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The long-term cost of childhood conduct problems: Finnish Nationwide 1981 Birth Cohort Study

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Background: Commonly recognized childhood conduct problems often lead to costly problems in adulthood. This study aimed to evaluate the long-term cumulative cost of childhood conduct problems until the age of 30. The costs included inpatient care, nervous system medicine purchases, and criminal offences. **Methods:** The study used population-based nationwide 1981 birth cohort data. Families and teachers assessed the conduct problems of the eight-year-olds based on Rutter questionnaires. We grouped 5,011 children into low-level of conduct problems (52%), intermediate-level of conduct problems (37%), and high-level of conduct problems (11%) groups, based on combined conduct symptoms scores. The analysis included the cohort data with the Care Register for Health Care, the Drug Prescription Register, and the Finnish Police Register. The cost valuation of service use applied national unit costs in 2016 prices. We used Wilcoxon rank-sum test to test the differences between groups and gender. **Results:** During 1989–2011, average cumulative costs of the high-level (€44,348, $p < .001$) and the intermediate-level (€19,405, $p < .001$) of conduct problems groups were higher than the low-level of conduct problems group's (€10,547) costs. In all three groups, the boys' costs were higher than girls' costs. **Conclusions:** The costs associated with conduct problems in childhood are substantial, showing a clear need for cost-effective interventions. Implementation decisions of interventions benefit from long-term cost-effectiveness modelling studies. Costing studies, like this, provide cost and cost offset information for modelling studies. **Keywords:** Costs; conduct problems; register-based study; cohort.

Introduction

Mental health problems of children and youth cause a considerable global burden. In the Americas and Europe, mental disorders ranked second among the causes of Disability-adjusted life years (DALYs) in children aged 5–15 years. (Baranne & Falissard, 2018). In the long-term, childhood conduct problems associate with various adverse outcomes related to diminished well-being and functioning, and wide range of adverse psychosocial outcomes (mental health problems, crime, substance use, and problems in sexual and partner relationships) (Fergusson, Horwood, & Ridder, 2005). Children with conduct problems may not engage in education, employment or training, have convictions, have visits to the emergency department, or attempts of suicide or self-harm. Also, they may have social isolation, low life satisfaction, overweight, daily cigarette smoking, high alcohol consumption, or are teen parents. (Wertz et al., 2018) Also, in adolescence the externalizing behaviour associate with increased mental health problems, relationship difficulties, lower education and social class, unemployment, and financial difficulties (Colman et al., 2009).

In addition, conduct problems in childhood associate with increased service use, such as health and social care, prescription medicines, injury claims, and criminal convictions and thus to costs to society (Gyllenberg et al., 2010, 2011, 2012; Lehti et al., 2013; Rivenbark et al., 2018; Sourander et al., 2006, 2007). Many short-term studies have found significant costs associating with conduct problems in childhood compared to children without these problems (Edwards, Cèilleachair, Bywater, Hughes, & Hutchings, 2007; Gerhardt, Heinzel-Gutenbrunner, & Bachmann, 2018; Guevara, Mandell, Rostain, Zhao, & Hadley., 2003; Knapp, Scott, & Davies, 1999; Kohlboeck et al., 2014; Mandell, Guevara, Rostain, & Hadley, 2003; Olesen, Gustavsson, Svensson, Wittchen, & Jönsson, 2012; Petrou et al., 2010; Romeo, Knapp, & Scott, 2006).

The long-term costing studies are rare and they use self-reported data on service use. In addition, their number of participants is low and include only disadvantaged areas with less than 20 years follow-up (D'Amico et al., 2014; Foster & Jones, 2005; Scott, Knapp, Henderson, & Maughan, 2001). In the United Kingdom, D'Amico et al. (2014) studied 43 boys from age of 18 to age range 25–30 and Scott et al., (2001) studied 142 10-year-olds to the age of 28. In the United States, Foster and Jones (2005) studied 664 school-aged (12–15 year old) children in a seven-year perspective. In these studies, childhood

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conduct disorder associated with ten- to five-fold, oppositional defiant disorder two-fold, and conduct problems without diagnosis two- to three-fold higher public costs compared to children without behaviour problems.

The included costs varied between the long-term studies. D'Amico et al., (2014) included costs of health (i.e. accident and emergency, general hospital, psychiatric outpatient services, inpatient services) and social care (i.e. state benefits and unemployment), medication of anxiety, depression, psychosis or ADHD, and criminal justice, that is costs of court and imprisonment. In their study, majority of the costs were due to criminal justice (57%) and the rest due to health and social services (43%). Scott et al., (2001) included costs of special education in school, health care (i.e. childhood hospital inpatient care and psychiatric outpatient care, adulthood abortions, miscarriages, psychiatric outpatient, and inpatient care), foster and residential care, breakdown of relationships, state benefits, and crime (i.e. convictions and time spent in prison). Foster and Jones (2005) included costs of special education in school, health care (i.e. general health, outpatient, and inpatient mental health services), medication related to emotional or behavioural problems and juvenile justice. In Foster and Jones (2005) and Scott et al., (2001), the biggest cost items were special education in school (31% in both), inpatient mental health (28% in Foster and Jones (2005)), and crime (35% in Scott et al., (2001)).

In this study, we estimated the cumulative costs of high-level and intermediate-level conduct problems compared to low-level conduct problems from age of eight until the age of 30. The costs included inpatient care, nervous system medication purchases, and criminal offences. This study contributes to previous knowledge about the long-term costs of childhood conduct problems by utilizing larger representative register data and longer follow-up of participants. The data for this study originate from the Finnish, 1981 Birth Cohort Study (FNBCS-1981) that contains data of a nationally representative sample of 1981-born children (Almqvist, Ikäheimo, et al., 1999) and official register-based data of subjects between years 1989 and 2011.

Previous studies on the same cohort data found significant differences in service use by gender. For example, boys' childhood conduct problems associated with higher use of antidepressants, antipsychotics, and adulthood psychiatric inpatient care (Gyllenberg et al., 2010, 2011, 2012) and a higher risk of committing criminal offences (Sourander et al., 2006, 2007) than children without conduct problems. In addition, girls' conduct problems associated with other than medical reason abortions compared to girls without conduct problems (Lehti et al., 2013). In this long-term analysis, we also investigate the cost difference between genders in monetary units.

Methods

Study subjects

We used data from the representative nationwide birth cohort that contains a 10% (n = 6,017) sample of 60,007 children born in 1981 in Finland. The study selected representative subsamples of communities according to their degree of urbanization: urban, suburban, and rural districts in 1989, when the children were eight years old. In larger cities, the study selected a representative subsample of school classes from local school. In small communities, the study included all children (Almqvist, Ikäheimo, et al., 1999).

Figure 1 describes the flow of the study subjects. In 1989, researchers could not reach 70 subjects and 134 refused to participate. From 5,813 (96.6%) children participating, 462 participants were lost or had inappropriately documented identification numbers. In 1989, parents and teachers responded to the questionnaires about children's conduct problems. The data from both informants were available for 5,160 (85.8%) children. We excluded 58 subjects who died and 91 subjects who moved abroad during the 1989–2011 study period (Official Statistics of Finland (OSF) register: Causes of death; Population Register Centre). The final analysis sample included data for 5,011 (83.3%) children.

The Joint Commission on Ethics of Turku University and Turku University Central Hospital approved the research plan for the Finnish 1981 Birth Cohort Study, and the parents of children gave informed consent at baseline.

The psychiatric symptom measures

Parents and teachers assessed the psychiatric symptoms of eight-year-olds based on Rutter's questionnaires (Rutter, 1967; Rutter & Graham, 1966), which have been validated in the Finnish eight-year-old population (Kresanov, Tuominen, Piha, & Almqvist, 1998).

The Rutter's questionnaire provides overall symptoms and has three subscales (a) emotional or neurotic type disorders (five items on the parents' questionnaire (RA2), four items on the teachers' questionnaire (RB2)), (b) conduct or antisocial type disorders (five items on the RA2, 6 items on the RB2) and (c) hyperactivity (three items on the RA2, three items on the RB2). Each item had a rating scale of 'doesn't apply' (0), 'applies somewhat' (1), and 'certainly applies' (2) (Rutter, 1967). We use only items concerning conduct symptoms and thus the maximum score is 10 in parent's and 12 in teacher's assessment.

We summed the conduct symptom ratings of parents and teachers and divided participants separately by gender into three groups; a low-level (Low) of conduct problems (0%–50% of the gender), an intermediate-level (Intermediate) of conduct problems (50%–90% of the gender), and a high-level (High) of conduct problems (90%–100% of gender). The Low group had 2,603 (52% of the total 5,011), the Intermediate group 1,854 (37%), and the High group 554 children (11%) (Figure 1). Almqvist, Kumpulainen, et al., (1999) describe the behaviour and emotional symptoms of the original cohort in detail.

Use and costs of services and medication

This study used three different Finnish national registers jointly: the Care Register for Health Care, the Drug Prescription Register, and Finnish Police Register to obtain the service use of the study subjects. In Finland, municipalities fund public health care, patients' copayments have only a minimal role. Medication costs are paid partly by the patients and majority of the costs is reimbursed by the Social Insurance Institution already in the pharmacies. The state is responsible for the cost of the police. The panel data included 23 years (1989–2011). We linked the official registers with cohort questionnaire data

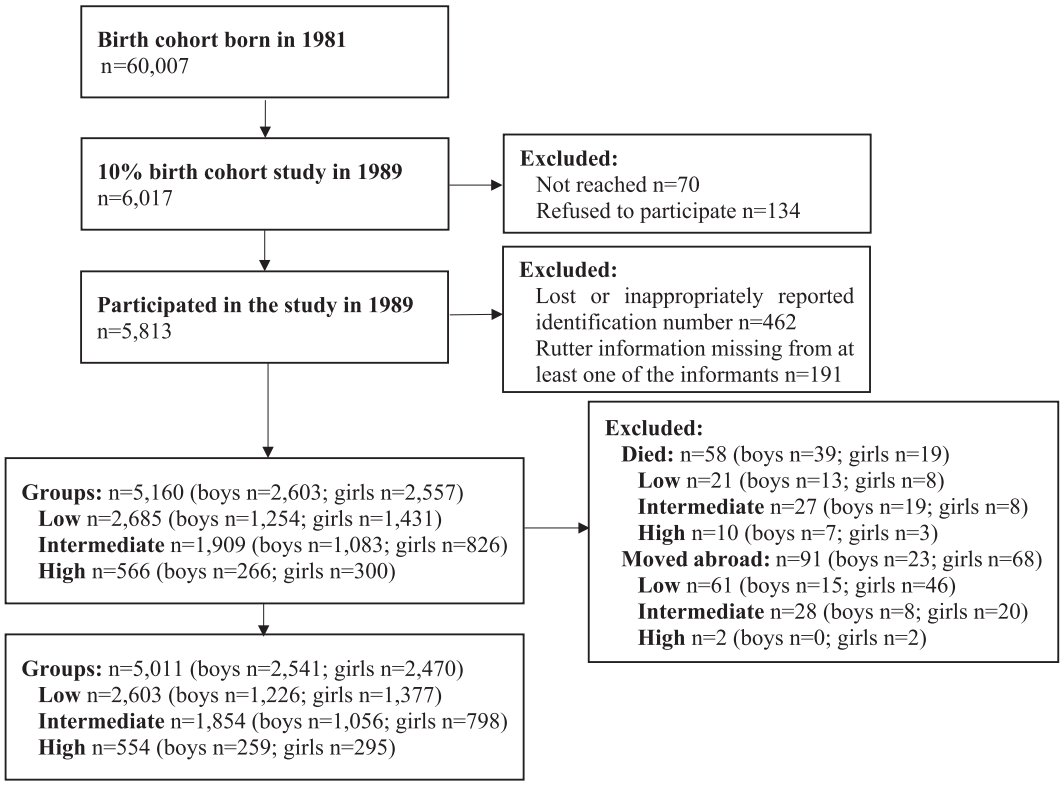

Figure 1 Flow-chart of the study subjects

using unique id code derived from the personal identity code every Finn has.

Care Register for Health Care, until 1994 called the Hospital Discharge Register, stores information about inpatient care in public health services (Finnish Institute for Health & Welfare: Care Register for Health Care). Our data contained information about diagnoses, admission, and discharge dates of all inpatient care from 1989 to 2009. In 1989–1995, the diagnostic codes used ICD-9 and since 1996, ICD-10. For this study, a physician coded the specialty field for each main diagnosis using the first three characters. Based on specialty field, we grouped the inpatient care into psychiatric and somatic care. The cost valuation used Finnish specialty field inpatient care unit costs per diem multiplied by length of stay (Kapiainen, Väisänen, & Haula, 2014; Table S1). The conversion of the unit costs to 2016 values used the price index of health care expenditures in Finnish municipalities (OSF: Price index of public expenditure).

The Social Insurance Institution of Finland (Kela) administers the Drug Prescription Register, which contains information about purchased prescribed medicines (Kela: Statistics on reimbursements for prescription medicines). The data include information about purchases of outpatient medication and exclude medication in public hospitals. Our data contained information about Anatomical Therapeutic Chemical (ATC) classification codes, date of purchase, and the costs. The data contained only nervous system medicines (N-group) for the years 1994–2005. We converted the purchases in Finnish Marks (FIM) during 1994–2001 into euros using the official rate 5.94573 FIM/€ (OSF: Change in the value of money). The conversion of costs to 2016 prices used the consumer price index for the years 1994–1995 and wholesale price index of medicine for the years 1995–2016 (OSF: Consumer price index; OSF: Producer price indices).

The Finnish Police Register is a nationwide electronic database containing all criminal offences (OSF: Offences known to the police). Our data contained information about the type of suspected criminal offences and the date of registration for over 15-year-olds during 1996–2011. In Finland, the age of criminal liability starts at the age of 15. If the police suspected multiple offences at the same time, each had its own registration. The threshold for police to register the suspicion of criminal offending is rather low, as the police must register every offence of which they became aware (Elonheimo et al., 2014). We grouped the offences into economic offence, assault and aggravated assault, theft, drug offence, minor violence and threatening, damaging property, car theft or equivalent offence, traffic offence (excluding minor traffic offences), drunk driving, rape or equivalent offence, other sexual offence, robbery, homicide, and miscellaneous offence. The register does not contain data on sanctions for offences and costs of sanctions, like imprisonment, nor the financial damage caused by the offence. We valued the criminal offences with Finnish unit costs for criminal investigations (Hinkkanen, 2008; Table S2) converted to 2016 using the price index of public expenditure for the Ministry of the Interior (OSF: Price index of public expenditure).

Statistical analyses

The cost data were right-skewed and 16.7% of the subjects had zero total costs. We grouped the cumulative costs into total, inpatient care, psychiatric and somatic, criminal offending, and medicine costs. We calculated medians and means with standard deviations for the costs in the Low, Intermediate, and High groups, and also separately for boys and girls. In addition, we calculated the 95% confidence interval for the costs from 1,000 bootstrapped iterations. To test the differences between groups (Low vs. Intermediate, Low vs. High, Intermediate vs. High) with our very skewed data, we used the Wilcoxon rank-sum test. In addition, we tested the group differences separately by gender and gender differences within groups.

To represent time trends in the total, inpatient, medicine, and criminal offending costs, we calculated the annual average

costs for each study year. All statistical analyses used Stata statistical software (SE14.2) and the limit for statistical significance was 0.05.

Results

Costs in the conduct problems groups

Table 1 shows the average costs of the total, inpatient care, medicines, and criminal offences in groups. In the period of 1989 to 2011, average total costs were higher in the Intermediate (€19,405, $p < .001$) and High (€44,348, $p < .001$) groups than in the Low group (€10,547).

In 1989–2009, average costs of inpatient care were higher in the Intermediate (€11,947, $p < .001$) and the High (€24,832, $p < .001$) groups than in the Low group (€7,518). In somatic care, the average costs were higher in the Intermediate (€6,293, $p < .001$) and the High (€9,046, $p < .001$) groups than in the Low group (€5,512). Similarly, the average costs of psychiatric inpatient care were higher in the Intermediate (€5,654, $p < .001$) and High (€15,786, $p < .001$) groups than in the Low group (€2,006).

In 1994–2005, the average costs of medicine in the High group (€228, $p < .001$) were higher than in the Low group (€95). The Intermediate group's average medicine costs (€156, $p = .111$) were similar to the Low group (€95). The average criminal offence costs of the Intermediate (€7,302, $p < .001$) and the High (€19,288, $p < .001$) groups were higher than in the Low group (€2,934) during 1996–2011.

Gender differences

Table 2 displays the gender-specific costs. In all three groups, the average total and criminal offence costs for boys were higher than the corresponding costs for girls. In the Low group, inpatient care and somatic care costs for boys were higher than the corresponding costs for girls, but the psychiatric care costs were similar. Costs of medicines for boys were lower than the corresponding costs for girls in the Low group. In the Intermediate group, costs of medicines for boys were higher than the corresponding costs for girls. In both Intermediate and High groups, the inpatient care and somatic care costs were similar between genders, but psychiatric care costs for boys were higher than the corresponding costs for girls. In the High group, the costs of medicines were similar between genders.

Time trends in the costs

Figures 2A–C show the trends in the average annual costs during the study period for total, inpatient, medicine, and criminal offending for each group. During 1989–2011, the total costs fluctuated in all groups because of the fluctuation of inpatient care costs. The fluctuation was largest in

Table 1 Mean cumulative costs (2016 euros) by type in conduct problem groups (Low, Intermediate, and High)

	Low (n = 2,603)			Intermediate (n = 1,854)			High (n = 554)			Cost difference (p-value)			
Cost type	Median	Mean (*SD*)	95% CI	Median	Mean (*SD*)	95% CI	Median	Mean (*SD*)	95% CI	Low vs. Intermediate	Low vs. High	Intermediate vs. High
Total costs	3,681	10,547 (38,147)	9,087–12,008	4,719	19,405 (78,662)	15,934–22,876	8,130	44,348 (121,076)	33,846–54,849	<.001	<.001	<.001
Inpatient care	3,035	7,518 (26,870)	6,502–8,535	3,800	11,947 (53,274)	9,690–14,204	6,066	24,832 (89,723)	17,294–32,370	<.001	<.001	<.001
Medicines	0	95 (599)	72–119	0	156 (967)	114–198	0	228 (1,071)	137–319	.111	<.001	<.001
Criminal offences	0	2,934 (22,397)	2,079–3,788	0	7,302 (56,708)	4,805–9,799	57	19,288 (77,348)	12,459–26,116	<.001	<.001	<.001
Subanalyses of inpatient care												
Somatic care	3,033	5,512 (12,093)	5,046–5,979	3,444	6,293 (12,989)	5,694–6,892	5,496	9,046 (22,096)	7,202–10,889	<.001	<.001	<.001
Psychiatric care	0	2,006 (23,287)	1,109–2,903	0	5,654 (50,878)	3,431–7,877	0	15,786 (87,077)	8,475–23,097	<.001	<.001	<.001

Table 2 Gender-specific mean costs by type in conduct problem groups (Low, Intermediate, and High)

	Low (n = 1,226)			Intermediate (n = 1,056)			High (n = 259)			Cost difference (p-value)		
Boys	Median	Mean (SD)	95% CI	Median	Mean (*SD*)	95% CI	Median	Mean (*SD*)	95% CI	Low vs. Intermediate	Low vs. High	Intermediate vs. High
Total costs	4,101	11,398 (35,985)	9,296–13,500	5,548	21,466 (67,872)	17,205–25,728	11,524	67,021 (156,687)	47,675–86,366	<.001	<.001	<.001
Inpatient care	3,147	7,881 (29,550)	6,148–9,615	4,044	12,553 (51,700)	9,353–15,753	6,992	31,899 (115,578)	17,917–45,881	.005	<.001	<.001
Medicines	0	71 (489)	45–97	0	184 (1,170)	115–253	0	268 (1,252)	114–422	.041	<.001	<.001
Criminal offences	0	3,446 (20,045)	2,322–4,569	100	8,729 (42,146)	6,113–11,345	749	34,854 (104,980)	22,200–47,508	<.001	<.001	<.001
Subanalyses of inpatient care												
Somatic care	3,033	6,010 (14,739)	5,138–6,882	3,420	6,646 (14,805)	5,735–7,556	5,055	8,473 (14,563)	6,644–10,303	.085	<.001	<.001
Psychiatric care	0	1,871 (25,524)	400–3,342	0	5,908 (48,957)	2,880–8,935	0	23,426 (115,331)	9,565–37,286	<.001	<.001	<.001

	Low (n = 1,377)			Intermediate (n = 798)			High (n = 295)			Cost difference (p-value)			Cost difference by gender within groups (p-value)		
Girls	Median	Mean (*SD*)	95% CI	Median	Mean (*SD*)	95% CI	Median	Mean (*SD*)	95% CI	Low vs. Intermediate	Low vs. High	Intermediate vs. High	Low	Intermediate	High
Total costs	3,080	9,790 (39,972)	7,750–11,829	4,019	16,677 (90,969)	10,539–22,815	6,180	24,442 (71,961)	16,111–32,772	<.001	<.001	<.001	<.001	<.001	<.001
Inpatient care	3,033	7,195 (24,242)	5,955–8,435	3,696	11,145 (55,312)	7,425–14,865	5,544	18,628 (57,765)	12,132–25,123	.002	<.001	<.001	.022	.165	.144
Medicines	0	117 (682)	81–153	0	118 (603)	76–161	0	193 (884)	95–291	.443	.059	.208	<.001	.039	.150
Criminal offences	0	2,478 (24,298)	1,214–3,742	0	5,413 (71,548)	589–10,238	0	5,621 (34,364)	1,689–9,552	<.001	<.001	<.001	<.001	<.001	<.001
Subanalyses of inpatient care															
Somatic care	3,033	5,069 (9,095)	4,589–5,549	3,448	5,826 (10,085)	5,129–6,523	5,544	9,549 (27,050)	6,204–12,893	.004	<.001	<.001	.027	.595	.689
Psychiatric care	0	2,126 (21,107)	1,012–3,240	0	5,319 (53,343)	1,441–9,198	0	9,079 (49,930)	3,291–14,867	.035	<.001	.008	.808	.016	<.001

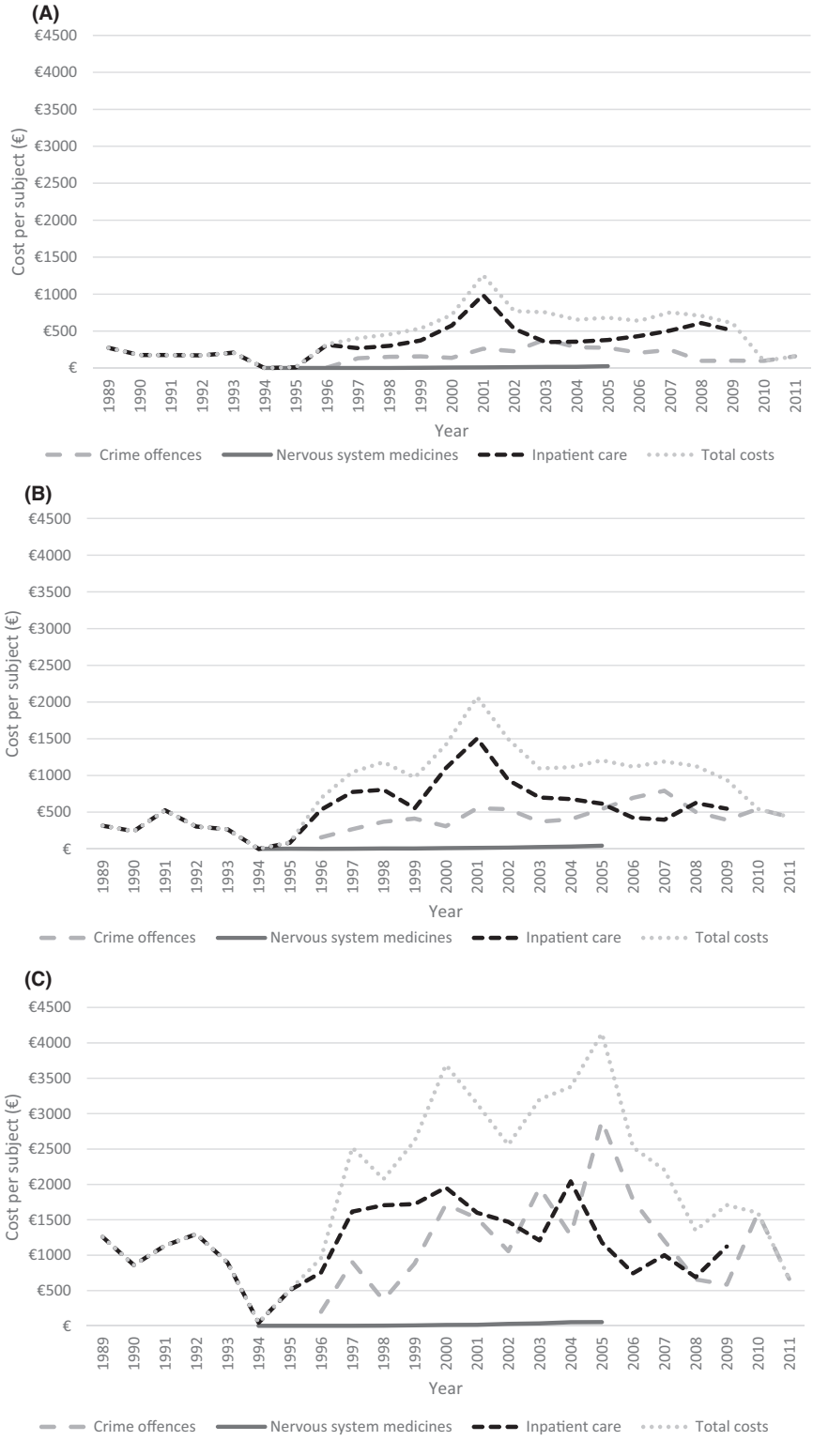

Figure 2 (A) Average total annual costs per subject in Low group by service type. (B). Average total annual costs per subject in Intermediate group by service type. (C). Average total annual costs per subject in High group by service type. Total cost data was for the whole study period (1989–2011). Cost data for crime offences was from 1996 to 2011. Nervous system medicine purchases data was from 1994 to 2005. Data for inpatient care costs was from 1989–2009. Because of the data periods, the lines in the figure might be shorter

the High group. Most of the total costs cumulated from inpatient care and criminal offences in all groups. Medicines had only a minor effect on the total costs. The time-trend in medicines was stable until children were 16-year old (year 1997), and after that started rising in all groups. In criminal offences, the time-trend was rather stable in Low and Intermediate groups. In the High group, the trend was rising until the children were 24-year old (year 2005) and after that the trend started to decrease rapidly with a peak when the children were 29-year old (year 2010).

Discussion

In a 23-year period, individuals with a high-level (High) of childhood conduct problems had four-fold and an intermediate-level (Intermediate) of conduct problems two-fold higher public costs compared to children with a low-level (Low) of conduct problems measured at the age of eight. The analysis included costs of inpatient care, nervous system medicine purchases, and criminal offences, that is investigation.

Most of the total costs cumulated from inpatient care and criminal offences in all three groups. The nervous system medicine costs had only a minor effect on the total costs in all groups. The high-level of conduct problems group had higher costs than low-level of conduct problems group in all cost categories. The intermediate-level of conduct problems group had higher costs than the low-level of conduct problems group in all cost categories except medicines costs.

In all three conduct problems groups, the average boys' total costs were higher than girls' costs. Also, the differences between groups were larger for boys than for girls: the total costs for the high-level of conduct problems compared to the low-level conduct problems group were six-fold for boys and double for girls. In the high-level of conduct problems group, for the boys the share of psychiatric care in inpatient care costs was higher (73%) than for girls (49%).

Our findings were consistent with previous long-term costing studies. The costs difference between children with and without conduct problems have been three-fold (D'Amico et al., 2014; Foster & Jones, 2005; Scott et al., 2001) and with a diagnosed conduct disorder even higher: five-fold in Foster and Jones (2005) and 10-fold in Scott et al., (2001).

In all three previous studies, costs of crime caused the biggest share of the difference in total costs. In our study, the criminal offence costs included only the costs of police investigation, which represent about 45% of the total costs of criminality to the control system (investigation, consideration of charges by the prosecutors and courts, and enforcement of punishment) (Hinkkanen, 2008). If the share of costs to the control system is the same 55% in all groups, then the average costs for crime for boys in the high-level group would be €77,453, a rise of €42,599. For boys in the low-level group, the cost estimate would rise only €4,211. Still, the magnitude of difference in total costs remains the same: six-fold between boys in high-level and low-level groups.

In previous long-term studies, education represented one fifth of the difference in total costs for conduct disorder versus no problems group (Foster & Jones, 2005; Scott et al., 2001). Social services have not been comprehensively covered in previous studies. D'Amico et al., (2014) had only transfers and Foster and Jones (2005) did not include social services at all. Scott et al., (2001) included only foster and residential care which accounted for 10% of the difference in total costs for conduct problems or disorder versus no problems group. The costs for primary care did not differ much between children and youth with and without conduct problems. According to Foster and Jones (2005), inpatient mental health services contribute more to total cost differences (35% of the difference in total costs between conduct disorder group and no problems group) than outpatient mental health (14% of the difference in total costs). Unfortunately, we were not able to assess the magnitude of the missing data on education, social services, and outpatient care in our study due to lack of information.

Also, this costing study concerned only the registered services used by the children. The families of children and victims of the crimes might have used services which are not included in the data.

The registries covered only partly the study period of 1989 to 2011. Nervous system medicine purchase information contained outpatient medicines from 1994 to 2005. The missing years have only a negligible effect on the results. In addition, although the inpatient data lacked the last two years, we believe that its effect on the results was also minor, as the study included the most important years in the analysis.

We were unable to use, for example, matching (Gerhard et al., 2018) or regression techniques (D'Amico et al., 2014; Kohlboeck et al., 2014) to control for confounding variables, like parents' mental health history, socio-economic, or demographic variables. These issues may affect differently the resource use and thus costs by gender and in the three groups categorized based on the conduct problems in childhood.

Overall, the present social and health care systems are different than in earlier times. The service use of today's children might differ a lot from the children born in 1981. More services are available and services are more frequently provided in primary care or in social care not included in analysis. Thus, the average cost is not precise, but the results give an estimate of the cost differences between children with and without conduct problems.

Despite the limitations of this study, we had multiple strengths compared to previous research. The data were from a large, nationwide, population-based birth cohort which enabled register-based service use analyses. In addition, the study subjects were representative of the full age cohort without focusing on only children living in socio-economically deprived areas. Our follow-up was up to 23 years and the study was able to group children based on both parents' and teachers' validated assessment of the children's psychiatric symptoms. In addition, we were able to conduct gender-specific analyses.

The official register-based data on service use was probably more reliable and objective than self-reported information. The quality of the Care Register for Health Care (Finnish Institute for Health & Welfare: Care Register for Health Care) is from satisfactory to very good (Sund, 2012). The inpatient care information covered all-cause care. That way, we were able to provide a comprehensive view of the use of inpatient care in groups. On the other hand, self-reported data could include cost items that do not appear in registers.

The Finnish Police Register contained all types of crimes committed by individuals between ages 15 and 30 which are the most criminally active years (Elonheimo et al., 2014). Although the costs of criminal offences included only criminal investigations, we believe that it represents quite well the sizes of cost differences between groups.

Conduct disorders lead to health losses: globally they represent 3.9% of the disability adjusted life years (DALYs) due to mental disorders. In comparison, attention-deficit/hyperactivity disorder (ADHD) represents 0.8% and depression 37.3% (Global Burden of Diseases, 2019). In practice, the high costs of conduct problems call for cost-effective screening, prevention, and treatment of the problems. For example, parent-based interventions effectively reduce childhood externalizing behaviour problems (Mingebach, Kamp-Becker, Christiansen, & Weber, 2018). Long-term economic evaluations have found that parent training as prevention and treatment of childhood conduct disorders are cost-effective (Mihalopoulos, Sanders, Turner, Murphy-Brennan, & Carter, 2007; Nystrand, Feldman, Enebrink, & Sampaio, 2019; O'Neill, McGilloway, Donnelly, Bywater, & Kelly, 2013; Sampaio et al., 2018).

Conclusion

The consequences and costs associated with conduct problems in childhood are substantial to society. The high costs justify development and evaluation of interventions for childhood conduct problems. Implementation decisions benefit from long-term cost-effectiveness modelling studies. Costing studies, like this, provide valuable cost and cost offset information for modelling studies. Future analyses should use large representative cohort data and include information about all relevant services and their costs like health and social care, medication, education, and criminal investigations and sanctions.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. Specialty fields of inpatient care coded according to the ICD-9 and ICD-10 classifications and unit costs.
Table S2. Unit costs for criminal offence types.

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Key points

- Short- and long-term costs of conduct problems are high.
- High-level of conduct problems group public costs were four-fold compared to low-level of conduct problems group. For boys, the difference between groups was six-fold.
- The high long-term costs of conduct problems call for the development and use of cost-effective screening, prevention, and treatment.
- This costing study, using large representative cohort data, provides information for modelling studies on long-term cost-effectiveness of prevention and treatment of conduct problems to support implementation decisions.

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