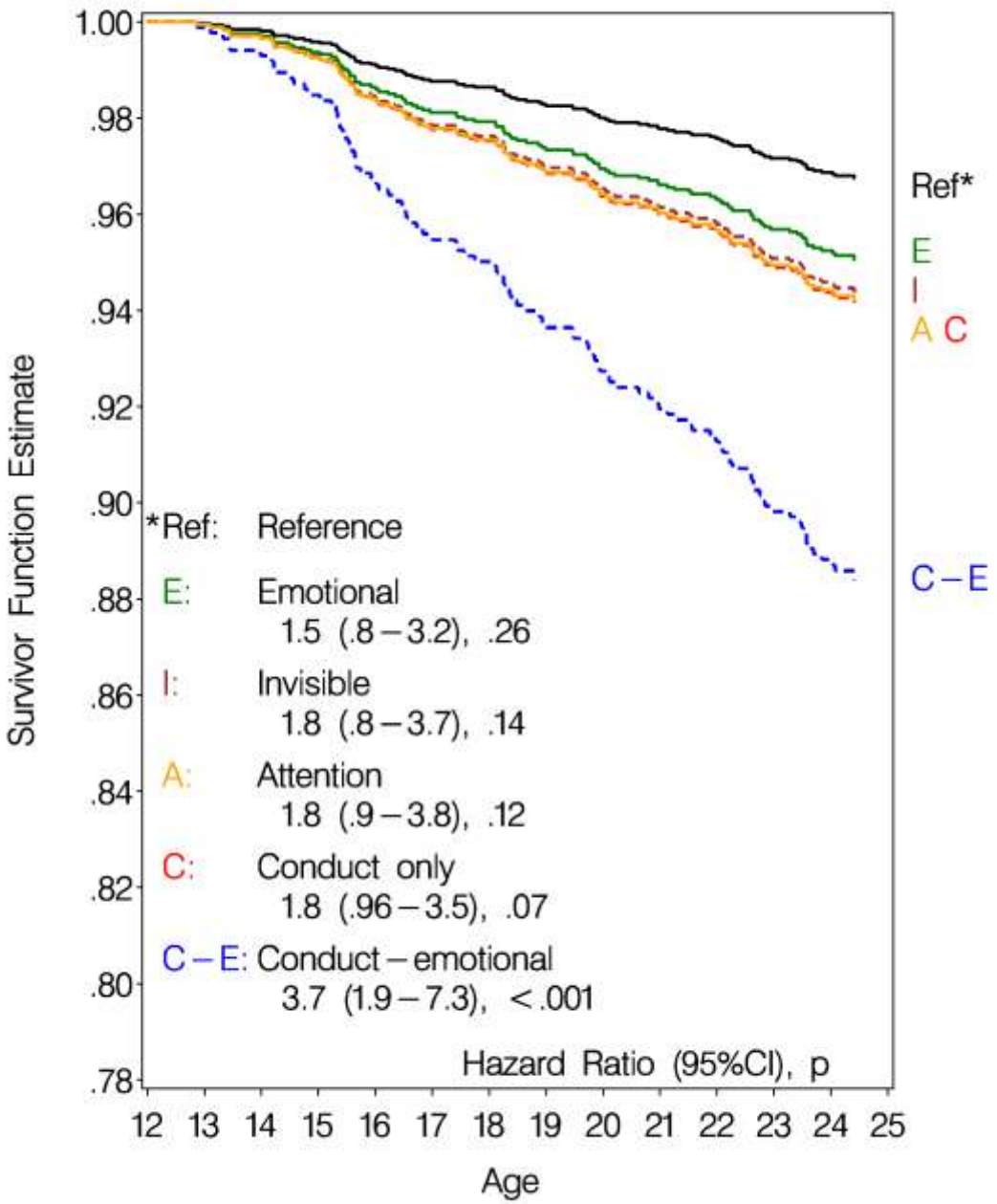
.92
.90
.88
.86
.84
.82
.80
.78
Survivor Function Estimate
* – Screen negative
+ Screen positive
2.7 (1.8 – 4.1), < .001
Hazard Ratio (95%CI), p
12 13 14 15 16 17 18 19 20 21 22 23 24 25
Age


1.00
.98
.96
.94
.92
.90
.88
.86
.84
.82
.80
.78
Survivor Function Estimate
12 13 14 15 16 17 18 19 20 21 22 23 24 25
Age
*Ref: Reference
I: Invisible
1.6 (.8 – 3.0), .19
E: Emotional
2.7 (1.7 – 4.3), < .001
C: Conduct only
3.0 (1.8 – 5.2), < .001
A: Attention
3.1 (1.7 – 5.7), < .001
C – E: Conduct – emotional
5.9 (3.7 – 9.4), < .001
Hazard Ratio (95%CI), p
Ref*
I
E
C
A
C – E


Survivor Function Estimate
1.00
.98
.96
.94
.92
.90
.88
.86
.84
.82
.80
.78
12 13 14 15 16 17 18 19 20 21 22 23 24 25
Age
Ref*
E
I
A C
C – E
*Ref: Reference
E: Emotional
1.5 (.8 – 3.2), .26
I: Invisible
1.8 (.8 – 3.7), .14
A: Attention
1.8 (.9 – 3.8), .12
C: Conduct only
1.8 (.96 – 3.5), .07
C – E: Conduct – emotional
3.7 (1.9 – 7.3), < .001
Hazard Ratio (95%CI), p