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Short and long-term outcomes for children from families with problematic substance use

PhD dissertation

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Kirsten S. Frederiksen,
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List of studies

Paper 1

Frederiksen, K. S., Hesse, M., Grittner, U., & Pedersen, M. U. (2021). Estimating perceived parental substance use disorder: Using register data to adjust for non-participation in survey research.

Addictive Behaviors, *119*, 106897. https://doi.org/https://doi.org/10.1016/j.addbeh.2021.106897

Published in Addictive Behaviors 2021.

Paper 2

Frederiksen, K. S., Hesse M., Brummer J. & Pedersen M. U. (2021). The impact of parental substance use disorder and other family-related problems on school-related outcomes

Drug and Alcohol Dependence Reports, vol 3, 100041, https://doi.org/10.1016/j.dadr.2022.100041

Published in Drug and Alcohol Dependence Reports, March 2022

Paper 3

Frederiksen, K. S., Hesse M. & Pedersen M.U. (2022) Problematic parental substance use, childhood family structures and adverse outcomes in young adulthood

Submitted to Nordic Alcohol and Drug research (NAD), Jan 2022

Overview of the thesis

This PhD-thesis contributes towards a better understanding of problematic parental substance use (PSU) and how it affects the children involved. The thesis is based on three independent papers investigating: 1) the prevalence of PSU in the general population of youth in Denmark, 2) school outcomes and 3) adverse outcomes related with family structure and years living with the parent with a problematic substance use (SU).

Paper	**Research question**	**Data (*measures*) and methods**	**Main findings**
1	1) What is the prevalence of self-reported PSU in the general population of 15-25-year-olds? 2) How is the estimate when adjusting for non-participation?	▪ Survey (n=10.414) (*self-reported PSU*) ▪ Register data concerning parental substance-related contacts (*register-based PSU*) ▪ IPW-methods and adjusted estimate ▪ Logistic regression models	1) The crude prevalence of self-reported PSU among Danish 15-25-year-olds was 12.7% 2) Higher prevalence of parental substance-related contacts among non-participants compared with the participants. 3) When adjusting for non-participation an adjusted estimate was 15.2%
2	How are family-related problems, including PSU, associated with school-related outcomes (grades at graduation and further enrollment)?	▪ Survey (n=6,784) (*self-reported PSU*) ▪ Registers (*grades, further enrollment and family-related problems)* ▪ Latent class analysis (*types of families*) ▪ Linear regression model (*grades*) ▪ Logistic regression models (*further enrollment*)	1) Families with different levels of problems were identified ("Low ACE* families", "Families with PSU", "Families with long-term unemployment" and "High ACE families") 2) Significantly lower grades among youth from the other families compared with "Low ACE families" 3) Higher odds of no further enrollment among "Families with PSU" and "High ACE families"
3	How are childhood family structures (intact/non-intact, +/- PSU and living with a parent with SU) associated with adverse outcomes during age 15-20 (not in employment/education, hospitalization, mental disorders and criminality)?	▪ Survey (n=9,770) (*self-reported PSU*) ▪ Danish Civil Registration System (*family structures*) ▪ Registers (*not in education or employment, hospitalization, mental disorder and criminality*) ▪ Logistic regressions models (*outcomes during age 15-20 year*)	1) Living with both parents protected (intact families) against adverse outcomes in young adulthood 2) If PSU was present in intact families, the odds of not being in education or employment increased, as did hospital admissions, mental disorders and criminality 3) Highest odds of adverse outcomes were found in non-intact families with 0-4 years of living with a parent with SU

* ACE=adverse childhood experiences

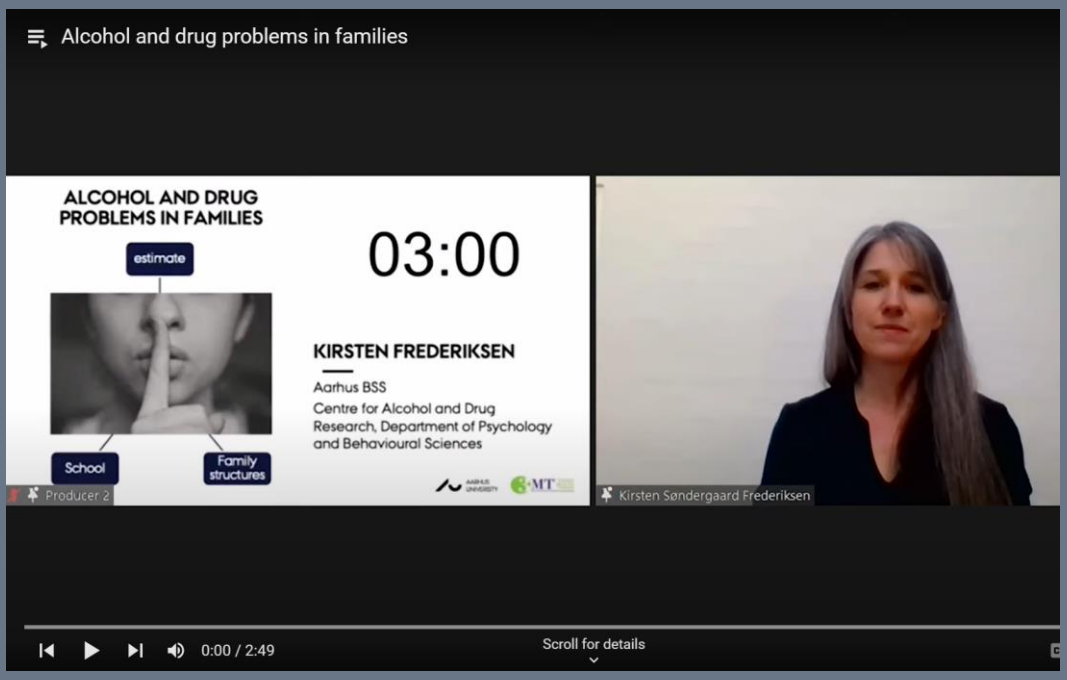
The PhD-project explained in 3 minutes,

from the 3 Minute Thesis Competition Jan 2021

arranged by Aarhus University

Watch the presentation here

(https://youtu.be/Pd83fHEIRsY)



Chapter 1: Introduction

The possible consequences for the children exposed to problematic parental alcohol and drug use are well researched and two main trends can be pointed out in the existing research: 1) a focus on different adverse childhood experiences (ACE) which often afflict a childhood and adolescence with problematic parental substance use (PSU) and 2) possible negative impact on the children's lives and personal development. In other words, PSU can lead to difficult life experiences during childhood – experiences the children have to handle, digest and maybe be scarred for life by, without ever really experiencing a healing of these wounds, with adverse outcomes later in life (Haugland, Carvalho, et al., 2021; Selbekk et al., 2019; Velleman & Templeton, 2016). At the same time, PSU can affect the child's social, mental and behavioral development and have both short-term and long-term consequences with, for instance, increased risk of poor school performance, problematic substance use and mental problems (Brummer et al., 2021; Burdzovic & O'Farrell, 2017; Finan et al., 2015; Kuppens et al., 2020).

These two aspects, possible adverse experiences and the child's own difficulties in life, have been investigated in several research projects which have looked not only into the increased risk for these children and families, but also into protective factors and the variety of family types and levels of problems. The research investigating these adverse experiences agrees in its findings that children with PSU have, compared with other children, a higher risk of experiencing neglect and maltreatment in a range of areas (Anda et al., 2002; Dube et al., 2001; Hanson et al., 2006; Haugland, Carvalho, et al., 2021; Orford, Velleman, et al., 2010; Selbekk et al., 2019; Taplin et al., 2014; Tedgård et al., 2019):

- violence victimization of children and adolescents
- poor and/or neglectful parenting
- Insufficient and inadequate nurturing
- experiencing or witnessing neglect or abuse (physical, verbal or sexual)

The negative experiences which are often present for children and adolescents with PSU can lead to the child having difficult and negative feelings such as shame, guilt, fear, anger and embarrassment (Järvinen, 2015; Templeton et al., 2009). An example of the correlation between PSU and ACE is how it has been estimated that 30% of cases concerning child abuse included a parent with alcohol problems and how 60% of cases concerning domestic violence occurred under the influence of alcohol (Dube et al., 2001).

The other trend in the research with its focus on negative effects of PSU has investigated both short-term and long-term consequences, and the possible problems which these children are facing personally during youth and adulthood. Mental, emotional and health problems are often more prevalent children and youth with PSU (Brown-Rice et al., 2017; Brummer et al., 2021; Christoffersen & Soothill, 2003; Jääskeläinen, 2016; Kuppens et al., 2020; Raitasalo & Holmila, 2017; Staton-Tindall et al., 2013). In childhood, school is often more challenging for children experiencing PSU, resulting in lower school performance, more skipping school days and higher rates of drop-out (Berg et al., 2016; Hafekost et al., 2017). In adolescence, PSU is associated with mental problems (Jääskeläinen, 2016) such as internalizing, self-injury, suicide ideation and suicide attempts (Ohannessian, 2015; Pisinger et al., 2016; Pisinger, Hawton, et al., 2017), externalizing problems (Finan et al., 2015; Hussong et al., 2010) and depression (Fuller-Thomson et al., 2013).

1.1 The influence of other problems on these children's well-being

PSU seldom stands alone for often many other problems – social, economic and mental – occur at the same time, problems which themselves can affect a child's mental and physical health, level of IQ, learning capabilities, the child's own substance use patterns and his or her attitudes in general. Together, side by side with the PSU, these have an important impact on the individual's situation in both childhood, adolescence and adulthood – in areas such as life at work, educational level and family life (Balsa, 2008). Four important mechanisms are operating here: 1) genetic hereditary factors, 2) pregnancy, 3) parental behavior and knowledge, and 4) stressors in the local environment like economic problems, marital conflict and separation. These are problems which are more common in homes with PSU compared with others.

The genetic hereditary factor may contribute to intellectual disability or cognitive deficits (Khemiri et al., 2020) as well as mental disorders (Leis & Mendelson, 2010) and problematic substance use (SU) (Edwards et al., 2015; Schuckit, 2014; Vink, 2016). Genetic studies have demonstrated how problematic SU/substance use disorder (SUD) is moderately to highly heritable and can explain much of the intergenerational transmissions of SU/SUD (Kendler et al., 2003; Zhang et al., 2021). The

different difficulties in childhood and adolescence can also be related to possible neurodevelopmental consequences of substance misuse in pregnancy (e.g., foetal alcohol spectrum disorders, FASD). FASD is a continuum of disabilities such as growth deficits, physical abnormalities, problems with concentration and social skills, as well as an increased vulnerability to mental health problems (Kaminen-Ahola, 2020). Disabilities concerning concentration and social skills are also found in prenatal drug exposure (Bandstra et al., 2010). Parental behavior, knowledge and practices are also important in relation to the child's behavioral and social competences, which can be impaired by lack of parental support, inconsistency from one or both parents and neglectful parenting (Moffitt & Capsi, 2006; National Academies of Sciences, 2006). The influence of parental behavior and parenting was important in a study by Conners-Burrow et al. (2013) investigating the relationship between maternal SUD and externalizing behavior in preschool children. The study concluded, that maternal substance use problems did not have a significant impact on the behavioral outcomes of preschool children if the parenting was not harsh and the family conflicts were low. This shows how other stressors in the family and the environment, such as family conflict, conflict-ridden divorces or early parental death, are associated with adverse outcomes (Amato, 2000; Conners-Burrow et al., 2013; Nickerson et al., 2011; Strohschein, 2005).

1.2 PSU as independent factor?

Outcomes, such as learning disabilities, mental disorders and problematic SU, are often investigated in relation to the consequences of PSU, but, as mentioned above, PSU is seldom a causal risk factor on its own, and the adverse impact on child well-being may be affected by PSU in interaction with other problems. Research has provided ambiguous answers to whether PSU has an independent effect on the different negative outcomes for the children being observed by the researchers. While some studies have concluded that parental substance abuse has independent effects on adolescents' mental disorders and harmful substance use (Jääskeläinen, 2016; Rognmo et al., 2012), other research suggests that the greatest impact on the well-being of young people is related to a dysfunctional family structure irrespective of parental substance abuse (Anda et al., 2002; Bailey et al., 2006; Christoffersen & Soothill, 2003). Looking at challenges in school as an example, research has also found how the severity, level and numbers of ACE correlates with problems at school and learning difficulties, low levels of schooling attainment, lack of school engagement and skipping school days (Cawley et al., 2001; Crouch et al., 2019; Dovran et al., 2019; Robles et al., 2019).

A Finnish study using register-based longitudinal data on a cohort born in 1991 (n=60,000) and their biological parents concluded that PSU had an effect on adolescents' mental disorders independent

of the impact of other kinds of ACE (Jääskeläinen, 2016). A different conclusion is found in an American study (Dube et al., 2001) that investigated long-term effects of parental alcohol abuse and a number of other types of ACE in relation to an increased risk of offspring alcohol abuse later in adulthood, as well as an increased risk of marrying a person with alcohol abuse. They concluded that ACE showed a strong relationship between alcohol abuse in adult life for persons irrespective of whether they had a parental history of alcohol abuse, and that ACE have an effect on the risk of alcohol misuse independent of parental alcoholism. In a meta-analysis of 56 studies and 220 effect sizes Kuppens et al. (2020) found a significant relationship between PSU and child well-being, and concluded that PSU can be a risk factor. At the same time, the authors underscored the substantial unexplained variance in the meta-analysis, which could arise from unmeasured factors influencing child well-being.

1.3 Protective factors

Even though research has concluded that PSU is a considerable risk factor for adverse childhood experiences and adverse outcomes, it is important to recognize the large proportion of children with PSU and other family-related problems who function well and do not develop serious problems. A number of protective factors have been identified in the substantial proportion of affected children who cope with their life conditions and don't show the same negative development in their mental health. Hughes et al. (2019) studied the relationship between ACE, health-harming behaviors and poor health. The analysis showed the importance of supportive childhood relationships, and, in particular, of a secure parent-child attachment – this has been a consistent finding in the research concerning protective factors (Wlodarczyk et al., 2017).

Velleman and Templeton (2016) divided protective factors into individual factors (such as active agency, feeling of control, hobbies and good problem-solving skills), family factors (supporting and trusting relations, low levels of separation from primary caregiver, consistency and stability in everyday family life) and community factors (sense of caring, mutual protection, positive school experiences, attendance at school, achievement and acknowledgement of success).

In this way, it is recognized how other problems often mix in with PSU, sometimes aggravating the impact of PSU, sometimes attenuating it; it is also recognized that children do not always experience the same level of consequences and personal problems, even if they seem to start out with similar problems.

1.4 Existing research: methodological issues?

These perspectives surrounding the question about PSU – its impact and the influence of other factors – may be explained by the complexity of the problem, but part of the explanation probably lies in the difficulty of establishing a proper methodological design. Methodological problems can be related to missing control groups or bias in relation to non-participation in the data collection. If only subpopulations are studied, such as a clinic population with parents in substance use treatment or families recruited from impoverished areas with massive socio-economic problems, the conclusions may not be representative of the general population (Anda et al., 2002; Bailey et al., 2006).

Another methodological issue concerns survey research and non-participation, as it is difficult to recruit participants (response rates are in general decreasing (de Koning et al., 2021)) and non-participants will often differ systematically from participants in terms of social, mental and psychological problems (Christensen et al., 2015; Elgán & Leifman, 2013; Gundgaard et al., 2007). This may bias the results and also the possibilities for generalization. Lastly, it is important to recognize how PSU is often associated with shame and carries the fear of stigma, and some children experiencing PSU may be reluctant to report it (Kraus et al., 2017; Wesson et al., 2017). This creates a problem and a bias in the analysis, which needs to be investigated further and met by a strong methodological design. Staton-Tindall et al. (2013) stated how existing research about PSU and maltreatment did not succeed in reflecting or embracing the complexity of the problem or suggest how future research should use improved measures and methods. A strong methodological design that acknowledges and takes into account not only historical data on the family relations and circumstances during the childhood and youth of the children experiencing PSU, but also different sources of information about PSU and the different family related problems is important. It is hoped that the present study is a significant contribution in this regard.

1.5 The aim of the present study

The aim of the present study was firstly, to estimate the prevalence of PSU in the general population of youth in Denmark and, secondly, to investigate the short-time outcomes in school performance and, thirdly, to investigate adverse outcomes in young adulthood of living together with a parent with problematic SU in the childhood

The focus of the study was on Danish young people (national representative survey) who reported PSU. The project was based on these self-reports taken from the quantitative survey data which was linked together with historical register data from the young people's time of birth (starting from 1989) up to 2015/2018. Seen against the background of the very different research findings and the

methodological limitations in previous research, this study offers a substantial contribution with both different data sources as well as new knowledge about PSU.

1.5.1 Estimating the prevalence of PSU in a general population

It is important to investigate how many children and families are affected by PSU, as it can have numerous negative consequences for the child's well-being and welfare. Estimates have ranged from:

- Sweden: 4.6% with parental SUD and 13.1%-20.9% with parental alcohol problems (Elgán & Leifman, 2013; Ramstedt et al., 2021; Raninen et al., 2016)
- Germany: 11.2-20.2% with parental SUD (this study included tobacco use disorder) (Kraus et al., 2021)
- Norway: 15.6% with parental alcohol problems (Haugland, Carvalho, et al., 2021)
- Denmark: 7.09%-9.5% with perceived alcohol problems (Kristiansen et al., 2009; Pisinger, Holst, et al., 2017)
- Eastern Europe (included: 10 countries): 15.6% reported household alcohol abuse and 2.7% reported household drug abuse (Hughes et al., 2019)
- US: 11.9% of children under 18 years of age lived during the past year with at least one parent with alcohol or drug problems in the period 2002-2007 (SAMHSA. Substance Abuse and Mental Health Services Administration, 2009), while the ACE-study (Dube 2001) from San Diego found an estimate of substance abuse in the household (both alcohol and drug included) at 25.6%
- Australia: 13% of children aged 0-12 years were exposed to an adult with problematic alcohol use (binge drinking) (Dawe et al., 2008).

All in all, estimates from the world have shown a prevalence of PSU ranging from 4.6%-20.2%. It is possible geography can have an influence in the variance, but quite different estimates are observed within the same country, as is the case with the Swedish or German estimates.

It is more likely that the differences can be explained by different definitions including different types of substances (alcohol alone, both alcohol and drugs, as well as tobacco). In this way, one of the highest estimates was the German at 20.2%, which also included tobacco. The definitions included as well different levels of severity (from problematic substance use to dependency). Another explanation is the use of different data sources as well as by the choice of population

groups for study. Some of the above-mentioned estimates have only considered problematic parental alcohol use, and different self-reports have been used to measure PSU (parents' self-reports of their own alcohol or drug problems as opposed to the children's reports about parental alcohol or drug problems). The interviews and data collection have also been conducted in different life periods (adolescence as opposed to, for instance, adults who have reported PSU in their childhood). Different sources have been used to estimate PSU: the sources included structured clinical interviews of adults with children, self-reported consumption of alcohol and drugs in national sample surveys and registrations of contact with different services (for example, hospital admissions, treatment for SUD or mental health services) (Copello et al., 2010; Elgán & Leifman, 2013; Grant, 2000; Kraus et al., 2003; Manning et al., 2009; Raninen et al., 2016; Wilson et al., 2008).

By combining two different sources of information one can reduce the bias of non-participation as well as providing information not only about families seeking help, but also about the families that are, so to speak, hidden "PSU families".

The aim of paper 1 was, firstly, to estimate the prevalence of self-reported PSU in a general Danish population of 15-25-year-olds and, secondly, by using a register-based measure of PSU compare the prevalence among the participants compared with the non-participants. A possible difference between the participants and non-participants would be used to adjust the self-reported prevalence.

The hypothesis was that PSU, using the register-based measure, was less common among participants compared with non-participants. And by adjusting the prevalence of self-reported PSU with this information, the prevalence would increase.

1.5.2 PSU, family-related problems and school outcomes

Children and adolescents with PSU often report more problems in school and poorer school performance than the average pupil, such as lower grades, more skipping school days and negative school experiences (Crouch et al., 2019; Kuppens et al., 2020; Ramstedt et al., 2021; Sadler et al., 2017; von Stumm et al., 2020).

In the study by Ramstedt (2021) school problems were investigated among other ACE. The findings showed that 19.3% of the children with a parent with a drinking problem reported being bullied at least once (versus 7.6% among their peers). 31.1% did not enjoy school (versus 19.3%) and 35.1% had skipped school at least once (versus 24.3%). In the study of Casas-Gil and Navarro-Guzman

(2002) school performance for children of parents in treatment for alcohol problems was lower when it came to intelligence, repeating a grade, low academic performance, skipping school days and dropping out of school. The study population and the control group were comparable as regards the distribution on age, sex, school grade and social environment. Berg et al. (2016) showed how parental alcohol-related disorder was associated with lower school performance by their offspring, but most of the effects were explained by other adverse psychosocial circumstances (parental mental problems, parental criminality and welfare interventions). This finding suggests how research on the association between school performance and PSU should include other family-related problems.

The aim of Paper 2 was to identify different types of families with or without PSU and other family-related problems and to compare school outcomes; school outcomes consisted of two elements: 1) grades at graduation from compulsory school and 2) further enrollment in education.

It was hypothesized how children with PSU would have lower grades and be less likely to continue their education. It was furthermore hypothesized how additional stressful events and family-related problems would compound the negative outcomes.

1.5.3 PSU, family structures in childhood and adverse outcomes in young adulthood

Families can have many different constellations which create well-functioning and healthy environments for children in the family. And different family-constellations in themselves do not necessarily create problems for the children. But how is the picture when PSU is present? Is living with a parent with SU preferable to parental absence?

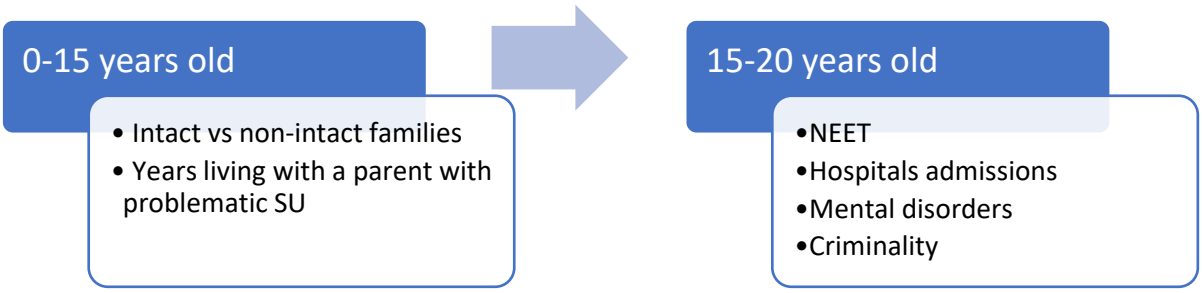
Families with PSU, in comparison with other families, more often experience issues like parental separation, economic problems and parental mental health problems as well as a dysfunctional family environment with conflicts and harsh parenting (Haugland, Carvalho, et al., 2021; Jääskeläinen et al., 2016; Kuppens et al., 2020; Velleman & Templeton, 2016). Holst et al. (2020) found an inverse association between the numbers of years children live in an intact family – with or without parental AUD – and offspring AUD. The risks for offspring AUD decreased with the number of years spent living in an intact family, and was lowest for young people living in intact families all 15 years. The same pattern was present for young persons without parental AUD, indicating how the family structure (years spent in an intact family) had a greater impact than living with a parent with AUD. In two other Danish studies of internalizing problems and drinking patterns among young

people (Pisinger et al., 2016; Pisinger, Holst, et al., 2017), living with the parent with AUD did not affect the existing associations between parental AUD and, respectively, offspring internalizing problems and drinking problems.

These findings call for further investigation, looking into more than one outcome (e.g., offspring AUD) and into living with a parent with a problematic SU as the independent variable in an analysis of the association between family structures, number of years living with the parent with SU and a range of outcomes in young adulthood.

The aim of Paper 3 was to investigate the association between childhood family structures, including years living with a parent with SU in the first 15 years of childhood and adverse outcomes in young adulthood during the age of 15-20. Adverse outcomes in this study were taken to embrace the following: not being in education, employment or training (NEET), hospital admissions, mental disorders, and, lastly, convictions for criminality.

It was hypothesized that: 1) living with both parents during childhood would protect against adverse outcomes; 2) having a parent with a problematic SU would increase the odds of adverse outcomes; and 3) the longer a child or young person lived with the person with a problematic SU during childhood and adolescence, the higher odds of adverse outcomes would be.



Chapter 2: Key concepts

2.1 Problematic parental substance use (PSU)

The conceptualising of problematic parental substance use takes its starting point in the consequences derived from, and related to, the substance use – primarily the harm perceived and experienced by the children. The children's self-reports of PSU express how one or both parents' use of substance is perceived as something more problematic, compared with the norm. Another critical area in the present concept of PSU is the consequences related to different parental problems, which can be physical, psychological or social problems connected with the substance use (defined in section 3.3.1 "Self-reported and register-based PSU (Paper 1)"). There are physical consequences, such as when alcohol and drug-related diseases involve admission to services provided by the health system, which involved the classification from "International statistical Classification of Diseases and related health problems" (ICD-10) (World Health Organization, 2004). There are psychological problems with substance related mental health problems (ICD10-codes). There are legal problems, where crimes have been committed due to substances (e.g., drunk-driving). And there is the ultimate consequence: of death from a substance-related cause (ICD10 codes). The study also includes an assessment of treatment for SUD and medication for the treatment of SUD, both of which are obvious indicators of the presence of problems related to substance use.

The conceptualising of the parental problems with alcohol and drugs has changed during the PhD-project, with the term "disorder" used initially. Thus, the term "Parental substance use disorder" was used in Paper 1 and Paper 2. The reasoning for using this term was to underscore a focus on physiological, behavioral and cognitive phenomena characterized by loss of control and by continued use despite harm related to this use (Rehm et al., 2013; Saunders et al., 2018). And the span in the disorder-concept embraced the different measures from both the self-reports and the register-based measures. The concept is furthermore nomenclature for substance related problems in international classification systems, such as ICD10 and "Diagnostic and Statistical Manual of Mental Disorders" (DSM-5) (APA (American Psychiatric Association), 2013; Saunders et al., 2018; World Health Organization, 2004). But using "disorder" as a concept can be perceived as problematic, when

it comes to the families only identified by self-reports. One question about problematic PSU in a survey study should not be seen as the basis for identifying the existence of a disorder, and, likewise, some of the register-based measures, such as drunk-driving, are not the same as having a substance use disorder. On this background, the dissertation and Paper 3 were revised and instead use the present concept "problematic parental substance use".

ICD-10 have been criticised for using a language and terminology with a high degree of pathologizing and a personification of the problem, where a person's identity is defined by the nature of the problem (Madden & Henderson, 2020; Scholten et al., 2017). A person is reduced to one characteristic, such as "addict" or "alcoholic father". The present study has its focus on the children and the link and relations with PSU and other factors on their lives, such as school and different problems in young adulthood. It investigates other family-related problems like separated families, parental mental problems and criminality, but does not reduce the parent as a person to being simply "divorced father", "depressed mother" or "criminal father". Instead of talking about substance use in isolation, attention in this study is aimed at the consequences and harm experienced by the children. This is also reflected in the Family concept elaborated below.

The concept of PSU in the present study was used from the perspective that problematic use of substances, dependency and disorder - as well as problems and consequences related with such use – can be fluctuating. Studies have shown how problems related with substance use rarely constitute a chronic state, but is interrupted by periods of reductions, recovery, abstinence and relapse (Heyman, 2013; Klingemann et al., 2010). Based on this background, the self-reported PSU and the register-based information are only indications of the existence of PSU and problems derived from it, and which will often have affected the family for several years before contact with different services was established. It could have been a more or less severe dependency/disorder and lasting a shorter or longer time. But the combination of the survey data and register data adds to the complexity of PSU. The self-reported PSU can include some of the families which may not seek help or need treatment, and who in this way are not captured by the register data because these parents do not appear in the official helping/treatment system; the register data for its part covers the families with more severe problems related with substance use, but in many cases the adolescent/adult children affected here will probably not participate in survey research (Christensen et al., 2015; Groves, 2006).

2.2 The family concept

In the present study the family was the frame in which PSU and its consequences for the children were studied. All families have different environments and all parents have different parenting styles, and studies have found how these – like a secure parent-child attachment or a supportive adult relation – can have a great impact on how the children are doing in the long run even though their childhood has been affected by a lot of problems like parental separation, economic problems and PSU (Finan et al., 2015; Kristjansson et al., 2009; Wlodarczyk et al., 2017). As mentioned earlier, families with PSU often face more problems than families without PSU, and the use of the family as a concept is only helpful if we see the family as a whole social unit and see its interplay with aspects of the immediate world around it, including the problems the family encounters. In the present study this was attempted by including information about different family-related and parental problems, such as parental crime, parental mental disorders, parental chronic disease, family dissolution etc. But it was recognized how these were only fragments of the total picture of the families and their surroundings.

The British psychologist Jim Orford is one among several critics pointing out how the existing research and thinking about families with parental alcohol and drugs problems are dominated by models which view family members in a more or less pathological light (Orford, Copello, et al., 2010; Orford, Velleman, et al., 2010). This is the case when researchers and people in general talk about wives of men with drinking problems and see these wives as psychopathological themselves and as co-dependent, or when parents of young adults with drug problems are viewed as having been abusive to their children or otherwise inadequate in their parenting.

The two approaches differ in the way they view the problem: while in the non-pathological model it is similar to other stressful circumstances and disasters, in the pathological approach it is similar to disorders like anorexia. Instead of talking about the addiction in itself, the attention should be generated both to the harm experienced by the affected family members, and to the issue of which coping strategies and support structures the members are using (Orford, Copello, et al., 2010). In this present study, the attention is to a larger degree on the harm experienced by the children as well as on different family-related problems reflected in the different registers. The coping strategies and support structures are not within the scope of this study.

2.3 Adverse childhood experiences (ACE)

“Adverse childhood experiences” was framed as a concept in connection with The Adverse Childhood Experiences study from 1998 (Felitti et al., 2019). Before the ACE study, different studies

were made of the question of childhood abuse and other damaging childhood experiences, but often with only examination of single types of abuse (Felitti et al., 2019). The combined effects of different types of physical, sexual and emotional abuse and the long-term consequences were only sporadically researched (Moeller et al., 1993), and Felitti was the first to investigate the relationship of adult health risk behaviors, health status, and disease states to childhood abuse and household dysfunction. Childhood abuse and household dysfunction were defined by the following experiences:

Childhood abuse

- Psychological abuse
- Physical abuse
- Contact sexual abuse

Household dysfunction

- Exposure to substance abuse
- Mental illness
- Violent treatment for mother/stepmother
- Criminal behavior

ACE have a documented effect on physical and mental health, and on related behavioral related outcomes. ACE is not only affecting the children during their childhood, but can increase risks of different negative life course outcomes (Hansen et al., 2021; Haugland, Dovran, et al., 2021; Hughes et al., 2019; Shin et al., 2018). The initial definition from Felitti's study has been developed and changed in later studies – e.g., only including parental incarceration, violence, household mental illness and problematic SU/SUD (Crouch et al., 2019) - but the focus on the combined effect of several adverse childhood experiences was common to them all. This may be a part of the debate and critique of ACE as a concept and how it is "a chaotic concept" without consistent definition across studies, and how it has been developed from studies with small effect sizes and populations (Edwards et al., 2019).

Events often related with adverse childhood experiences (but not always) are included in the present study – experiences such as parental substance-related diseases, disorders, crime or cause of death which were a part of the PSU-definition (**Paper 1**), the family-related problems included in the analysis of school outcome (**Paper 2**) and family dissolution included in the analysis of living with the parent with a problematic SU (**Paper 3**). The ACE-concept implies that the experiences lead to later adverse outcomes, but research has found how the severity of the outcomes depends on the

resilience of the child, on protective factors and on the timing of ACE, among other things (Flaherty et al., 2013; Hansen et al., 2021; Hughes et al., 2019). The study of Hughes et al. (2019) investigated the association between ACE, adverse outcomes and childhood relationships among young adults in ten European countries. And it concluded that ACE can be affected by resilience factors such as supportive childhood relationships.

Chapter 3: Methodology

The study population in the present study consisted of 10,414 young Danish people aged 15-25 invited to participate in two comparable national sample surveys – "The National YouthMap Surveys". The questionnaires investigated substance use and well-being as well as social, mental and physical problems (Pedersen et al., 2018; Pedersen et al., 2017). And among the questions was one asking participants if they were experiencing PSU at the time or had experienced PSU earlier in their lives.

The sample, together with the interviews, was linked with register data on a secure server at Statistics Denmark. Using a register about family relations enabled an identification of the parents of the sample, and register data on both the sample and their parents was extracted from several Danish registers covering the years 1989-2018.

3.1 YouthMap survey from 2014 and 2015

The two national sample surveys were conducted by the Centre for Alcohol and Drug Research in 2014 and 2015. The survey sample was randomly selected from The Danish Civil Registration System (Pedersen, 2011) by Statistic Denmark. An invitation was sent by postal letter with a code to the electronic survey, which was followed by telephone interviews. 5,755 interviews were conducted either by the electronic questionnaire or by telephone interview, and the response rate for the combined survey sample was 55.3%.

The survey data was used to define self-reported PSU, and the questions about PSU in the two surveys were comparable (see section 3.3.1).

The sample of 10,414, including information about participation/non-participation and the self-reported PSU, was linked together with ten registers which provided information about the young people and their parents from the time of birth and up to 2015/2018 (Table 2).

3.2 National registers

National registers in Denmark contain individual-level data on the entire population, which can be linked to survey samples through personal identification number (Thygesen et al., 2011). In the present study, register data was extracted on the sample of young people and their parents covering the years from the time of birth until 2015 in Paper 1, and for some register data on the sample the period was until 2018 in Papers 2 and 3 (Table 2).

Table 2. Information selected from population-based registers

Register	Starting from (year)	Register-based PSU	Other measures based on register data in Papers 2 & 3	
		Paper 1	**Paper 2**	**Paper 3**
The National Patient Register	1989	Parent: alcohol and drug-related diseases	Parent: chronic diseases	Youth: hospital admissions.
The Psychiatric Central Research Register	1989	Parent: substance-related diagnosis	Parent: any mental disorder diagnosis	Youth: any mental disorder diagnosis
The Danish Central Crime Register	1989	Parent: substance-related criminality	Parent: criminality (excl. substance & traffic related)	Youth: criminality (excl. traffic related)
The Register of Causes of Death	1989	Parent: substance-related causes of death		
Register for Drug Abuse Treatment; National Alcohol Treatment Register	Drug: 1996 Alcohol: 2006	Parent: treatment of SUD		
The National Prescription Register	1995	Parent: dispensed prescription drugs for substance dependency		
The Student Register	2001		Youth: Grades from the General Certificate	
The Employment Classification Module	1989	Parents' level of education	Youth: further education Parents' level of education	Parents' level of education
Danish registers on personal labor market affiliation	1989		Parents: long-term unemployment	Youth: Not in education or employment
The Danish Civil Registration System	1989	Identity of parents sex and ethnicity	Not living with both parents sex and ethnicity	Intact/non-intact families + residential parent sex and ethnicity

3.3 Measures

The present study investigates how alcohol and drugs problems affect the children in the short-term and the long-term. By using national sample survey studies and register data it is possible to look into different circumstances for, respectively, the parents and the young adults.

The two data sources with multiple registers and youth-reports from the survey were a major strength of this study. On the one hand, register data provided information about the non-participants, as well as about families with different substance-related contacts in different societal institutions, while, on the other hand, the self-reports provided information about families with PSU that, e.g., have never received help or treatment or committed a crime.

3.3.1 Self-reported and register-based PSU (Paper 1)

Paper 1 investigated the prevalence of self-reported PSU and how register-based information about parental substance-related contacts can be used to adjust for non-participation. This necessitated two measures of PSU based on, respectively, the survey data and the register data.

Self-reported PSU: Among questions about psychological, social and physical problems, the participants were asked whether or not their parents had (or had had) problems with alcohol or drugs (the choice of words was the Danish word “misbrug” corresponding to the English “abuse”) (Pedersen et al., 2017). This survey question was used to define the self-reported PSU, which included 731 young persons, corresponding to 12.7% of the 5,755 participants.

Register-based PSU: Register data measured different parental alcohol and drug problems, which were defined from the following (Helweg-Larsen, 2011; Kildemoes et al., 2011; Lynge et al., 2011; Mors et al., 2011):

- substance-related diseases: hospitalization in the period 1989–2016 with an alcohol- or drug-related diagnosis, such as alcoholic liver disease, alcohol induced chronic pancreatitis or degeneration of nervous system due to alcohol
- substance-related disorders: registration with F10–19 diagnosis in the period 1989–2015
- substance-related crime: substance-related charge and sentence in the period 1989–2015 (e.g., drunk-driving and/or possession, smuggling, and/or sale of drugs)
- treatment for SUD: registrations in the National Alcohol Treatment Register (2006-2015) or the Register for Drug Abuse Treatment (1996-2015)
- Medication for the treatment of SUD: Parents who had received in the period 1995–2015 one or more prescription medications used to treat alcohol dependence (ATC N07BB:

disulfiram, calcium carbimide, acamprosate, naltrexone, nalmefene) and/or opioid dependence (ATC N07BC: buprenorphine, methadone, levacetylmethadol, lofexidine, levomethadone, diamorphine, buprenorphine (combinations))

- Substance-related deaths: alcohol- or drug-related causes of death in the period 1989-2015 (same diagnosis as used in substance-related diseases).

3.3.2 PSU, family-related problems and school outcomes (Paper 2)

"School outcomes" was measured by two criteria: grades at the final examination in compulsory school and further enrollment in education after compulsory school.

Grades at the final examination: a grade point average calculated on the grades at examination in the following subjects: oral Danish, oral English, oral physics/chemistry biology and geography, written mathematics (weighted 0.5) and written Danish. The grade point system in Denmark is a seven-point scale from -3 to 12 (-3, 0, 2, 4, 7, 10 and 12), with 12 the top grade and -3 the lowest.

Further enrollment in education: enrollment in general or vocational upper secondary education during the two years following the final examination in compulsory school.

Family-related problems:

1) PSU using a combined measure of the self-reported PSU and the register-based PSU (defined in Paper 1)
2) Parental long-term unemployment: three consecutive years, or more than three non-consecutive years, of social benefit receipt or unemployment. The period was from the child's birth until (and including) the year of their 15th birthday
3) Not living with both parents: if the child lived apart (not same residence) from one or both parents during one or more years from birth until and including the year of their 15th birthday
4) Parental chronic disease: type 2 diabetes, chronic obstructive pulmonary disease, asthma, rheumatoid arthritis and osteoporosis, in the period 1989-2015
5) Parental mental health problems: any record in the Psychiatric Central Register in the period 1989-2015 (except F10-F19 diagnoses, which were included in PSU), in the period 1989-2015
6) Parental criminality: convictions except traffic offences and the parental substance-related criminality included in the register based PSU; the period was from the child's birth until (and including) the year of their 15th birthday

3.3.3 PSU, family structures and adverse outcome (Paper 3)

Five different family structures were defined from 1) whether the child during their first 15 years lived together with both parents or not, 2) whether PSU was present and 3) if PSU was present, the number of years the child spent living with the parent with a problematic SU:

1) Intact families without PSU
2) Intact families with PSU, 15 years of living with the parent with a problematic SU
3) Non-intact families without PSU
4) Non-intact families with PSU, 0-4 years of living with the parent with SU
5) Non-intact families with PSU, 5-15 years of living with the parent with SU

Four outcomes defined **adverse outcomes** during age 15-20:

- Not in education, employment or training (NEET) (this only refers to 20-year-olds)
- Any kind of hospital admission, noting the reason for the admission (illness, accident, violence, suicide attempt and other reasons)
- Diagnosis for mental disorder, noting the subgroup of disorder (anxiety, behavioral and emotional as well as other types).
- Criminal conviction except traffic offences, noting the type of conviction (property, drug-related and other offences)

3.4 The combination of survey and register data

The concept “problematic parental substance use” (PSU) was used to embrace the different types of parental alcohol and drug problems, which in the present study were measured by self-reports and register-based information. Information about PSU from self-reports provided unique insight into the life of young people, families and parents, where the majority most likely are not in contact with any welfare or family services or institutions (Bellis et al., 2014; Pisinger, Holst, et al., 2017; Raninen et al., 2016). Many parents with alcohol or drug problems never seek help, and the majority of the families with these kinds of problems are to be found in population samples (Ramstedt et al., 2021). This kind of information cannot be obtained via registers or clinical studies because these sources only capture citizens who are in contact with different services and institutions (Elgán & Leifman, 2013; Hanson et al., 2006). Using young people’s own perceptions of their parents’ problems with substances also has the advantage that it is not an external assessment categorizing the parents as having problematic SU, but the children themselves assessing the nature of the problem. On the other hand, it is uncertain whether the parents themselves would report a problematic SU. Self-

reports can also be biased with under- or over-reports, for a number of reasons. Some children and adolescents may look at their parents and upbringing without feeling they are experiencing, or have experienced, substance problems or suffered any harmful effects, even though the surroundings would classify the parental drinking or drug use as excessive, and maybe within the definition of PSU. Loyalty to the parents' secret or a feeling of stigma and shame are other factors that can affect the respondents' inclination to report parents' possible problems with alcohol or drugs (Orford, Velleman, et al., 2010; Tamutienė & Jogaitė, 2019). Self-reports of substance-related harm may be influenced by individual, cultural, or temporal factors, and in this way the self-reports can open a door to a wide range of families, levels of problems and consequences of the substance use. But meta-analyses of cross-information correlations (agreement between reports by the person in question and reports by others) have shown significant larger correlations for reports of substance use compared with reports of other problems (Achenbach et al., 2005). In this way the ratings from children involved are often in agreement with parents' reports about their own substance use.

Some of the abovementioned problems can be addressed by complementing with register-based data. If self-reported PSU from surveys were used solely, knowledge about almost half of the sample would be missing due to non-participation and response-rates around 50%. And research has, as mentioned in the presentation of the aim of Paper 1 (section 1.5.1 "Estimating the prevalence of PSU in a general population"), found how non-participants often have higher levels of different problems than the participants.

The advantage with register data is the large study population and wide population coverage. This minimizes bias due to issues such as sample selection and non-participation which appears in survey research (Thygesen & Ersbøll, 2014). Contrary to the cross-sectional data in survey research, register data is often historical, which enables analysis of long-term outcomes using large samples over long periods (Thygesen et al., 2011). Existing research using register data has examined the contribution of genetic, biological, and environmental factors (Brummer et al., 2021). At the same time, register data is limited to representing the more severe cases. A hospital admission for an alcohol-related condition means the AUD is well-advanced. But a lot of parents will have a heavy use of alcohol and drugs without getting into contact with, or seeking help from, health services, and in this way they will not have an entry in the National Patient Register with a diagnosis for an alcohol-related disease even though the substance use may have varied consequences (Brummer et al., 2021; Christoffersen & Soothill, 2003).

An important aspect of combining different data sources is to acknowledge the complexity and the limitations. The timing of the PSU is unknown, as the self-reports did not include information about

the timing of the alcohol or drug problems, how many years the problem was ongoing or if it was still present. This is further discussed in the section 5.2 “Strengths and limitations”, but, for now, it is important to emphasize, how both the self-reports and the register-based measures were only indications of an existing problematic PSU and how the analyses of school outcomes and adverse outcomes in young adulthood were not investigating causality. Not knowing if the parental alcohol or drugs were present in childhood, the analysis of school related outcomes were only providing knowledge about how indications of how parental alcohol or drug problems can be linked with differences in school related outcomes or linked with adverse outcomes in young adulthood. This can be illustrated by a fictitious example of two young persons from the study: Person A reported PSU, while person B did not but had a farther who had received prescription medication for AUD from 2011. Both of them were 20 years old when they participated. Is it certain, the problematic PSU had been present in their childhood? No, it is not. And can causal assumptions be made about the problematic PSU and their school average point grade at the leaving examination? No, it can not.

But, it is very likely the families have experienced problems and different consequences related to SU during both childhood and youth. Research has demonstrated how problematic SU/SUD can develop over a long period before the parent will consider treatment for the substance use, as well as physical or mental problems (Green et al., 2020; Oleski et al., 2010; Scott & Walter, 2010).

By using information from two measures of PSU in the present study, it was possible to include different sources of information on PSU. But it is important to recognize that the two measures – the self-reports versus the register-based PSU – were not measuring the same kind of PSU. The different information was included in this study on the assumption that different register measures of PSU (substance related diseases, disorders, crimes, medications, treatments and causes of death) are as well as self-reported PSU an alarming sign of substance-related problems that affect children within the family.

3.5 Ethics

Information about the purpose of the study was described in the letter sent to the 10,414 young people when they were invited to participate in the YouthMap surveys. It was very specific about how participation was voluntary and that any incoming information and answers would be treated with confidentiality. The informed consent was given by participants on completion of the survey. The linkage between the register data and the survey data was registered at the Danish Data Protection Agency, and all confidentiality and privacy requirements were met.

3.6 Statistical analysis

3.6.1 Estimating self-reported PSU

Firstly, a descriptive analysis calculated the crude prevalence of young people reporting PSU in the YouthMap surveys. Secondly, using a descriptive stratified analysis reporting odds ratio, the prevalence of the register-based PSU among the non-participants compared with the participants was analyzed. For each parental substance-related contact a comparison was made between the participants with the non-participants. The relation and overlap between the two measures – the self-reported PSU and the register-based PSU – were calculated and illustrated. A logistic regression model investigated the probability for being a participant with regard to characteristics such as sex, age, parents' level of education and ethnicity, including an inverse probability weight (IPW) to account for the differences in PSU among participants and non-participants. Finally, an adjusted estimate (Pa) was calculated using information about the non-participants from the register-based PSU (R=ratio of incidence proportion of the register-based PSU compared with the self-reported PSU):

Pa = P (response rate + R(1 - response rate))

3.6.2 School-related outcomes

With a latent class analysis (LCA) four classes of families with different levels of family-related problems, including PSU, were identified. The hypothesis was that young people from different types of families with a variety of problems would have different challenges in school and in this way different school outcomes in terms of grades and further enrollment.

A descriptive analysis using an independent one-way ANOVA investigated the characteristics of the young persons from the four types of families, identified in the LCA.

Using a linear regression model, the differences between the family types and the young persons' grade point averages were investigated. A logistic regression model analyzed further enrollment in education. Both models controlled for sex, ethnicity and parents' level of education.

3.6.3 Family structures and adverse outcomes in young adulthood

Five different combinations of family structures were constructed with the following characteristics: intact/non-intact families, +/- PSU and years living with the parent with a problematic SU (0 years, 1-4 years, 5-14 and 15 years).

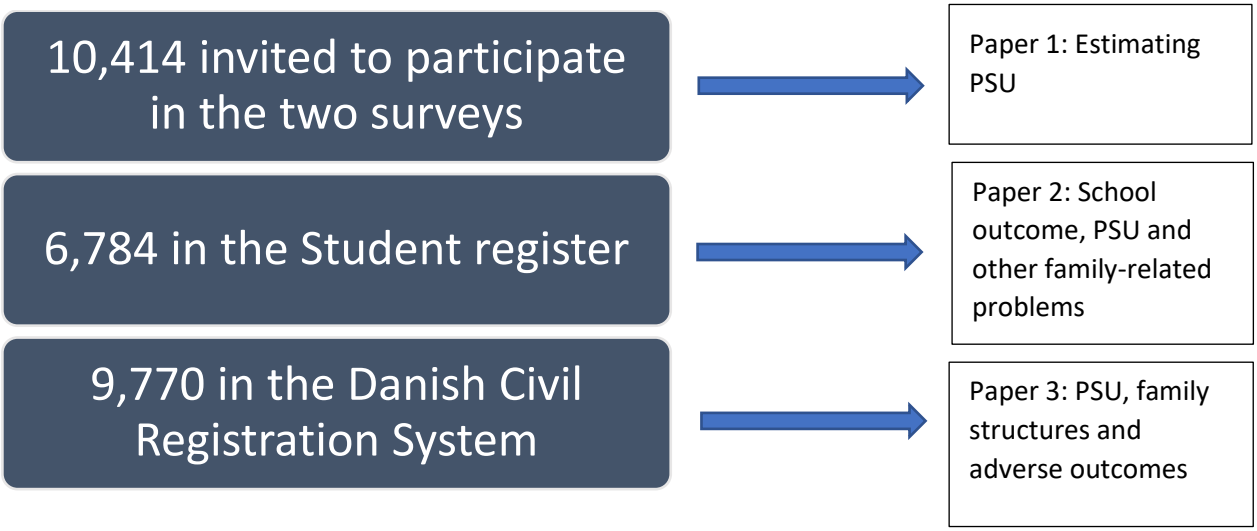
The association between the family structures and adverse outcomes for the young people during age 15-20 was analyzed using a binary logistic regression model. This enabled an analysis of whether young people from intact versus non-intact families with and without PSU (and different periods of cohabiting) had different odds of NEET (not in education, employment or training), hospital admissions, mental disorders or convictions for a crime. These adverse outcomes were investigated in more detail with logistic regressions models, looking into the differences between the five types of family-structures with regard to 1) receiving social benefits, enrolled in education or working, 2) different causes for hospitalization (illness, accidents, violence, suicide attempts and other causes), 3) types of diagnosis (anxiety disorders, behavioral and emotional disorders with onset usually occurring in childhood and adolescence and other disorders), and 4) types of crime (property, drug-related and others types of crime).

All models controlled for sex, ethnicity and parents' level of education.

All the analyses were run in STATA 15, 16 and 17 and R (R Core Team, 2013; StataCorp, 2019).

Chapter 4: Results

Three different analyses adressed the questions about how to estimate PSU, how school performance is affected by PSU, how it is affected by other family-related problems and, lastly, the adverse outcomes in young adulthood of childhood family structure including living together with the respective parent or of not doing so. The study population used in the three analyses:



4.1 Estimating self-reported PSU (Paper 1)

The crude prevalence of self-reported PSU was 12.7%. A comparison between the participants and non-participants with regard to the prevalence of the register-based PSU showed how PSU was more common (OR = 1.53; 95% CI: 1.38–1.70) among non-participants (18.4%) compared with participants (12.8%). In this study the self-reported PSU was adjusted for the non-participation and increased by 2.5 percentage points from 12.7 (95% CI: 11.8-13.6) to a total of 15.2% (95% CI: 14.5%–15.9%) of young Danish people in the age group 15-25:

Pa = P (response rate + R(1 - response rate))

Pa = 0.127*(0.55 + R*(1 - 0.55))

R = 18.37/12.7 = 1.45

Pa = 15.2 %

The study had its focus on the self-reported PSU and how an estimate can be more adequate when adjusting the estimate with register-data about substance-related contacts. At the same time this article identified where the two measures – self-reported and register-based PSU - were congruent and where they were not, and which persons were captured by 1) the register-based PSU measure only, 2) both the register-based and the self-reports measure and 3) the self-reported PSU only (Fig. 1). This created a basis for the two following studies using a combined measure from both the self-reports and the register data.

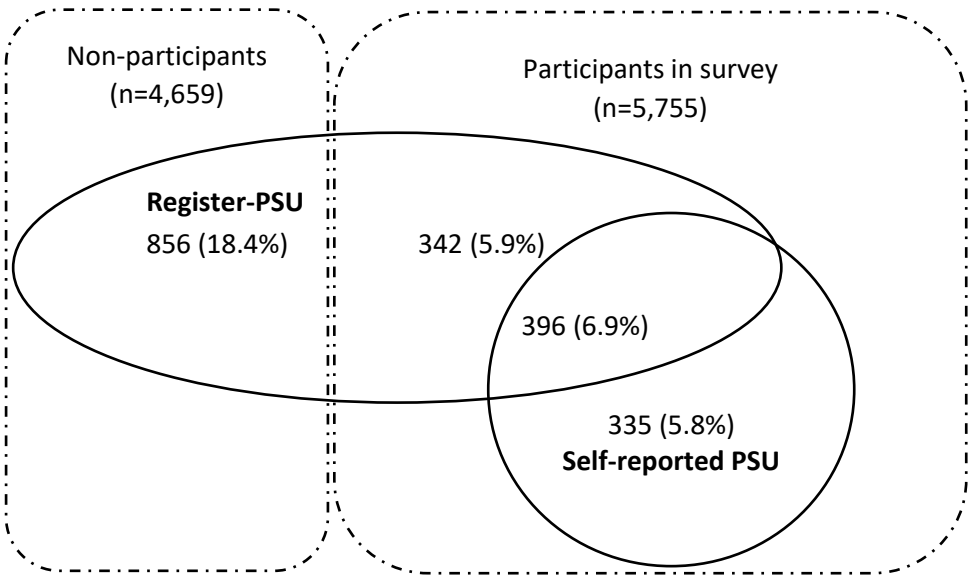


Figure 1: Overlap between the self-reported PSU and the register-based PSU.

4.2 PSU, family-related problems and school outcomes (Paper 2)

This study examined school performance in relation to family-related problems including PSU. "School outcomes", as has been noted, was interpreted as consisting of the two elements grade points average at graduation and enrollment in further education after graduation. The family-related problems were, besides PSU, children not living with both parents, and parental problems like criminality, mental disorders, chronic diseases and long-term unemployment. Firstly, four classes of families with different levels of family-related problems were constructed by the LCA: "Low ACE families" (n = 4,351; 64%), 2. "Families with PSU" (n = 549; 8%), 3. "Families with unemployment" (n= 1,477; 22%) and 4. "High ACE families" (n = 407; 6%).

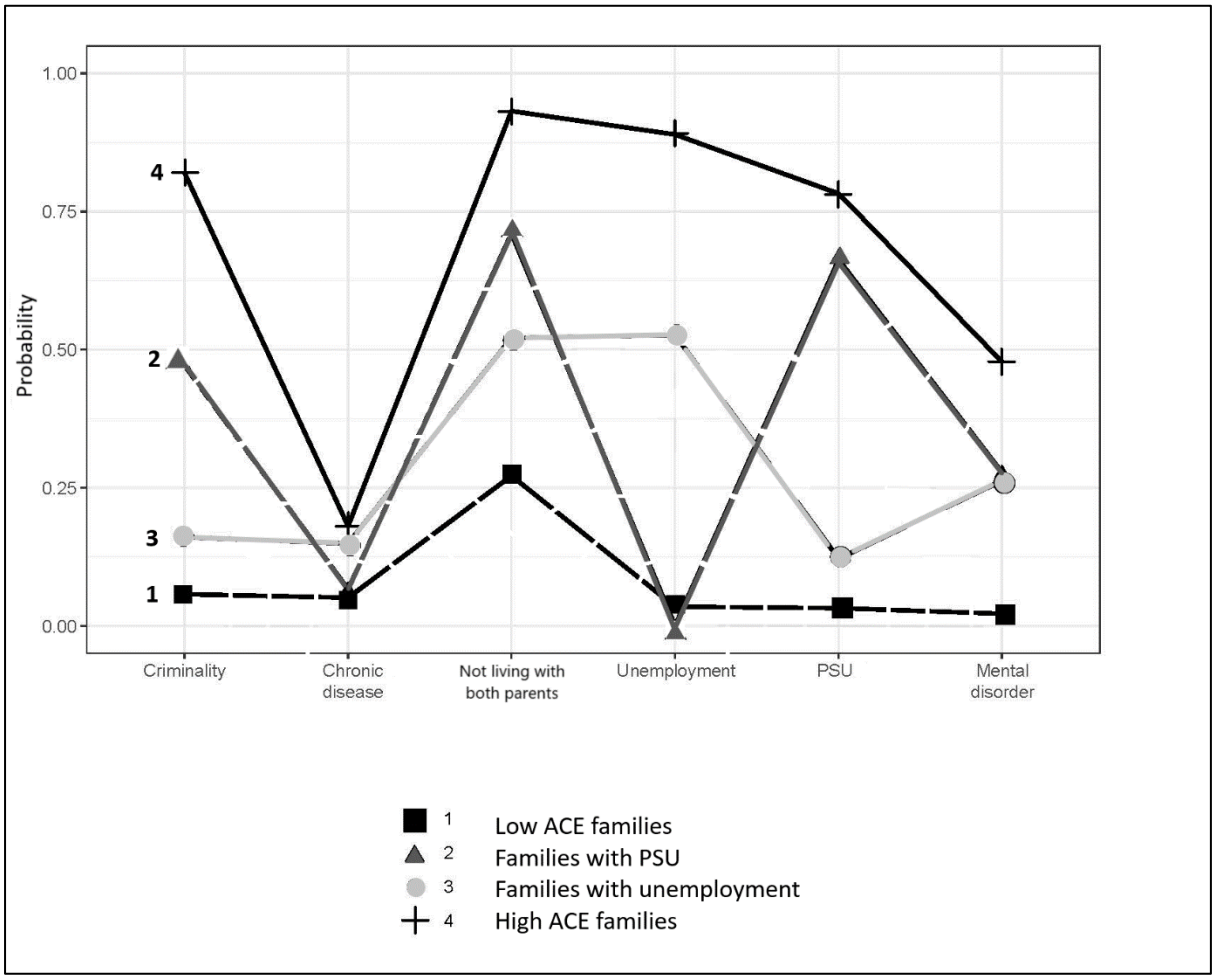


Figure 2: Marginal probabilities for the four classes of having six family-related problems

The young people from "Low ACE families" had low probabilities on all the different family-related problems (Figure 2). The probability for not living with both parents was at 0.25, which can be interpreted as a high level. But the Danish rates of divorce and non-cohabiting families are quite high and a Danish study showed how every third young person age 15 did not live with both parents (SFI

(Det Nationale Forskningscenter for Velfærd), 2016). The young persons from “Low ACE families” were in this perspective actually less affected compared with the general picture. Young people from “Families with PSU” had high probabilities for criminality (0.47), not living with both parents (0.71) and PSU(0.66), but low probabilities for parental chronic diseases (0.07), parental long-term unemployment (<.001) and parental mental problems (0.28). Young people from “Families with unemployment” had high probabilities for not living with both parents (0.52) and parental long-term unemployment (0.53), as well as the second highest probability for parental chronic diseases (0.15) and parental mental disorders (0.28). Young people from “High ACE families” were characterized by high probabilities on all six family-related problems.

The effect of these family-related problems on the first aspect of school outcomes, consisting of the grade average at graduation, was significant between youth from “Low ACE families” and the three other family types (Fig. 3). They had, by a significant margin, the highest average for females at 7.40 (95% CI: 7.30-7.50) on the Danish grade point scale from -3 to 12 (-3, 0, 2, 4, 7, 10 and 12), where higher grades indicate better performance. The males from “Low ACE families” had an average at 6.83 (95% CI: 6.72-6.93). Young persons from the two family types “Families with PSU” (for males: 5.93 ; 95% CI: 5.64-6.23; for females: 6.48; 95% CI: 6.20-6.76) and “Families with unemployment” (for males: 6.16; 96% CI: 5.99-6.33; for females: 6.63; 95% CI: 6.44-6.81) had almost the same average, but scored significantly lower compared with “Low ACE families” as well as significantly higher than young persons from “High ACE families”, which had the lowest grade point average (for males: 5.58; 95% CI: 5.22-5.94; for females: 5.79; 95% CI: 5.48-6.11).

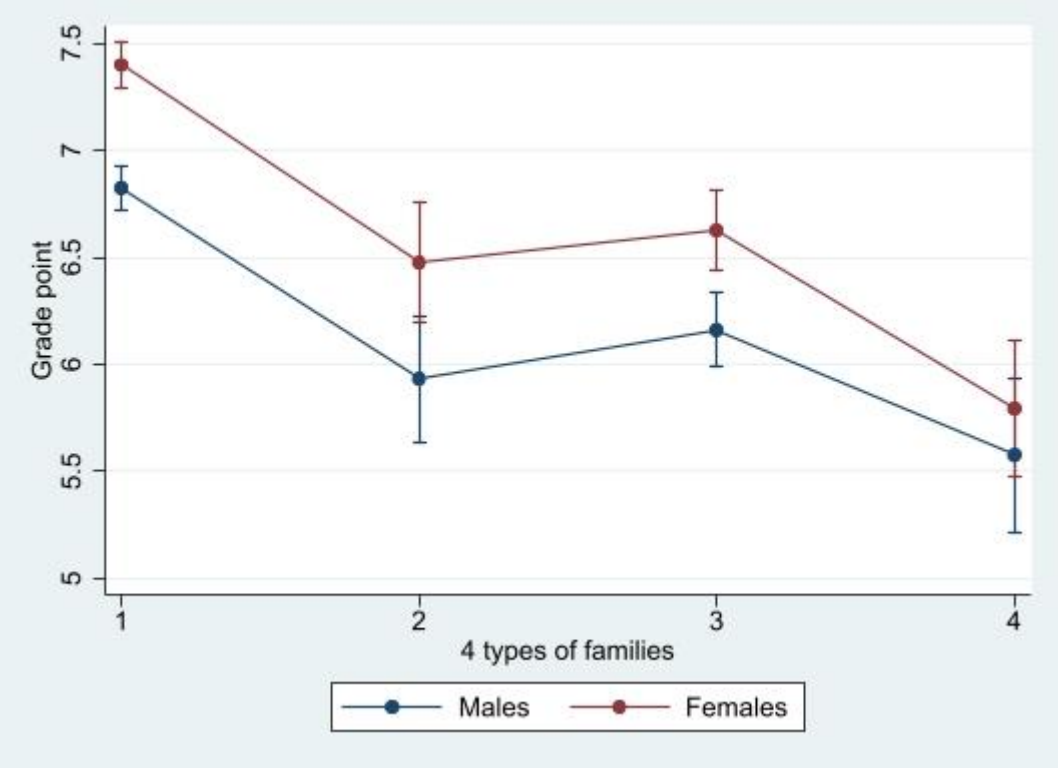


Figure 3: The young people's grade point averages
by family type with predictive margins (incl. 95% confidence intervals (CI))

Concerning enrollment in further education after graduation only 420 (6.2%) were **not** enrolled in some kind of education program the two subsequent years after graduation. The analysis showed higher odds of not being enrolled in further education for females from the other types of families compared with females from "Low ACE families" ("Families with PSU": OR=2.16; 95% CI: 1.22-3.85; "Families with unemployment": OR=2.08; 95% CI: 1.32-3.28; "High ACE families": OR= 3.41; 95% CI: 1.96-5.93). Higher odds of not being enrolled in further education were observed for the males from "Families with PSU" (OR= 1.51; 95% CI: 1.01-2.26) and "High ACE families" (OR=1.78; 95% CI: 1.11-2.26). .

4.3 PSU, childhood family structures and adverse outcomes in young adulthood (Paper 3)

The last study investigated if a childhood with PSU in the home had associations with adverse outcomes in young adulthood, when the children were 15-20 years old. Different family structures during the first 15 years of childhood were structured in five categories of intact versus non-intact family structures ("Intact"/"Non-intact") as well as with versus without PSU ("+PSU"/"-PSU"): 1) "Intact /-PSU" (n=4,273; 43.7%), 2) "Intact/ +PSU" (n=471; 4.8%), 3) "Non-intact /-PSU" (n=3,613; 37.0%), 4) "Non-intact /+PSU, brief" (living 0-4 years with the parent with problematic SU) (n=717; 7.3%) and 5) "Non-intact/+PSU, Long (, living 5-15 years with the parent with problematic SU) (n=696; 7.1%). Adverse outcomes in young adulthood were operationalized as not in education, employment, or training at age 20 (NEET), hospital admissions, any kind of conviction for a crime, and, finally, mental disorders (all three at age 15-20).

The analysis showed how 4.5% of the young people in the year of their 20th birthday were neither enrolled in education nor working, but received social benefits. 69.7% had been admitted to a hospital once or more during age 15-20. 9.1% had been diagnosed for one or more mental disorders during age 15-20. And, lastly, 11.4% had a conviction for a crime (age 15-20).

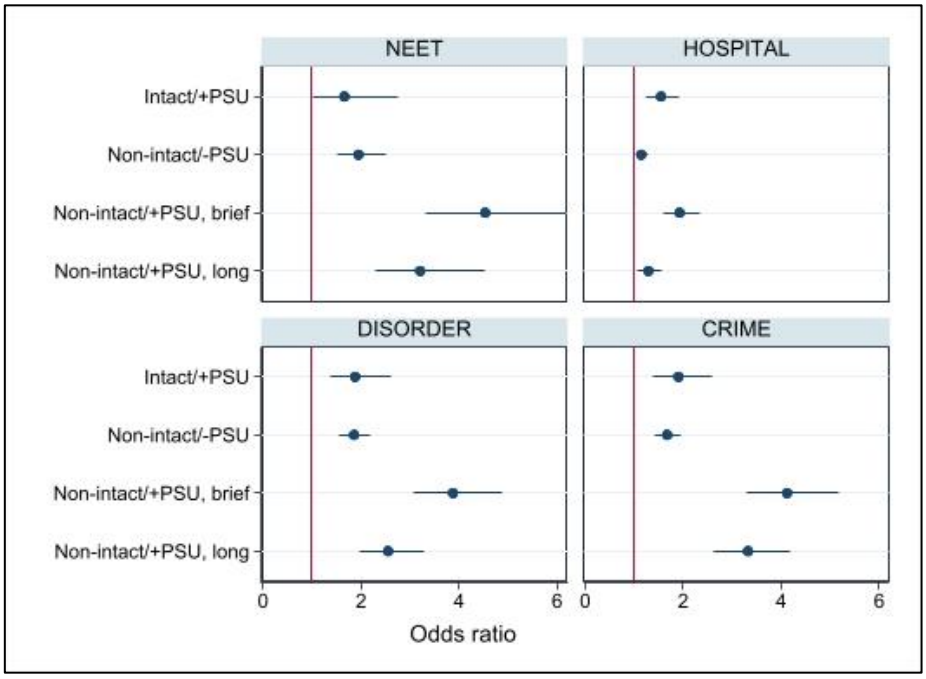


Figure 4: Family structures and odds ratio for adverse outcomes at age 15-20 from a logistic regression [c)] using "Intact/-PSU" as reference group (n= 9,770)[1]

[1] Notes: *Intact/-PSU*: Youth who had grown up in intact families without problematic parental substance use. *Intact/+PSU*: Youth who had grown up in intact families with problematic parental substance use. *Non-intact/-*

Logistic regressions models used “Intact/-PSU” as a reference group and calculated odds ratio (OR), which indicated possible increased odds of the different adverse outcomes for the young persons from the four other types of families (Fig. 4).

Young persons from intact families/+ PSU had higher odds with odds ratios between 1.53-1.88 of the different outcomes compared with the reference group. *Young persons from non-intact families/-PSU* had similar outcomes.

The highest odds were detected among *Young persons from non-intact families/+PSU, short* as the odd of NEET was almost five times as high compared with the reference group (OR=4.54; 95% CI: 3.33-6.18). The odds for hospital admissions (OR=1.93; 95% CI: 1.59-2.34) were also the highest, as were those for mental disorder (OR=3.88; 95% CI: 3.08-4.89) and convictions (OR= 3.33; 95% CI: 2.64-4.19), when compared with the reference group.

Young persons from the last type of family, *non-intact families/+PSU, long,* also had relatively high odds of the different outcomes, but not as high as the young persons with a short period of living with a parent with a problematic SU.

Looking closer at the analyses for the different outcomes – NEET, hospital admissions, mental disorders and crimes – revealed differences when it came to admissions in hospitals related to violence and suicide attempts, with higher odds among young people from non-intact families and especially non-intact families with PSU (both 0-4 years and 5-15 years’ living with the parent with SU). Also anxiety disorder and behavioral and emotional disorders were more prevalent in non-intact families, but especially for non-intact families with short (OR=4.25 for F4-diagnoses and OR=7.63 for F9-diagnoses). And, lastly, convictions for property and drug-related offences were more prevalent in non-intact families with PSU as well as in – although here the odds were lower – non-intact families without PSU.

PSU: Youth who had grown up in non-intact families without problematic parental substance use. *Non-intact/+PSU, brief:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for four years or less. *Non-intact/+PSU, long:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for five or more years.

NEET: not in education, employment or training (only for 20-year olds); *HOSPITAL:* hospital admission; *DISORDER:* diagnoses for mental disorders; *CRIME:* convictions for crime (excl. traffic offences). All models adjusted for sex, ethnicity other than Danish and parents’ higher education than primary school

Chapter 5: Discussion

In this study, it was firstly estimated how many young Danish people had experienced PSU. As hypothesized PSU was less common among survey participants compared with non-participants and when adjusting for this difference the prevalence of self-reported PSU increased. Furthermore, the analysis showed how school performance in compulsory school and further enrollment in education after graduation differed among young people from families with different problems. Especially young people from "Families with PSU" and "High ACE families" had higher odds both of achieving lower grades at graduation and of not being enrolled in further education. Young people from "Families with unemployment" also had lower grades but were enrolled in further education on the same level as young people from "Low ACE families". Lastly, the hypothesis about how intact families would be a protection against different problems (NEET, hospitalization, mental disorders and criminality) in young adulthood was supported, but not the hypothesis about how the number of years living with the parent with parental SU would tend to exacerbate the different adverse outcomes. Young people from non-intact families living with the parent with SU for 0-4 years had the highest odds for NEET, mental disorders, hospitalization and criminality – higher compared with young people living with the parent with SU for 5-15 years.

5.1 Findings compared with existing research

The adjusted prevalence of self-reported PSU was in the present study 15.2% (**Paper 1**). Estimates from the world have shown a prevalence of PSU ranging from 4.6%-20.2%. It is possible that geography has an influence on the variance, but quite different estimates are observed within the same country, as the Swedish and German estimates show. It is more likely the differences can be explained by different data sources as well as by different study populations. The highest estimate from San Diego of 25.6% included the whole household and not only the parents, which maybe explains the high level (Dube et al., 2003). It is also germane to mention the study only included adults visiting a health care clinic and in this way primarily included participants who actually sought help at the clinic or were referred there by their health care provider (Felitti et al., 2019). It is likely this population segment cannot be generalized to a general population, as this is a segment which is

more willing to seek help and treatment, and help-seeking behavior is more prevalent among people with higher levels of problems, lower educational background and lower income (Oleski et al., 2010).

If we want to know more about PSU in the general population at national level, it is important to investigate the prevalence of PSU in other population segments besides those seeking help. This is important for two reasons: firstly, because the majority of people with problematic alcohol and drug use never seek treatment and, secondly, because the major share of PSU is found in population samples. In the paper "Estimating…" I have adjusted the crude prevalence from a national sample survey by using register data. The findings showed how 15.2 % of young Danish people have experienced PSU. The study provides important information to Danish politicians as well as health sector and social sector professionals about young Danish people's exposure to PSU, and it also contributes to research focusing on estimating family-related problems, which are present across many types of individual, family and societal class. Family-related problems, such as PSU, will often be underestimated using survey data because knowledge about the non-participants is lacking, and this is a population segment with a considerably higher prevalence of PSU compared with participants. This study underlines – as has already been emphasized – the importance of including information about these non-participants, which is possible in Denmark thanks to the comprehensive national registers containing historical data.

The study reporting on school performance (**Paper 2**) showed the significant association between family-related problems and grades at graduation, as well as a partial association with enrollment in further education. Bot males and females from Families with PSU (males: 5.93; females: 6.48) and long-term unemployment (males: 6.16; females: 6.63) had significant lower grade point averages, but the lowest average was among young people from High ACE families (males: 5.58; females: 5.79) when compared with Low ACE Families. Previous research has reported the same link between school-related outcomes in relation to PSU and family-related problems. Casas-Gil and Navarro-Guzman (2002) found a mean grade at 6.40 among students without parental AUD and a significant lower mean grade at 5.65 among students with parental AUD. More recent research points to similar conclusions, for example in an Australian study of Johnson et al. (2017) where results from a national testing program showed a higher proportion of those who had failed to meet the benchmark among children with maternal AUD compared with a control group. A Swedish study found how parental alcohol-related hospital admissions were associated with their children achieving lower grades (z-score for grades at -0.43) and having a higher risk of not being eligible for secondary education, but most of the association was explained by psychosocial adversity (Berg et

al., 2016). The importance of other surrounding problems was emphasized in an American study (Crouch et al., 2019) of how children with 4 or more ACE, including household substance abuse, had higher odds of having to repeat a grade (OR=1.71; 95% CI, 1.19-2.47), which indicates lack of advancement through school.

The analysis of the enrollment in further education showed, furthermore, how young people from "Families with PSU" and "High ACE families" had increased odds of not being in education after graduation from compulsory school. The group of young people not enrolled in further education is, while fairly small, definitely a disadvantaged group. Only 420 (6.2%) in the present study were not enrolled in some kind of education program the two years after graduation. Official statistics show a similar picture with NEET rates at 9.1%-10.8% (2011-2020) in Denmark, which must be considered low compared with 35 other European countries (Denmark generally being placed between 10th and 15th in annual tables) (Eurostat, 2021). An important part of educational policies and labor market policies is the concern to have NEETs and drop-out rates for youth education that are as low as possible (Bekker & Mailand, 2019). This concern is generated not only by an awareness of the disadvantages which the individual will later face in terms of higher rates of unemployment and poverty than their peers who have graduated, but also at a societal level by the knowledge that it contributes to lower rates of economic growth, higher unemployment, and higher welfare and public health payments (Gitschthaler & Nairz-Wirth, 2018; Lyche, 2010). The individual issue is also reflected in the present study with the considerably higher odds of not being enrolled in further education among youth from "families with PSU" as well as from "high ACE families". The results suggest how family background is having an influence on the chances of enrollment in education after compulsory school, but it could be interesting for future research to investigate the characteristics of the young people themselves and possible individual differences, besides the family-related problems, when comparing this group with their peers.

The study about family structures and living with the parent with problematic SU (**Paper 3**) showed how living with both parents was a protective factor, how PSU together with non-intact families increased the odds of NEET, hospitalizations, mental disorders or criminality, but also how the number of years living with a parent with problematic SU did not appear to be a factor affecting this increase. When we look at the two groups of non-intact families with PSU – the first with 0-4 years of cohabiting and the second with 5-15 years of cohabiting – we do not find evidence that the latter group incurs higher odds of adverse outcomes in young adulthood. On the contrary, it is the former group that appears to have the higher odds of incurring negative outcomes, and this is an issue that

calls for further attention and research. It could be interesting to investigate if these are families with a more severe type of PSU and with additional problems that cause more conflict in the family and result in its early dissolution. These are families which may be placed in the category of "High ACE families" in Paper 2. Families in which the parents live together for most of their children's childhood may be families placed in the category "Families with PSU."

Other studies have shown how problematic parental alcohol and drug use in itself does not explain different adverse outcomes, but that other factors like other stressors in the environment of the family or surroundings have a greater impact (Berg et al., 2016; Conners-Burrow et al., 2013; Kristjansson et al., 2009). Pisinger et al. studied the relationship between internalizing problems (Pisinger et al., 2016) as well as drinking patterns (Pisinger, Holst, et al., 2017) among young people with parental AUD, but did not find in either study that living with the parent with AUD affected the existing association.

Another important aspect of whether PSU impacts the children in the long-term is the timing of PSU and at what chronological age it is experienced (Hansen et al., 2021). Research indicates that ACE experienced by young adolescents (aged 12+) cause more long-term consequences than ACE experienced by young people at an earlier age do (Flaherty et al., 2013), and this is supported by Jääskelainen, who found PSU to be a significant predictor of mental disorders and harmful substance use in children aged 13-17 years, but not in children 7-12 years old (Jääskeläinen, 2016). The same conclusion was arrived at by Crouch et al. in their study about ACE and school performance, where 13-17-year-olds had higher odds of poor school performance compared with 6-12-year-olds (Crouch et al., 2019). These studies did not investigate the degree of cohabiting, but the first two studies (Hansen et al. and Jääskeläinen) included non-intact families/parental marital status as a control variable and in the last-mentioned (Crouch et al.) divorce/separation was a part of the ACE. These research findings are not in accordance with the results in the present study, where the young people who only lived with the parent with problematic SU for 0-4 years are those with the highest odds of different adverse outcomes in young adulthood. Maybe it is more a question about family dissolution in an early age, as found in the study of Hope et al. (1998), who found higher risk related to parental divorce when it occurred when the child or children were fairly young compared with later parental divorce. Holst's study (2020) of family structure, parental AUD and offspring AUD also indicated higher risk for offspring AUD among those who had never lived in intact families or had only lived in them for a few years. And in this sense the family dissolutions had probably occurred in the early childhood.

The issue about the timing of PSU and family dissolution could be interesting to investigate further in relation to the question about living with PSU, as well as the environment of the family, family conflicts and other family-related problems.

5.2 Strengths and limitations

This study has several methodological strengths, including the combination of different data sources like self-reports and register data which contribute to capture PSU not only in families registered in national registers but also in families with more hidden problems. The longitudinal register data with a high level of completeness gives the opportunity to analyze family-related problems and family structures, as well as consequences, in the young people's young adulthood. But different methodological limitations must also be addressed.

Firstly, the self-reported PSU is measured using a single item question, and more information about the nature of the substance use and the different consequences could be added using a moderated version of the Children of Alcoholics Screening Test (CAST-6), which should also include questions about parental drug use disorder (Elgán et al., 2020). Secondly, a limitation was the subsequent question asking which parent had problematic SU, as it only included the categories "mother", "father" or "both". In this way, it excluded a range of other caregivers – for example, stepparents – and other types of family, such as families with parents of the same sex. Thirdly, the timing of PSU in the self-reports is unknown. The young people were only asked if one or both parents had or had had problems with alcohol or drugs, and not if the problem was ongoing at the time, or had occurred earlier in childhood or adolescence; nor were they asked for how many years the parent(s) had a problematic use of alcohol or drugs. Research has shown how substance use can change over years with periods of abstinence, relapses and escalation of the substance use, and possible problems related to the use (Heyman, 2013; Klingemann et al., 2010), and the young people in the present study will most likely have had different experiences with regard to the severity and length of PSU. The missing information about the timing was not only applicable for the self-reported PSU, but also for the register-based PSU. Information about the time of the registration itself was available, but it is almost certain PSU had been a problem in the families years before a registration took place, and very likely had different consequences for different family members. Research has demonstrated how a long period often passes with a problematic use of alcohol or drugs before an individual will seek help or treatment (Green et al., 2020; Oleski et al., 2010; Scott & Walter, 2010). In this way the time of the registration was not only an indication of an ongoing PSU, but also a likely indication of

up to several years with a problematic use of substance, and with different consequences experienced by the children and other family members.

The strength of using register data is the high level of completeness and the registration of severe mental disorders is for instance almost nationwide complete, because private psychiatric hospitals do not exist in Denmark (Mors et al., 2011). But the more mild and moderate disorders are often treated by the general practitioners and not registered in the Psychiatric Central Research Register, and register data is as mentioned in section 3.4 ("The combination of survey and register data") limited to represent the more severe cases. Alcohol- and drug-related disorders are stigmatized conditions and probably underreported in administrative data (Miettunen et al., 2011). An example is death certificates, which tend to underreport alcohol involvement, and using cause of death as a part of the register-based measure of PSU will only capture a fraction of the total cases (Cipriani et al., 2001).

The analysis should not be interpreted as propounding causal relations between, on the one hand, school performance and adverse outcomes in young adulthood and, on the other, PSU, but it does indicate how young people are affected by family structures and problems, and one of them, PSU, is certainly part of the impact, creating a more disadvantaged situation for many of these young people.

Finally, the deselection of analyzing the parents' sex in relation to school outcomes or long-term consequences should be mentioned, as maternal versus paternal SU is not included directly in the analysis. This is not based on an assumption that the sex of the respective parent is not important, but on the underlying goal of looking into family structure and family-related problems instead, using knowledge about the impact of the environment of the family or its surroundings. However, maternal versus paternal SU can be, of course, a potent factor in all this. Some studies have reported how paternal and maternal SU equally increase the risk (Hoffmann, 2002; Sørensen et al., 2011), while others have found that one of them (in some cases problematic maternal SU, in others problematic paternal SU) intensifies the risk, or affects it in some other way (Pirkola et al., 2005; Seljamo et al., 2006). A Finnish register-based study (Jääskeläinen, 2016) found how maternal SUD had a stronger effect on harmful substance use in adolescent children than paternal, while a Danish cross-sectional study did not find any difference in young people's drinking patterns when comparing maternal versus paternal alcohol problems (Pisinger et al., 2016).

5.4 Implications

The findings of the present study have, first of all, implications for the research field investigating and estimating PSU, since they underscore the importance of examining PSU with different data sources in combination, in order to capture families with different consequences related to the PSU. Survey data alone will underestimate how many young people are affected by PSU because of the higher prevalence of parental substance problems among non-participants, and because register data alone will only capture the most severely affected parents.

Research has shown that PSU can have an adverse impact during the formative years (Christoffersen & Soothill, 2003). The health and well-being of young people can be affected by structural factors, such as national wealth, income inequality and access to education (Viner et al., 2012). At the same time, research has also underscored the importance of protective factors, such as safe and supportive families, peers and schools. Protective factors in school can be positive school experiences, attendance at school, achievement and acknowledgement of success (Velleman & Templeton, 2016). This study of school-related outcomes should be contextualized within the existing research investigating the importance of retention in the educational system and how success in school can serve as a protective factor for young people who are experiencing PSU (Herke et al., 2020; Velleman & Templeton, 2016). Clearly, PSU and family-related problems are an obstacle in school for the young people affected, and this is a challenge that must be addressed: How can schools help children with PSU and family-related problems? Olsson et al. (2019) investigated the relation between adolescent heavy drinking and problematic consumption in the family and found how the association was mitigated by schools with a strong student focus, and suggested how effective and well-functioning schools could offer a compensatory effect for disadvantages in other areas in life and support health trajectories among young people. Similar findings were made in a study of childhood household dysfunction and psychiatric diagnosis in young adulthood, where school grades as a mediator had a significant effect on the relationship (Björkenstam et al., 2016). Furthermore there is a strong case for a far greater emphasis on implementing protective factors and preventive work in health care, the legal system and mental health services pointed at the group of young people coming from non-intact families with PSU. This group of young people is more prone than most to being involved in violence, to attempting suicide, to having anxiety disorders and behavioral and emotional disorders, and to as being involved in property- and drug-related offences. Screening tools could be implemented and interventions aimed not only at the young people but also their families could be activated when these young people are identified.

The present study points to a need for a focus, not only in the schools but also in families and social welfare institutions, on protective factors in the social environment for young people who are in families with PSU and other family-related problems.

5.3 Future research

Different findings in the present study give rise to several questions, reflections and ideas for further investigation. As mentioned above, the self-reported PSU was assessed with a single item question, and it could be interesting to compare the coverage of this measure with the coverage of an adjusted CAST-6 instrument to investigate whether more young people with PSU are captured in one or the other. Self-reporting, as well as being used to estimate the prevalence of PSU, could perhaps also be used as a screening tool in intervention and treatment services aimed at young people.

In relation to school performance, the analysis touched upon the school as a protective factor for children with PSU in relation to later adverse outcomes, and a future research project could investigate school programs aimed at strengthening these factors. Or in relation to this issue, researching how the enrollment and recruitment for further education after compulsory school can be strengthen, especially for the more disadvantaged youth.

Lastly, it could be interesting to investigate family environment and family conflicts and support more closely when analysing the question of the impact of living together with a parent with SU. And in the same context to investigate how prevention and intervention could be implemented to lower the share of violence, suicide attempts, property and drug-related offences and anxiety disorders among young people (in particular) from non-intact families with PSU.

Chapter 6. Conclusion

The aim of the present study was, firstly, to estimate the prevalence of PSU in the general population of young people in Denmark and, secondly, to investigate school-related outcomes performance and, thirdly, to investigate the childhood family structures including PSU and how it was linked with adverse outcomes in young adulthood.

Estimating the prevalence of PSU was based on the self-reported measure, and, when adjusting for non-participation using information about substance-related contacts in registers (register-based PSU), the estimate of young people (15-25 years old) with self-reported PSU was 15.2%. The self-reported PSU was used in combination with the register-based PSU in the next two studies of the relation between PSU and short- and long-term outcomes.

In second study PSU and other family-related problems were analyzed in relation with school-related outcomes. Four types of families were constructed with different levels and combinations of family-related problems. Young people from “Families with PSU” and “High ACE families” had higher odds for negative school-related outcomes, with lower grade points averages and more without further education, compared with young people from “Low ACE families”.

The adverse outcomes in young adulthood were investigated in relation with the family structures (intact vs. non-intact families, +/-PSU and years living the parent with a SU) and the results showed, how living with both parents during childhood protected against adverse outcomes. If the young people had a parent with SU the odds of adverse outcomes increased, and the highest odds for adverse outcomes were found among young persons from non-intact families with PSU; but we did not find higher negative impact the longer a child or young person lived together with the parent with SU during childhood and adolescence.

Chapter 7: Summary

Background

It can have a far-reaching impact for children if a parent has a problematic use of alcohol or drugs. The children can be more often exposed to different adverse situations and parenting (lack of parental attention, neglect, harsh parenting, lack of ritual and traditions like birthdays and Christmas, or being exposed to or witnessing violence and abuse) (Haugland & Elgán, 2021; Orford, Velleman, et al., 2010).

The prevalence of different developmental, social and mental problems is higher for this group of children, and is often reflected in problems in school, social networks or in a young person's own use of substances, as well as in behavioral problems (Brummer et al., 2021; Kuppens et al., 2020; Pisinger, Hawton, et al., 2017; Taplin et al., 2014). Against this background it is necessary to know the prevalence of the problem in the general population and to gain further knowledge about the children's challenges in school as well as about possible problems in young adulthood.

Aim

The study aimed to get a better understanding of problematic parental substance use (PSU) and how it is related with different problems for the children involved, by investigating:

1) the prevalence of PSU in the general population of youth (15-25-year olds) in Denmark
2) the relation between family-related problems, including PSU, and school outcomes
3) PSU, childhood family-structures and adverse outcomes in young adulthood of living with the parent with PSU.

Methods

A national sample survey study was combined with a retrospective register-based study (in the period 1989-2015/2018). 10,414 young people (aged 15–25) were invited to two national sample surveys in 2014 and 2015.

A crude prevalence of self-reported PSU was calculated based on participants' reports. A register-based prevalence of PSU for both participants and non-participants was used to adjust the crude prevalence of self-reported PSU.
Types of families with different kind of problems were identified using a latent class analysis, and the association between school outcomes in terms of average grade points at graduation and the family types was analyzed using a linear regression model. The association between the different family types and young people who did not enroll in further education after graduation from compulsory school was analyzed using a logistic regression model. Both models were stratified by sex.
Outcomes in young adulthood were analyzed in relation to PSU and family structures using a binary logistic regression model. Finally, the different consequences were analyzed in more detail with logistic regression models (e.g., types of criminality, and diagnosis for mental disorders).

Results

12.7% of the 5,755 survey participants reported PSU. Register-based PSU was more common (OR = 1.53, 95% CI 1.38–1.70) among non-participants (18.4%) compared with participants (12.8%). The estimated prevalence of the self-reported PSU increased by 2.5 percentage points when adjusted for non-participation, from 12.7% (95% CI: 11.8%-13.6%) to 15.2% (95% CI: 14.5%–15.9%).

In the analysis of school-related outcomes in relation with family-related problems the following types of families were identified: "Low ACE families", "Families with PSU", "Families with unemployment" and "High ACE families". The grade points average at graduation was significantly lower for both females and males in the three families compared with the reference group of "Low ACE families" (grade point average for males: 6.83, 95% CI: 6.72-6.93; for females: 7.40, 95% CI: 7.30-7.50). The lowest average was found among young people from "High ACE families" (grade point average for males:5.58, 95% CI: 5.22-5.94; for females: 5.79; 95% CI: 5.48-6.11). The odds of not being further enrolled in education the two following years after graduation was significantly higher for young people from "Families with PSU" (males: OR=1.51; 95% CI: 1.01-2.26; females: OR=2.16; 95% CI: 1.22-3.85 and "High ACE families"(males: OR=1.7895% CI:1.11-2.26; females: OR=3.41; 95% CI:1.96-5.93). Females, but not males, from "Families with unemployment" had also higher odds (OR=2.08; 95% CI: 1.32-3.28).

The analysis of the association between PSU, childhood family structures and outcomes in young adulthood showed higher odds for young people from other family structures compared with young people from intact families without PSU. The odds of adverse outcomes were similar for young people from intact families with PSU in comparison with intact families without PSU. The highest

odds for adverse outcomes were observed for the young people from non-intact families with PSU and 0-4 years of living with the parent with SU. The odds of not being in education or employment were significantly higher compared with the reference group of intact families without PSU (OR=4.54; p<0.001; 95% CI 3.33-6.18), as well as the odds of hospitalization (OR=1.93; p<0.001; 95% CI: 1.59-2.34), mental disorder (OR=3.88; p<0.001, CI: 3.08-4.89) and criminality (OR= 3.33; p<0.001; 95% CI: 2.64-4.19) compared with the reference group.

Conclusion

15.2% of young people aged 15-25 had reported PSU – this is an estimate adjusted for non-participation. In the absence of register data, youth-reported PSU is likely to underestimate the number of young people experiencing PSU.

School-related outcomes in terms of grade points average and further enrollment in education after graduation from compulsory school were linked with PSU and other family-related problems, and "High ACE families" had the lowest grade points average and highest odds of not being enrolled in further education. In the analysis of living with the parent with SU the hypothesis about how living with both parents during childhood would protect against adverse outcomes was supported by the analysis, which showed higher odds for adverse outcomes for young people from families with PSU and non-intact families compared with the reference group of intact families without PSU.

But the hypothesis about how an increase in the numbers of years living with the parent with SU would give an increase in the different adverse outcomes was not confirmed. The odds of adverse outcomes were highest for young persons from non-intact families with PSU living with the parent with SU for 0-4 years (versus living with the parent with SU for 5-15 years).

Chapter 8: Dansk resumé

Baggrund

Hvis forældre har et problematisk forbrug af alkohol eller stoffer, kan det have omfattende betydning for børnene. Børn i familier med rusmiddelproblemer er oftere udsat for negative oplevelser såsom manglende opmærksomhed og omsorg, uhensigtsmæssig opdragelsesstil, være udsat for eller vidne til voldelige forhold og overgreb (Haugland & Elgán, 2021; Orford, Velleman, et al., 2010). Der er ligeledes oftere børn, som oplever problemer i skolegangen, forskellige adfærdsmæssige og psykiske problemer, samt problemer med deres eget forbrug af rusmidler (Brummer et al., 2021; Kuppens et al., 2020; Taplin et al., 2014). På denne baggrund er det nødvendigt med nærmere kendskab til problemstillingen i den generelle befolkning, herunder andelen af børn og unge, som oplever forældres rusmiddelproblemer, hvordan de klarer sig i folkeskolen og hvilke problemer de kan møde i starten af deres voksenliv.

Formål

Med afsæt i unges rapporteringer af forældres rusmiddelproblemer samt register data for både de unge og deres forældre var formålet at undersøge:

1) andelen af unge i den generelle danske befolkning, som har oplevet forældres rusmiddelproblemer
2) unge fra familier med varierende problemer, heriblandt forældres rusmiddelproblemer, og om der er eventuelle forskelle i de unges karaktergennemsnit ved folkeskolens afgangseksamen samt i andelen, som ikke i løbet af de efterfølgende to år kommer videre i uddannelsessystemet
3) sammenhæng med familieforholdene i barndommen, forældres rusmiddelproblemer og senere problemer i starten af voksenlivet (15-20 år)

Data og metode

To national repræsentative spørgeskemaer blev kombineret med et retrospektivt register studie med data for både stikprøven og deres forældre fra de unges fødsel og frem til

undersøgelsestidspunkt (perioden 1989-2015, for enkelt registre op til 2018). I alt blev 10.414 unge i alderen 15-25 år, som udgjorde et nationalt repræsentativt udsnit, inviteret til to spørgeskemaundersøgelser i 2014 og 2015.

Estimeringen af forældres rusmiddelproblemer tog udgangspunkt i de unges selfrapporteringer. Ved hjælp af register data, anvendelse af IPW-metoden (Inverse probability weight) samt en justeret analyse af estimatet var det muligt at tage højde for den bias, som den manglende deltagelse i spørgeskemaundersøgelserne ellers ville være tilstede.

I analysen af de unges skolepræstationer blev fire familietyper identificeret ved hjælp af en latent klasse analyse. Forskelle i karaktergennemsnittet ved afgangseksamen blev analyseret ved hjælp af en lineær regressionsmodel, mens forskelle i andelen af unge, som efter folkeskolen ikke kom i videre uddannelse, blev analyseret med en binær logistisk regressionsmodel. Begge analyser blev stratificeret på køn.

Sammenhængen mellem forskellige problemer i starten af voksenlivet og familiestrukturerne i barndommen blev analyseret ved hjælp af logistiske regressionsmodeller. Problemerne i starten af voksenlivet var de unge, som var uden for uddannelses/arbejdssystemet, havde hospitalskontakter, psykiske problemer og domme for kriminalitet. Afslutningsvist blev subkategorier af de enkelte typer af hospitalskontakter, psykiatriske diagnoser og domme analyseret ved hjælp af logistiske regressionsmodeller.

Resultater

Ud af 5.755 unge, som deltog i spørgeskemaundersøgelserne, afrapporterede 12,7% (95% SI[2]: 11,8%-13,6%) at have oplevet forældres rusmiddelproblemer. Register data gav information om gruppen, der ikke deltog i undersøgelserne, og en analyse viste, at andelen med et register-baserede mål for forældres rusmiddelproblemer var højere for gruppen af unge, som ikke deltog (18,4%) sammenlignet med dem som deltog (12,8%). Det justerede estimat var 15,2% (95% SI: 14,5%–15,9%) af danske unge i alderen 15-25 år, som har oplevet forældres rusmiddelproblemer.

I analysen af skolepræsentationer og familie-relaterede problemer blev fire typer af familier klassificeret ved hjælp af den latente klasseanalyse: ”Familier med lavt niveau af familie-relaterede problemer”, ”Familier med forældres rusmiddelproblemer”, ”Familier med langtidsarbejdsløshed” og ”Familier med højt niveau af familie-relaterede problemer”. For både drenge og piger

[2] 95% sikkerhedsinterval

karaktergennemsnittet ved afgangseksamen signifikant højest for unge fra "Familier med lavt niveau af familie-relaterede problemer" (drenge: gennemsnit=6.83, 95% SI: 6.72-6.93; piger: gennemsnit=7,40; 95% SI:7.30-7.50). Det laveste gennemsnit var blandt unge fra "familier med højt niveau af familie-relaterede problemer" (drenge: 5,58; 95% SI: 5,22-5,94; piger: 5.79; 95% SI: 5.48-6.11). Odds[3] for ikke at komme videre i uddannelse de to følgende år efter folkeskole var signifikant højere for unge fra "familier med forældres rusmiddelproblemer" (drenge: OR=1,51; 95% SI: 1,01-2,26; piger: OR=2.16; 95% SI: 1.22-3.85) og "Familier med højt niveau af familie-relaterede problemer" (drenge: OR=1.78; 95% SI: 1.11-2.26; piger: OR=3.41; 95% SI: 1,96-5.93). Pigerne, men ikke drengene, fra "familier med langtidsarbejdsløshed" havde ligeledes større sandsynlighed for ikke at komme videre i uddannelse (OR=2.08; 95% SI: 1.32-3.28).

Resultatet i analysen af familiestrukturer og senere problemer i 15-20 års alderen viste, at unge fra ikke-intakte familier, som havde boet 0-4 år sammen med en forældre med et rusmiddelproblem, havde højeste odds alle fire konsekvenser: at være uden for uddannelses- og arbejdssystemet (OR=4.54; p<0,001; 95% CI 3.33-6.18), og for hospitalskontakter (OR=1.93; p<0.001; 95% SI: 1.59-2.34), diagnoser for psykiske problemer (OR=3.88; p<0.001, 95 % SI: 3.08-4.89) og for at have en dom for kriminalitet (OR= 2.63; p<0.001; 95% SI: 2.15-3.21)

Konklusion

15,2% af unge i alderen 15-25 år rapporterede at have oplevet forældres rusmiddelproblemer efter, at en analyse havde justeret estimatet for gruppen af unge, som ikke deltog i undersøgelsen. Hvis register data eller anden information vedrørende denne gruppe ikke er tilgængelig, er det sandsynligt, at selvrapporteret mål for forældres rusmiddelproblemer underestimerer andelen af unge, som rent faktisk oplever forældre med rusmiddelproblemer.

Skolepræstation og tilknytning til uddannelsessystemet er påvirket af familie-relaterede problemer, og flere typer af problemer i kombination kan både for piger og drenge give en øget risiko for et signifikant lavt karaktergennemsnit og manglende videre uddannelse de to følgende år efter folkeskolen.

Familiestrukturer såsom om forældrene bor sammen eller ej, og om forældres rusmiddelproblemer er tilstede eller ej, har en betydning for forskellige problemer i 15-20 års alderen, såsom at være uden for uddannelses- og arbejdssystemet, hospitalskontakter, psykiske problemer og kriminalitet. Intakte familier er en beskyttelsesfaktor, unge i familier med forældres rusmiddelproblemer er i øget risiko og de højeste odds for problemer i 15-20 års alderen var blandt ikke-intakte familier med

[3] Odds ratio udregnet i den logistisk regressionsmodel

forældres rusmiddelproblemer. Især unge fra familier, hvor forælderen med rusmiddelproblemer kun bor med barnet i kort tid (0-4 år), har den højeste sandsynlighed for de forskellige problemer i starten af deres voksenliv.

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Appendix

Paper 1: Estimating perceived parental substance use disorder: Using register data to adjust for non-participation in survey research.

Paper 2: The impact of parental substance use disorder and other family-related problems on school-related outcomes.[4]

Paper 3: Problematic parental substance use, childhood family structures and adverse outcomes in young adulthood

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Estimating perceived parental substance use disorder: Using register data to adjust for non-participation in survey research

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ABSTRACT

Aims: To estimate the prevalence of parental substance use disorder (PSUD) in the general population based on young adults' reports adjusted for non-participation using register-based indicators of PSUD.
Design: A national sample survey study combined with a retrospective register-based study. Setting Denmark. Participants 10,414 young people (aged 15–25 years) invited to two national sample surveys in 2014 and 2015 (5,755 participants and 4,659 non-participants).
Measurements: A crude prevalence of PSUD was calculated based on participants' reports. Parental data from medical, mortality, prescription, and treatment registers (from the young adults' birth until the time of the surveys) were used to estimate a register-based prevalence of PSUD for both participants and non-participants. Differences between participants and non-participants were analysed using bivariate comparisons. Inverse probability weighting was used to adjust for bias due to non-participation. The crude prevalence of PSUD based on survey data was adjusted using the ratio of incidence proportion of the register-based PSUD compared with the survey-based PSUD.
Findings: A total of 731 (12.7%) of the 5,755 survey participants reported PSUD. Register-based PSUD was more common among non-participants (856/4,659; 18.4%) compared with participants (738/5,755; 12.8%, OR = 1.53, 95% CI 1.38–1.70). The adjusted estimate of the survey-based PSUD increased by 2.5 percentage points, from 12.7% to 15.2%.
Conclusions: In the absence of register data, youth-reported PSUD is likely to underestimate the number of young people experiencing PSUD.

1. Introduction

Parental substance use disorder (PSUD) can have numerous negative consequences for children and young people in terms of health and welfare, including increased risk for emotional and health problems, poor performance in school, juvenile delinquency, and problems with substances in adolescence and beyond (Hanson and Chen, 2007; Johnson and Leff, 1999; Jääskeläinen et al., 2016; Smith and Wilson, 2016; Christoffersen and Soothill, 2003). Additionally, children in families with PSUD are more likely to be exposed to adverse experiences, such as insufficient and inadequate nurturing, inadequate supervision and monitoring, maltreatment, physical and psychological abuse and neglect, and domestic violence (Johnson and Leff, 1999; Christoffersen and Soothill, 2003; Raitasalo and Holmila, 2017).

It is important to shed light on how many children and families are affected by PSUD. Knowing the magnitude of the problem is an important first step in directing societal attention to detecting and helping affected families. Previous studies have estimated the prevalence of children and families affected by PSUD, but the majority are based on structured interviews of adults, parents' self-reported consumption of alcohol or drugs, or registrations of contact with different services (e.g., register-based data on hospital admissions, treatment for substance use disorders, or inpatient and outpatient mental health services) (Jääskeläinen et al., 2016; Christoffersen and Soothill, 2003; Dube et al., 2003; Sørensen et al., 2011; Taylor, 2011; Elgán and Leifman, 2013). Only a few studies have based the prevalence estimates on young people's perceptions of their parents' problems with substances (Elgán and Leifman, 2013; Bellis et al., 2014; Pisinger et al., 2017; Hanson et al.,

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2006). Self-reports provide unique insight into the prevalence of perceived PSUD that could not be obtained via registers or clinical studies because the latter sources only capture citizens who are in contact with different services and institutions in society, such as the treatment sector or the judiciary system (Pisinger et al., 2017; Raninen et al., 2016).

The majority of the existing research has methodological limitations. Participants may not be representative of the general population of young people because they are recruited from particular settings (Bailey et al., 2006; Anda et al., 2002). If the target group is drawn from a clinical setting or from treatment registers, the study will only cover the group of parents who seek treatment (Christoffersen and Soothill, 2003; Raitasalo and Holmila, 2017). In general population surveys, recruitment of participants is always a challenge, and non-participants may differ systematically from participants (Elgán and Leifman, 2013; Pisinger et al., 2017; Hanson et al., 2006; Bellis et al., 2014). Differences between participants and non-participants in terms of the distribution of social, mental, and psychological problems (Gottlieb Hansen et al., 2011; Groves, 2006; Christensen et al., 2015; Gundgaard et al., 2007; Vinther-Larsen et al., 2010) may bias the results. Parental substance use may be associated with shame and fear of stigma, and like other hidden populations, children from families with PSUD may be less likely to participate in surveys (Kraus et al., 2017; Wesson et al., 2017). This creates a problem for the accuracy of prevalence estimates using this methodology and may produce a bias in the analysis, which needs to be investigated further.

Only a few studies have focused on young people's perceptions of PSUD, and to our knowledge, no studies have considered non-participation when estimating the prevalence of PSUD. In the present study, we aimed to examine the prevalence of PSUD based on reports by young people who participated in two national surveys. By means of register data, it was possible to access information regarding different types of substance-related contacts among the parents of participants as well as non-participants. Subsequently, this defined a register-based measure of PSUD. This enabled us to examine differences related to PSUD between participants and non-participants. Using information from two different measures of PSUD (i.e., the survey-based measure and the register-based measures), it was possible to include two different sources of different information on PSUD (see 2.1.2 and 2.3). The PSUD measured by the youth-reports and the PSUD measured by the registers were not the same kind of PSUD. However, the register-based PSUD was used to adjust for differences between participants and non-participants on the assumption that different register measures of PSUD (substance related diseases, disorders, crimes, medications, treatments and causes of death) are as well as youth-reported PSUD an alarming sign of substance-related problems that affects children within the family.

2. Present study

The primary aim of this study was to estimate the prevalence of Danish 15–25-year-olds who perceived one or both parents to have a substance use disorder. The secondary aim was to use register data to compare the prevalence of PSUD among survey participants and non-participants and, accordingly, to adjust for non-participation in the estimation of the young people's perceived PSUD.

We hypothesized that PSUD, as measured by register-based indicators, would be less common among participants compared with non-participants, due to the fact that children from families with PSUD were less likely to participate in the survey studies. Therefore, the adjustment for non-participation would lead to a higher prevalence of perceived PSUD. The hypothesis was not pre-registered.

3. Method

The analyses drew on data from two separate sources: two national sample surveys among 15–25-year-old Danish young people and data from various registers.

3.1. The survey data

The Centre for Alcohol and Drug Research conducted two national sample surveys in 2014 and 2015 (the National YouthMap Surveys) on substance use, wellbeing, and different kinds of social, psychological, and physical problems (Pedersen et al., 2017, 2018). The survey samples were randomly selected from the Central Person Register by Statistics Denmark (the central authority on Danish statistics, see http://www.dst.dk/en). The invitation to participate in the survey was sent by postal letter with a code giving access to the electronic survey. This request was followed by telephone interviews with those who had not yet participated. The questions in the 2014 and 2015 surveys were comparable.

3.1.1. Sample

The samples from 2014 and 2015 studies consisted of 5,520 and 4,920 young people (born in the period 1989–2000), respectively. The analyses in the present study were conducted on the combined sample of unique persons, giving an overall sample of 10,414 (5755 participants and 4659 non-participants) (Table 1).

In 2014, 55.5% of the young people participated (n = 3,064), and in 2015, 55.6% participated (n = 2,704). Twenty-six of the young people were invited both to the 2014 and 2015 surveys (so-called duplicates). Thirteen of these duplicates participated in both surveys. Only the 2015 data from these participants were used. In total, the survey data consisted of interviews with 5,755 young people (response rate: 55.3%).

3.1.2. Measures

PSUD

Young people were asked if their parents had or have had a substance use disorder. Specifically, PSUD was defined as an affirmative response to the following question: *"Does one or both of your parents have (or has one or both of your parents had) a substance abuse problem, with the*

Table 1
Demographic characteristics of the sample and the participants.

		Sample (includes non-participants) n = 10,414	2014 survey (participants only) n = 3,064	2015 survey (participants only) n = 2,704
Sex	Female	48.6%	49.9%	50.3%
	Male	51.4%	50.1%	49.7%
Age	15–19 years	44.8%	50.8%	51.0%
	20–25 years	55.2%	49.2%	49.0%
Parents' highest level of education	Primary school	16.4%	10.2%	10.4%
	Upper secondary school	49.0%	49.5%	48.5%
	Higher education	34.6%	40.3%	41.1%
Ethnicity	Danish origin	85.1%	89.7%	90.6%
	Immigrants/descendants	14.9%	10.3%	9.4%

exception of cigarettes?" Affirmative responses were followed by a question assessing whether the response applied to the mother, father, or both parents. Note that this question implies a maximum of two parents, even though, in some cases additional people might meaningfully be considered parents (e.g., step-parents).

3.2. The register based data

Denmark and other Nordic countries have population and health care registers with individual-level data on the entire population. This population-based register data can be linked to survey participants and non-participants through a personal identification number (Thygesen et al., 2011). We used a family relation register to identify the parents of survey participants and non-participations. Register data on the parents covering the years 1989–2015/16 were then extracted from seven different registers (Table 2). These data concerned criminal activity, mortality, health care, mental health services, and treatment for substance use disorders and were used to define six different types of substance-related contacts among the parents and, subsequently, a register-based measure of PSUD. The survey data and the register data were linked and stored on a secure server at Statistics Denmark.

3.3. Measures

3.3.1. Substance-related diseases

Substance-related diseases among parents were defined as at least one hospitalization in the period 1989–2016 with an alcohol- or drug-related diagnosis, such as alcoholic liver disease, alcohol induced chronic pancreatitis or degeneration of nervous system due to alcohol. The diagnoses were identified using the National Patient Register (Lynge et al., 2011). Only diseases and conditions that are 100% alcohol attributable were included (Centers for Disease Control and Prevention USDoHHS) (International Classification of Diseases (ICD-10): B18.2, E24.4, G31.2, G62.1, G72.1, I42.6, K29.2, K70.0-K70.4, K70.9, K86.0, O35.4, P04.3, P04.4, P96.1, Q86.0, R78.0, T40.0-T40.5, T51.0, T51.1, T51.9, X45, X65, Y15, Z71.4, Z71.5). Both primary and secondary diagnoses were included.

3.3.2. Substance-related disorders

Substance-related disorders among parents were defined as at least one registration in the Psychiatric Central Research Register (Mors et al., 2011) with a primary or secondary F10–19 diagnosis in the period 1989–2015. Examples of diagnoses include alcoholic psychosis, opioid dependence or cannabis-related disorders.

Table 2
Information selected from the population-based registers.

Registers	Measures	Years
The National Patient Register	Alcohol- and drug-related diseases	1989–2015
The Psychiatric Central Research Register	Alcohol- and drug-related mental disorders	1989–2015
The Danish Central Crime Register	Charges and sentences for drunk-driving, possession and/or sale of illicit drugs	1989–2015
The National Prescription Registry	Dispensed prescription drugs for substance dependency	1995–2015
The National Alcohol Treatment Register (NAB)/ The Register for Drug Abuse Treatment (SIB)	Treatments for alcohol and drug misuse	Alcohol treatment 2006–2015 Drug treatment 1996–2015
The Register of Causes of Death	Substance-related causes of death based upon the death certificates	1989–2015

3.3.3. Substance-related crimes

Substance-related crimes among parents were defined as at least one substance related charge and sentence (e.g., drunk-driving and/or possession, smuggling, and/or sale of drugs) registered in the Danish Central Crime Register (Ravn, 2001) in the period 1989–2015.

3.3.4. Treatment for substance use disorders

Parent treatment for alcohol or drug use disorders was defined as at least one registration in the National Alcohol Treatment Register or the Register for Drug Abuse Treatment (Schwarz et al., 2018; DST SD, 2018) in the period 2006–2015.

3.3.5. Medication for the treatment of substance use disorders

Parents who had received prescription medication for the treatment of addictive disorders (excluding nicotine dependence) were identified using the National Prescription Registry (Kildemoes et al., 2011). Medication for the treatment of substance use disorders was defined as the receipt of one or more prescription medications used to treat alcohol dependence (ATC N07BB: disulfiram, calcium carbimide, acamprosate, naltrexone, nalmefene) and/or opioid dependence (ATC N07BC: buprenorphine, methadone, levacetylmethadol, lofexidine, levomethadone, diamorphine, buprenorphine (combinations)) (Methodology, 2020) in the period 1995–2015.

3.3.6. Substance-related deaths

Parental substance-related deaths were defined as an alcohol- or drug-related cause of death recorded in the Register of Causes of Death (Helweg-Larsen, 2011) (ICD-10): B18.2, E24.4, G31.2, G62.1, G72.1, I42.6, K29.2, K70.0-K70.4, K70.9, K86.0, O35.4, P04.3, P04.4, P96.1, Q86.0, R78.0, T40.0-T40.5, T51.0, T51.1, T51.9, X45, X65, Y15, Z71.4, Z71.5).

3.3.7. Any register-based PSUD

Parents who satisfied any of the above criteria were classified as having any register-based PSUD.

3.4. Ethics

The young people invited to participate in both surveys were informed of the purpose of the survey in the invitation letter. The letter stated that participation was voluntary and the interviews would be kept confidential by the Centre for Alcohol and Drug Research. Participants indicated their informed consent by completing the survey. The interviews were all carried out by trained interviewers from Statistics Denmark. Both studies, which involved the linking of the register and the survey data, were approved by the Danish Data Protection Agency. All confidentiality and privacy requirements were met.

3.5. Statistical methods of analysis

Firstly, the crude prevalence estimate of PSUD was calculated based on the survey data.

Secondly, we investigated whether PSUD was less common among participants by comparing register-based PSUD among participants and non-participants. The differences between the two groups were assessed using chi-squared tests reporting odds ratios (OR), and the Woolf approximation was used to calculate the standard errors (SE) and confidence intervals (CI) of the OR (Table 3). The reference group was the young people with no PSUD according to the registers. The overlap between the two measures (i.e. register-based PSUD and survey-based PSUD) was calculated (Fig. 1), and the demographic characteristics of those for whom both was present: survey-based PSUD and registry PSUD, as well as for those for whom only survey-based PSUD or only register-based PSUD was present (Table 4).

Thirdly, we investigated whether there was bias in the survey-based prevalence estimate of PSUD due to lower participation among youth

Table 3
Bivariate comparisons between participants and non-participants.

	Sample n = 10,414	Participants n = 5,755	Non-participants n = 4,659	OR (95% CI) for PSUD among non-participants compared to participants [a]
Parents with substance-related diseases	1.7% (177/10,414)	1.4% (81/5,755)	2.2% (96/4,659)	1.47 (1.09–1.99)
Parents with substance-related disorders	3.7% (388/10,414)	2.9% (164/5,755)	4.8% (224/4,659)	1.72 (1.40–2.11)
Parents charged/convicted of substance-related crimes	8.3% (860/10,414)	6.3% (361/5,755)	10.7% (499/4,659)	1.79 (1.56–2.06)
Parents attending any treatment for substance use disorders	4.1% (n = 423/10,414)	3.2% (184/5,755)	5.1% (n = 239/4,659)	1.64 (1.35–1.99)
Parents receiving medications to treat substance use disorders	8.8% (920/10,414)	7.5% (434/5,755)	10.4% (486/4,659)	1.43 (1.25–1.64)
Parental substance-related cause of death	0.4% (45/10,414)	0.4% (24/5,755)	0.5% (21/4,659)	1.08 (0.60–1.95)
Any register-based PSUD[b]	15.3% (1,594/10,414)	12.8% (738/5,755)	18.4% (856/4,659)	1.53 (1.38–1.70)

[a] PSUD = parental substance use disorder; OR = odds ratio; CI = confidence interval. [b]Parents who had one or more of the above substance-related contacts.

from families with (register-based) PSUD. Other studies have discussed different ways to capture the effect of non-participation and possible underestimation, including using multiple imputation or different kinds of weights (Ekholm et al., 2010; Gorman et al., 2017; Tolonen et al., 2019; Mäkelä, 2003). In the present study, an inverse probability weight (IPW) was chosen to account for differences in PSUD among participants and non-participants and thus for selection bias. The weights were based on a logistic regression model on selected characteristics, yielding in a probability for being a responder conditional on these characteristics (Table 5). The model included the following covariates: sex, age, parents' highest education and ethnicity. The IPW methods allows to use the survey data by accounting for selection bias to identify more vulnerable groups which is not possible using only registry data (Lohr and Raghunathan, 2017; Seaman and White, 2013).

Finally, the crude prevalence estimate of PSUD was adjusted for non-participation based on the differences between participants and non-participants (Gottlieb Hansen et al., 2011):

$$P_a = P(\text{response rate} + R[1 - \text{response rate}])$$

P_a was the adjusted prevalence, P was the crude prevalence, and R was the ratio of incidence proportion of the register-based PSUD compared with the survey-based PSUD.

4. Results

A total of 731 (12.7%) of the 5,755 15–25-year-old participants reported having a parent with a current or previous substance use disorder. This formed the crude prevalence of the survey-based PSUD.

Except for substance-related causes of death, non-participants had significantly higher odds of the different types of register-based PSUD measures (OR from 1.43 to 1.79) (Table 3). The prevalence of any register-based PSUD was lower among participants (738/5,755; 12.8%) compared with non-participants (856/4,659; 18.4%, difference: 5.6%, 95%CI: 4.1%-7.0%), and the odds of any register-based PSUD were significantly higher among non-participants (OR = 1.53, 95% CI 1.38–1.70). Fig. 1 illustrates how combining information from the register-based PSUD (n = 1,594) with the youth-reported survey-based PSUD (n = 731) resulted in a total of 1,929 young people experiencing PSUD.

As shown in Fig. 1, register data identified 856 young people from the group of non-participants, as well as 342 young people from the group of participants who were not identified by the survey. Of the 5,755 participants, 396 (6.9%) were identified by both the survey- and the register-based PSUD measures. Using survey data to measure PSUD will capture 68.1% of the cases of PSUD among participants. The survey-based PSUD measure identified 335 young people that were not identified by the register-based PSUD measure (31.2% of the total participants with PSUD).

Use of the two measures resulted in three groups "only register-PSUD", "register-PSUD/survey PSUD" and "only survey-PSUD" (see Table 4). An initial analysis of the differences in demographic characteristics showed there was a difference in gender with more females in the survey-PSUD only group and more males in the register-PSUD only group. Using survey-data also resulted in more young people with higher educated parents (30.6% and 30.4% in the two survey groups and 24.4% in the register-PSUD only group). The survey-PSUD only group was also older compared with the two other groups, but the difference was not significant.

The probability of responding to the survey was lower for youth with register-based PSUD (OR = 0.59, 95% CI 0.53–0.66). Based on the logistic regression model, an IPW was calculated. Furthermore, the IPW was used in a comparative analysis of youth who reported PSUD (n = 731) and the rest of the participants (n = 5,024). As shown in Table 5,

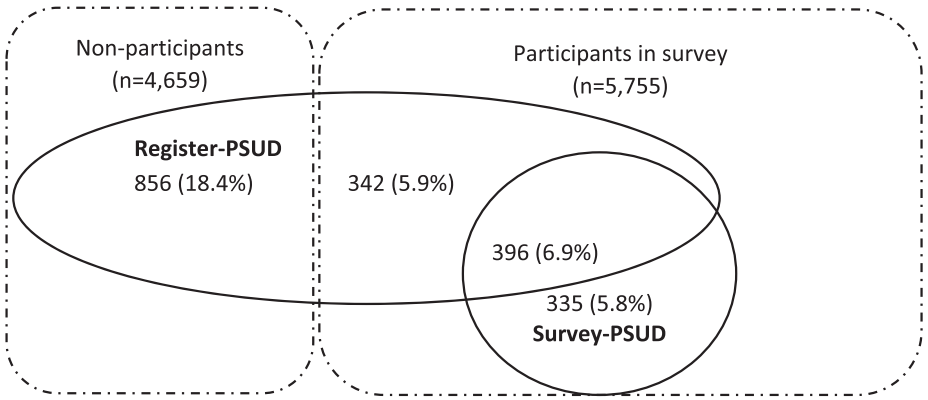

Fig. 1. Overlap between the survey-based parental substance use disorder (PSUD) and the register-based PSUD.

Table 4
Descriptives, and OR and 95% CI from Multinomial logistic regression comparing demographic characteristics between the three groups of PSUD-information basis.

	Sex	Male	Female		OR (95%CI) for comparison between groups
Only register-PSUD (n = 1,198)		51.2%	48.8%		ref
Register-PSUD + survey-PSUD (n = 396)		45.7%	54.3%		1.25 (0.99–1.57)
Only survey-PSUD (n = 335)		43.3%	56.7%		1.38 (1.07–1.75)
	Age	15–18	19–25		
Only register-PSUD (n = 1,198)		21.6%	78.4%		ref
Register-PSUD + survey-PSUD (n = 396)		21.3%	78.7%		1.02 (0.77–1.34)
Only survey-PSUD (n = 335)		18.1%	81.9%		1.25 (0.91–1.72)
	Parents' highest level of education	Primary school	Upper secondary school	Higher education	
Only register-PSUD (n = 1,198)		19.5%	56.2%	24.4%	ref
Register-PSUD + survey-PSUD (n = 396)		16.4%	53.0%	30.6%	1.23 (1.04–1.46)
Only survey-PSUD (n = 335)		21.2%	48.4%	30.4%	1.11 (0.91–1.32)

youth who reported PSUD were older (over the age of 18) and were more likely to be a female, of Danish origin compared with descendants/immigrants and to have parents with a lower level of education.

The survey-based PSUD was adjusted for non-participation using the register-based PSUD for non-participants shown in Table 3 (16.63%).

$$P_a = P\ (\text{response rate} + R(1 - \text{response rate}))$$
$$= 0.127*(0.55 + R*(1 - 0.55))$$

$$R = 18.37/12.7 = 1.45$$

The adjusted estimate of PSUD (15.2%, 95% CI: 14.5%–15.9%) was compared with the crude estimate (12.7%, 95% CI: 11.8%–13.6%) and was found to be 2.5 percentage points higher.

5. Discussion

Consistent with our hypothesis, PSUD, as measured by the register-based indicators, was less common among survey participants compared with non-participants. Therefore, the results showed that young people with PSUD were less likely to respond to the survey, and adjusting for this difference, led to an increase in the prevalence of youth-reported PSUD.

5.1. Strengths and limitations of the study

The major strength of this study is its use of both multiple registers and youth-reports to study a phenomenon that may be shrouded in stigma and taboo. This provides us with not only the possibility to adjust for non-participation, but also to include PSUD among non-participants based on register data. This is a huge strength, as failing to include non-participants in future analyses, would underestimate the prevalence of PSUD.

Another strength of the study is that it reveals the shared and different populations defined in survey-based PSUD and register-based PSUD. This sheds light on how the two data sources cover some of the same cases but also identify new groups and different young people experiencing PSUD. It could be interesting in future analyses to investigate the characteristics of the young people and families that, for example, are identified by the survey-based PSUD measure and not the register-based PSUD measure.

The study presents some initial analyses of the demographic differences between the three groups captured by the survey and register based measures of PSUD: the young people captured by the register-based PSUD only, young people captured by the survey-based PSUD only, and young people captured by both the register-based and the survey-based PSUD. It could be interesting in future analyses to investigate if the two measures capture different types of families and PSUD. It could be hypothesised that the register-based PSUD measure captures families with multifaceted and severe problems, while the survey-based PSUD measure captures families with fewer and less severe supplementary problems. A weakness of the study is that PSUD is assessed by a single item asking if the parents "*have (have had) a substance abuse problem*". Future studies may consider a standardised screening tool like the Children of Alcoholics Screening Test (CAST-6) (Elgán et al., 2020). Furthermore, we have no knowledge about whether the parents themselves would report problematic substance use. Young people could over- or underreport PSUD for a number of reasons, including a lack of reference for normal drinking or drug use, a sense of loyalty to their parents, or conflicts with their parents due to unrelated issues. The 342 cases that were identified by the register-based PSUD measure but not the survey-based PSUD measure indicate the difficulties with youth-reporting. This illustrates how participants do not report PSUD even though one or both parents have substance-related entries in the registers and could reflect lack of knowledge or realization. It may be that the parent is an absent father about whom the young person does not have any knowledge, or the young person may deliberately withhold information about parental substance use problems because of stigma. Research has also shown that awareness of PSUD increases in adulthood (Dube et al., 2001).

Table 5
Logistic regression comparing the PSUD-survey group with the other participants.

N = 5,755		OR (95% CI) for PSUD compared to the rest of the participants[a]
Sex		
	Male	Ref
	Female	1.23 (1.04–1.45)
Age		
	15–17	Ref
	18–25	1.60 (1.36–1.88)
Parents' highest level of education		
	Primary school	Ref
	Upper secondary school	0.46 (0.35–0.61)
	Higher education	0.32 (0.24–0.42)
Ethnicity		
	Danish	Ref
	Descendants	0.60 (0.42–0.85)
	Immigrants	0.74 (0.39–1.42)

[a] Weighted using the inverse probability weight.

Another limitation is our lack of knowledge about the timespan of the PSUD and whether it represented a long or short period of the young people's lives. A further limitation is that the survey asked only about the father and mother without specifying if these referred to biological or social parents, such as adoptive or step-parents. Furthermore, it excluded a range of other caregivers and – in the case of rainbow families – several parents of the same gender. In future research, it could be interesting to investigate for which parents the young people are reporting PSUD and how long (if at all) they have lived together with the parent concerned.

5.2. Implications

PSUD is an important subject for research. Information and knowledge about the families, parents, and children affected by PSUD, as well as the consequences of PSUD, are necessary to address the stigma surrounding the issue. Using both register- and survey-based data, it is possible to identify PSUD not only among young participants in national sample surveys but also among the more hidden populations not participating in such research.

The findings underscore the importance of discussing both the strengths and limitations of using national sample surveys to examine PSUD. An estimate solely based on survey data will underestimate how many young people are affected by PSUD due to the higher prevalence of parental substance problems among non-participants. Register data provides a means of adjusting for some of the underestimation. In future research using the National YouthMap Surveys, an adjustment based on the presented method can be applied when calculating the prevalence of PSUD. One direction for future research could be to replicate this study with new National YouthMap Surveys in order to validate the observed differences and relationships between youth-reported PSUD and register-based PSUD.

In a Danish context, this presented method and the combination of data sources leads to a more accurate picture of PSUD among young people. It raises the question of how the surrounding society can detect and help the affected families. It is not enough to strengthen screening for alcohol and drug problems among parents who visit hospitals or general practitioners. In order to reach families with hidden PSUD, it is necessary also to ask children about their parents' substance use problems. The PSUD question contributes important information about a young person's background and possible current obstacles. The question from the National YouthMap Surveys could function as a screening tool in intervention and treatment services aimed at young people. Future research could investigate how this question can be implemented in different services.

The development of these strategies is also relevant in an international context. There is no reason to believe the difference between participants and non-participants should be much larger or smaller in Danish survey research compared with research in other countries. Adjustment for non-response is relevant for all survey research. In Denmark, adjustments can be made using data from national registers.

5.3. Conclusion

The prevalence of register-based PSUD differed considerably between non-participants and participants in a national sample survey, as more non-participants had parents with a substance-related contact in the Danish registers. Adjusting for this difference, the estimate of young people aged 15–25 years who experienced PSUD in Denmark was 15.2%.

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CRediT authorship contribution statement

Kirsten Søndergaard Frederiksen: Conceptualization, Data curation, Formal analysis, Methodology, Software, Writing - original draft, Writing - review & editing. **Morten Hesse:** Conceptualization, Formal analysis, Writing - review & editing. **Ulrike Grittner:** Conceptualization, Formal analysis, Writing - review & editing. **Mads Uffe Pedersen:** Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Supervision, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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The impact of parental substance use disorder and other family-related problems on school related outcomes

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ABSTRACT

Aims: To identify young people with different levels of family-related problems, including parental substance use disorder (PSUD), and investigate differences in grades at graduation from compulsory school and further enrollment in education.

Methods: Participants included 6784 emerging adults (aged 15–25 years) from samples drawn for two national surveys in Denmark 2014-2015. Latent classes were constructed using the following parental variables: PSUD, offspring not living with both parents, and parental criminality, mental disorders, chronic diseases and long-term unemployment. The characteristics were analyzed using an independent one-way ANOVA. Differences in grade point average and further enrollment were analyzed using linear regression and logistic regression, respectively.

Results: Four classes of families were identified: 1. "Low adverse childhood experiences (ACE) families", 2. "Families with PSUD", 3. "Families with unemployment" and 4. "High ACE families". There were significant differences in grades, with the highest average among youth from "Low ACE families" (7.11, 95% CI: 7.04–7.18) and lower averages among youth from the other types of families ("Families with PSUD" = 6.20, 95% CI: 6.00–6.41; "Families with unemployment" = 6.39, 95% CI: 6.27–6.52; "High ACE families" = 5.66, 95% CI: 5.42–5.90). Youth from "Families with PSUD" (OR = 1.65; 95% CI: 1.19–2.29) and "High ACE families" (OR = 2.25; 95% CI: 1.58–3.20) were significantly more likely not to be enrolled in further education compared with "Low ACE families".

Conclusions: Young people who experience PSUD, both as the primary family-related problem as well as among multiple family-related problems, are at increased risk for negative school-related outcomes.

1. Introduction

How do family-related problems affect children's success in school and their educational attainment? School is perhaps the most pivotal context outside the home and where children spend a significant amount of time. Success in school and academic achievements have an effect on the later health, well-being and problem behavior of individuals (Gauffin et al., 2013; Hawkins et al., 1992; Herke et al., 2020; Johnson and Leff, 1999). At a societal level, governments often focus on educational attainment as a tool to promote social mobility (Landersø and Heckman, 2017), and researchers have argued (and debated) how having a well-educated general population is economically beneficial (Browne et al., 2010; Hanushek, 2016). School is often seen as a catalyst for changes in families (Chilton et al., 2015), or at least as an institution with possibilities for reducing social inequalities and increasing social mobility (Iannelli, 2013).

This points to the importance of looking into the impact of adverse family background for success or failure in the educational system. Children enter the school environment and navigate through the school years with varying levels of family-related problems and adverse childhood experiences (ACEs), including parental substance use disorders (PSUD), parental mental disorders, parental early death, neglect and domestic violence. Research has shown how different kinds of ACEs can impact not only family life but also children's relations to other children and adults, later mental health, and substance use (Bellis et al., 2015; Björkenstam et al., 2017; Dovran et al., 2019; Dunn et al., 2013; Kessler et al., 2010). The severity, level and number of ACEs also correlate with school hardship and learning difficulties (Dovran et al., 2019), schooling attainment (Cawley et al., 2001), as well as lack of school engagement, school absenteeism and repeating grades (Crouch et al., 2019; Robles et al., 2019).

PSUD is of particular interest, as it is a potentially modifiable ACE. Children living with PSUD experience more challenges in the school setting compared with their peers (Sher, 1997) and are at greater risk for low academic performance, skipping school days and dropping out of school (Berg et al., 2016b; Casas-Gil and Navarro-

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Guzman, 2002a; Chandy et al., 1993; Hafekost et al., 2017; Knop et al., 1985; Murphy, 1991).

Even though the relationship between PSUD and children's school performance has been quite comprehensively researched, there are significant limitations in the existing literature. PSUD does not exist in a vacuum and is often linked to other family-related problems that may influence a child's upbringing adversely (Ellis et al., 1997; Hafekost et al., 2017). Socioeconomic status (SES) is one factor that has been shown to be associated with both educational achievement and substance use disorders (Kendler et al., 2020; von Stumm et al., 2020). However, the link between SES and substance use disorders is likely to differ between countries and regions (Grittner et al., 2020), and in the Danish context, the correlation between heavy drinking and SES is very weak (Bloomfield et al., 2006). Other family-related problems have only sporadically been taken into account in the research on school performance. A full analysis of school performance, where different parental mental, somatic, legal and work-related problems are included, would be a significant contribution to the literature. The failure to take other family-related problems into account may explain some of the inconsistencies in the existing research Casas-Gil and Navarro-Guzman (2002b). included a control group in their study about school performance and parental alcohol use disorder but did not include other family-related problems in the analysis Hafekost et al. (2017). investigated maternal alcohol use disorder and school attendance but did not have data about the family environment to include in the analysis, and, on this basis, the underlying reasons for non-attendance were difficult to ascertain Berg et al. (2016a). did include information about parental crime and mental health problems. However, the study focused on parental hospital admissions for alcohol-related disorders and, thus, primarily captured only the most severely affected families. This resulted in less variation in the levels of problems, but, most importantly, it reflected another limitation in the existing research. Much of the previous research is based solely on clinical populations (parents in alcohol or drug treatment or children in family services) or families otherwise identified with multiple problems (Casas-Gil and Navarro-Guzman, 2002a; Khemiri et al., 2020; Knop et al., 1985; Miller and Jang, 1977; Murphy, 1991) and makes it difficult to generalize the findings to a broader context that includes children from different layers of society with different levels of family problems. This highlights the importance of including populations across a range of levels of problems. Lastly, some of the research relies on one type of data source only, like registers, or data from the parents, such as clinical interviews or questionnaires. Self-reports from children on PSUD provide insight into problems not defined externally by researchers but by the emerging adults themselves. By combining self-reports with rich longitudinal register-data, it is possible to capture a wider range of families.

1.1. Present study

By including a range of family-related problems and different levels of problem severity, the present study addresses some of the shortcomings in previous research. The primary aim of the study was to compare grades at graduation from compulsory school and further enrollment in education after compulsory school among Danish 15–25-year-olds from different types of families with or without PSUD and other family-related problems. We hypothesized that children experiencing PSUD would have lower grades and be less likely to continue their education and that additional stressful events and family-related problems would compound the negative impact of PSUD.

2. Materials and methods

The analyses drew on data from two national sample surveys among 15–25-year-old Danish young people (the National YouthMap Surveys), which were conducted by the center for Alcohol and Drug Research in 2014 and 2015 (Pedersen et al., 2017). By combining these cross-sectional datasets with register data on both the young adults and their parents, it was possible to study school performance and family-related problems from the birth of the young adults through their adolescence.

2.1. The survey data

The National YouthMap Surveys investigated substance use, wellbeing, and different kinds of social, psychological and physical problems. Of the 10,414 young people invited to take part in the surveys, 5755 participated (55.3%). Details on the National YouthMap Surveys, the methods and design have been published elsewhere (Frederiksen et al., 2021; Pedersen et al., 2018, 2017).

2.2. The register-based data

The population and health care registers in Denmark contain individual-level data on the entire population and can be linked to survey data through a personal identification number (Thygesen et al., 2011). We used a family relation register to identify the parents of the young people invited to participate in the National YouthMap Survey. Register data on grades from the General Certificate of Secondary Education as well as register data on further enrollment in education were then extracted and linked with the survey data on a secure server at Statistics Denmark.

Other registers were used to identify the following parental and family-related problems during the young adults' childhood: parental criminality, parental mental disorders, parental chronic diseases, parental long-term unemployment, and separation from parents (Table 1). Registrations were identified in the period from the young person's birth until their 15th birthday, except parental mental disorders and chronic diseases, which were tracked until the time of the survey, as diagnosis for these types of conditions can often be delayed (Cornally and McCarthy, 2011; Green et al., 2020; Oleski et al., 2010; Scott and Walter, 2010).

2.3. The study population

The study population was derived from the random sample of 10,414 young adults invited to participate in the two surveys. The present study included a subgroup of 6784 young people who had an entry in the school register and a grade point average calculated on the basis of the official guidelines (for school subject guidelines and weights, see Table 3; for the study population, see the flowchart in Fig. 1).

Of the sample of 10,414 young people, 3630 had missing values in the Student Register. Participants with missing school data and the study population differed in the distribution of sex (53.3% vs. 50.5% male), ethnicity (73.5% vs. 91.3% with Danish origin) and parents' highest level of education (32.4% vs. 7.8% with compulsory education, 42.6% vs. 52.4% with upper secondary and 25.0% vs. 39.8% with higher education) (Table 2). One reason for the missing values was the implementation timeline of the register, which was introduced in 2001 but did not have full coverage until 2006. Other reasons were that participants may have been sick or institutionalized, or may have attended schools that do not hold exams (such as Waldorf Schools that opt out of exams). Lastly, immigrants were more likely to have missing data, perhaps because they had been living elsewhere during the time they graduated.

2.4. Measures concerning grades at graduation and further enrollment in education

2.4.1. Grades from the general certificate of compulsory education

Compulsory education in Denmark spans nine years, from approximately age 6 to 15. Most young people attend public school, and these students participate in national exams. Most private schools do

Table 1
Information selected from population-based registers.

Register	Measure	Years
The Student Register	Grades from the General Certificate of Compulsory Education	2001–2016
The Employment Classification Module	Further enrollment in education	1985–2018
The National Patient Register	Parental chronic diseases	1989–2015
The Psychiatric Central Research Register	Parental mental disorder diagnoses (except alcohol- and drug-related disorders)	1989–2015
The Danish Central Crime Register	Parental convictions/charges (except some types of traffic offenses)	1989–2015
Danish registers on personal labor market affiliation	Parental long-term unemployment	1989–2015

Table 2
Comparison of the group with missing data in the Student register and the study population.

		Missing Student Register data n = 3630	Study population n = 6784	Overall sample N = 10,414	Chi2 Pr = 0.007
Sex					
	Male	53.3%	50.5%	51.4%	
	Female	46.7%	59.5%	48.6%	
Ethnicity					<0.001
	Danish origin	73.5%	91.3%	85.1%	
	Descendants/ immigrants	26.5%	8.7%	14.9%	
Parents' highest level of education					<0.001
	Compulsory	32.4%	7.8%	16.3%	
	Upper secondary	42.6%	52.4%	49.0%	
	Higher education	25.0%	39.8%	34.7%	

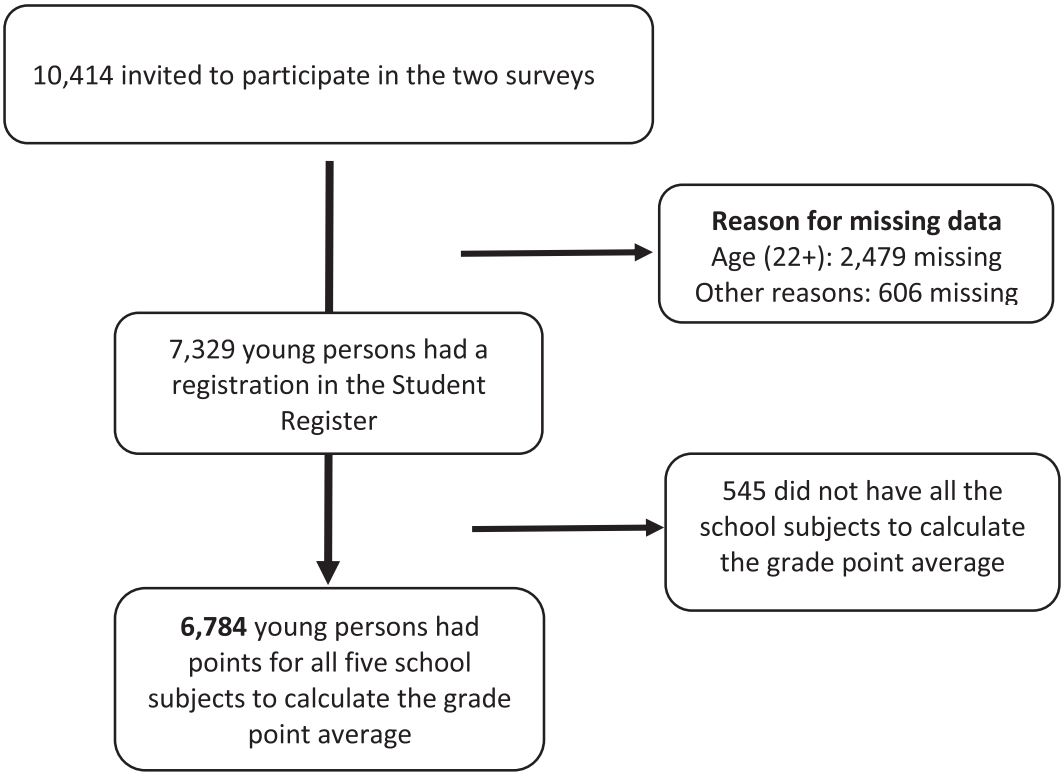

Fig. 1. Flowchart for study population.

the same, with the exception of schools such as Waldorf Schools that opt out of exams. Information on the participants' grade point averages was obtained from the Student Register covering the years 2001–2016 (Sørensen, 2020). The grade point system in Denmark is a scale from −3 to 12 (−3, 0, 2, 4, 7, 10 and 12), and higher grades indicate better performance. Grades of −3 and 0 are failing marks, 7 is the general average and 12 indicates complete fulfillment of the goals of the subject matter. A continuous variable with the weighted grade point average was calculated on the basis of the official guidelines (The Ministry of Children and Education, 2020) (Table 3). The grades were thus based on exams taken when the participants were approximately 15 to 16 years old.

2.4.3. Further enrollment in education

Further enrollment in education was defined as any registration in the category of "Enrolled in education" in the Employment Classification Module (Petersson et al., 2011) in the two years following the final examination in school. The education could either be general or vocational upper secondary education. The general upper secondary educa-

Table 3
Official guidelines for grade point average.

Compulsory exams	Weighting
Danish, oral	100%
English, oral	100%
Physics/chemistry biology and geography, oral	100%
Mathematics, written	50%
Danish, written:	
Orthography	25%
Reading	25%
Written representation	50%

tions are divided into four different types of preparatory programmes for tertiary education, which are usually for young people ages 15–19 (Education MOCA, 2021). A vocational program is a practical educational program, which qualifies for employment as a skilled worker.

2.5. Measures concerning family-related problems

2.5.1. Parental substance use disorder (PSUD)

PSUD was identified using survey and register data. A parent was considered to have PSUD if at least one of the following criteria was satisfied: (1) the young person responded in the survey that their parent had a current or previous substance abuse problem or (2) the parent had a register entry for a substance-related disease, disorder, charge/conviction, cause of death or treatment (for further information, see Frederiksen et al. 2021).

By combining self-report and register-based measures, it was, on the one hand, possible to get information on the families that did not appear in the register, and, on the other hand, it was possible to get information from the registers on the non-participants of the survey studies (Frederiksen et al., 2021).

PSUD was reported by 447 of the young adults, and 947 of the young adults had parental registrations for substance-related contacts. Some of the young persons both reported PSUD in the survey and had parental registrations for PSUD. With the combination of self-reports and the information from the registers, a total of 1145 (16.9%) young adults had PSUD. This measure of PSUD included young adults with PSUD reported in the survey alone, PSUD reported in the survey and identified in the register, and PSUD identified in the register alone.

2.5.2. Parental long-term unemployment

Information on parents' employment status was obtained from Danish registers on personal labor market affiliation (Petersson et al., 2011). Long-term unemployment was defined as three consecutive years, or more than three non-consecutive years, of social benefit receipt or unemployment (including unemployment benefits and early retirement but not State Education Support or parental leave).

2.5.3. Not living with both parents

Information was obtained about whether or not the young person lived with both biological parents from the year of birth up to and including their 15th birthday. If the child lived apart from one or both parents during one or more years, they were considered to have experienced "Not living with both parents".

2.5.4. Parental chronic, serious physical disease

A parent was classified as having a chronic, serious disease if they had received a primary or secondary diagnosis in the National Patient Register (Lynge et al., 2011) for the following diseases (Sundhedsdatastyrelsen, 2017; World Health Organization, 2004): type 2 diabetes, chronic obstructive pulmonary disease, asthma, rheumatoid arthritis and osteoporosis (International Classification of Diseases (ICD-10) codes: E11, J44, J45, M05, M06, M80, M81 and M82). The National Patient Register contains records for all hospital contacts in Denmark, including inpatient, outpatient, and acute contacts.

2.5.5. Parental mental health problems

A parent was considered to have had a mental disorder if they had any record in the Psychiatric Central Register (Mors et al., 2011; Sahl Andersen et al., 2011) (except F10-F19 diagnoses, which were included in the PSUD measure). Similar to the National Patient Register, the Psychiatric Central Register contains all types of hospital-based episodes of psychiatric care, including inpatient, outpatient and acute episodes.

2.5.6. Parental criminality

Parental criminality was defined as a conviction or charge registered in the Danish Central Crime Register (Ravn, 2001). Convictions and charges related to traffic offenses were excluded. Driving under the influence was included as an indicator of PSUD.

2.6. Ethics

Participants in both surveys were informed of the purpose of the survey in an invitation letter in which the voluntary participation and confidentiality measures were detailed. Participants indicated their informed consent by completing the survey. Both studies, which involved the linking of the register and the survey data, were registered at the Danish Data Protection Agency, and all confidentiality and privacy requirements were met.

2.7. Statistical methods of analysis

A Latent Class Analysis (LCA) was performed to investigate different types of families with different levels of family-related problems, including PSUD. LCA is a powerful and flexible method for identifying and understanding unobserved groups in a population. Based on the existing research, we believed that there were groups among the young people with different family-related problems and that these groups would have different school outcomes. Using LCA, we fitted a model to determine which individuals were likely to belong to each group based on information available from the survey and register data. The following variables were included in the LCA model:

- -/+ parental mental disorder
- -/+ parental criminality
- -/+ parental long-term unemployment
- -/+ not living with both parents
- -/+ parental chronic disease
- -/+ PSUD

One, two, three, four and five classes were fitted using multinomial logistic regression models and compared to determine which of these models fits best. We used goodness-of-fit statistics, Akaike's and Bayesian information criterion (AIC and BIC), entropy and the classification probabilities to determine the best fit (Table 4).

After the LCA was performed, a descriptive analysis used an independent one-way ANOVA to investigate differences in the characteristics of the young persons from the classes. Differences between the latent classes in terms of grade point average and further enrollment in education were analyzed using linear regression and logistic regression, respectively. Both models controlled for ethnicity (Danish origin vs. immigrant/descendants) and parents' level of education (compulsory education only vs. any higher education). We tested for interaction between the classes and offspring sex. Due to the significant interactions, we stratified both models by sex (male/female). The analyses were run with STATA 15 and 16, as well as R (R Core Team, 2013; StataCorp., 2019).

3. Results

The comparison showed the model with four classes had the lowest BIC (see Table 4). Based on the latest recommendations on using BIC

Table 4
Model fit information.

Number of classes	BIC	AIC	Entropy	Predicted posterior probability	LRTp-value
1	38,770	38,729	.	1	0.000
2	36,449	36,361	.69	.91	0.000
3	36,335	36,199	.36	.78	0.000
4	**36,309**	**36,132**	**.63**	**.80**	**0.039**
5	36,331	36,113	.65	.82	0.86

LRT: Likelihood ratio test; AIC: Akaike's information criterion; BIC: Bayesian information criterion
Note: The selected model with four classes is marked with bold type.

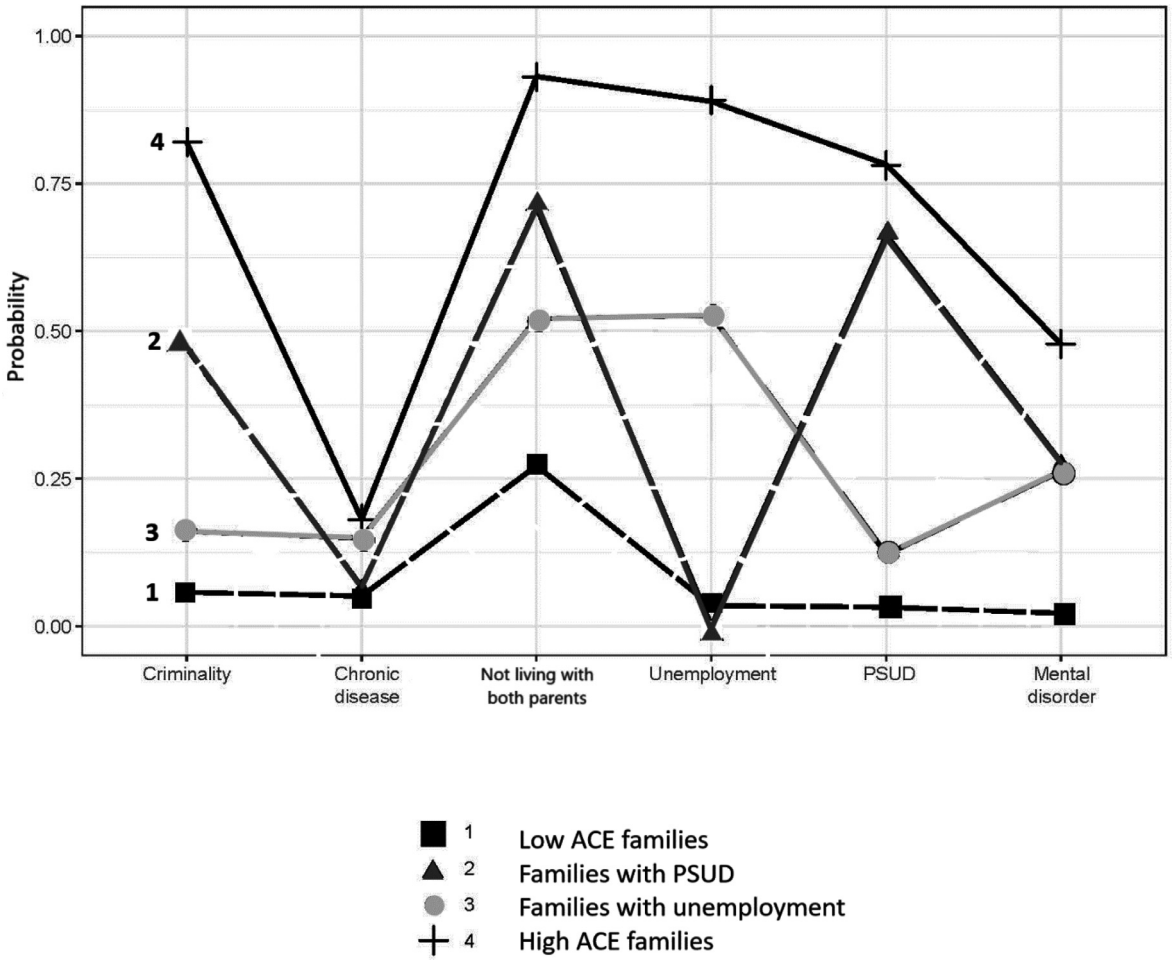

Fig. 2. Marginal probabilities for the four classes of having six family-related problems.

(and not AIC or the chi-square test), as well as considerations about the theoretical meaningfulness of the classes, the model with four classes was selected as the best-fitting model for our data (Nylund et al., 2007; Schreiber, 2017; Weller et al., 2020).

Based on the four-class model, the identified classes were labelled 1. "Low ACE families" (n = 4351; 64%), 2. "Families with PSUD" (n = 549; 8%), 3. "Families with unemployment" (n = 1477; 22%) and 4. "High ACE families" (n = 407; 6%). The latent class marginal means (Fig. 2) showed the probability in each group of having one or more of the family-related problems.

For "Low ACE families" (Class 1), the marginal probabilities were low for all the different family-related problems. For "Families with PSUD" (Class 2), the marginal probabilities were high for PSUD (0.66) and not living with both parents (0.71) and, to a lesser extent, for parental criminality (0.47). The marginal probability was lower for parental mental disorders (0.28) and particularly low for parental chronic diseases (0.07) and parental long-term unemployment (<0.001).

"Families with unemployment" (Class 3) had high marginal probabilities of not living with both parents (0.52) and parental long-term unemployment (0.53). The marginal probability of parental mental disorders was not high but still present for many of the families (0.28). The marginal probability of parental chronic diseases was quite low (0.15) but higher than for "Low ACE families" and "Families with PSUD" (Class 1 and Class 2, respectively). Lastly, "High ACE families" (Class 4) showed the highest marginal probabilities in all areas: PSUD (0.78), not living with both parents (0.93), parental criminality (0.82), parental long-term unemployment (0.89), parental mental disorders (0.48) and parental chronic diseases (0.18).

As shown in Table 5, the young people from the four types of families differed especially with regard to ethnicity ($F(3,6780)=241.9$, $p<0.001$) and parental level of education ($F(3,6780)=107.5$, $p<0.001$). In terms of ethnicity, the post hoc Bonferroni test revealed no differences between "Low ACE families" and "Families with PSUD" or between "Families with unemployment" and "High ACE families" but significant differ-

Table 5
Descriptive characteristics from a one-way independent ANOVA for young people from the four types of families (N = 6784).

	Low ACE families n = 4351	Families with PSUD n = 549	Families with unemployment n = 1477	High ACE families n = 407	P-value
Offspring sex					0.002
Males	2207 (50.7%)	259 (47.2%)	781 (52.9%)	176 (43.2%)	
Females	2144 (49.3%)	290 (52.8%)	696 (47.1%)	231 (56.8%)	
Offspring ethnicity					<0.001
Danish	4208 (96.7%)	530 (96.5%)	1131 (76.6%)	322 (79.1%)	
Immigrants/ descendants	143 (3.3%)	19 (3.5%)	346 (23.4%)	85 (20.9%)	
Parents with low level of education (compulsory education only)	172 (4.0%)	49 (8.9%)	224 (15.2%)	88 (21.6%)	<0.001

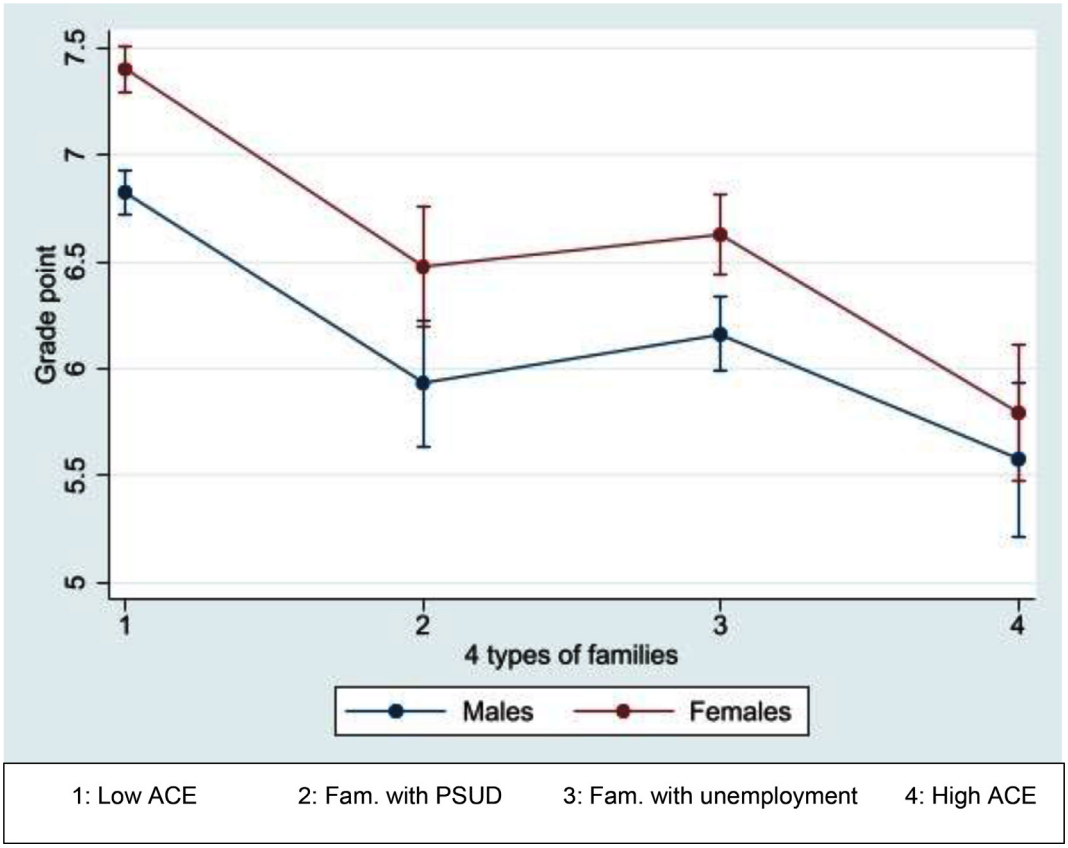

Fig. 3. Predictive margins (incl. 95% confidence intervals (CI)) for the young people's grade point averages by family type and offspring sex.

ences between the other types of families. In terms of parental education, the post hoc Bonferroni test showed significant differences between all four classes. Offspring sex differed between some of the types of families ($F(3,6780)=4.81$, $p = 0.002$), and the post hoc Bonferroni test revealed differences between "Low ACE families" and "High ACE families" as well as between "Families with unemployment" and "High ACE families".

3.1. Level of family-related problems and school performance

The grade point average (Fig. 3) was highest among young persons, both males and females, from "Low ACE families" (grade point average for males: 6.83, 95% CI: 6.72–6.93; for females: 7.40, 95% CI: 7.30–7.50). Young persons from "High ACE Families" had the lowest grade point average, and young persons from "Families with PSUD" had almost the same grade point average as youth from "Families with unemployment". Females had significantly higher grade point average compared with males in all families, except those from "High ACE families" (5.79; 95% CI: 5.48–6.11). Among males, the lowest grade point average was observed among those from "High ACE families" (5.58; 95% CI: 5.22–5.94) and "Families with PSUD" (5.93; 95% CI: 5.64–6.23) with overlapping confidence intervals.

Of the 6784 young people, only 420 (6.2%) were not enrolled in some kind of education program after graduation (Table 6). Using young people from "Low ACE families" as the reference group, higher odds of not being enrolled in education were observed for young people from "Families with PSUD" and "High ACE families", in particular among females ("Families with PSUD": OR=2.16, 95% CI: 1.22–3.85; "High ACE families": OR=3.41, 95% CI: 1.96–5.93). Females, but not males, from "Families with unemployment" had higher odds of not being enrolled in further education (OR=2.08; 95% CI: 1.32–3.28).

4. Discussion

Consistent with our hypothesis, PSUD and other concurrent family-related problems had an impact on the young people's school performance and chance of being further enrolled in education after complet-

Table 6
No further enrollment in education, by the four latent classes of young people stratified by offspring sex [a] ($N = 6778$ [b]) from logistic regression.

	Low ACE families($n = 4347$)	Families with PSUD($n = 549$)	Families with unemployment($n = 1475$)	High ACE families($n = 407$)
Not enrolled	237 (5.5%)	48 (8.7%)	90 (6.1%)	45 (11.1%)
Males	Ref.	OR = 1.51$p = 0.04495$% CI: 1.01–2.26	OR = 0.91$p = 0.55495$% CI: 1.01–2.26	OR = 1.78$p = 0.01695$% CI: 1.11–2.26
Females	Ref	OR = 2.16$p = 0.00995$% CI: 1.22–3.85	OR = 2.08$p = 0.00295$% CI: 1.32–3.28	OR = 3.41$p < 0.00195$% CI: 1.96–5.93

[a] Controlled for ethnicity and parents' level of education.
[b] 6 missing.

ing compulsory school. The analysis indicated that different types of family-related problems have different levels of impact.

The results of the present study are consistent with prior research showing that experiencing higher levels of adversity in childhood is associated with poorer school-related outcomes. In a study of a population with a high risk for reported adversities (adult participants recruited in prisons and substance abuse and mental health treatment settings), severity levels were strongly associated with the likelihood of school difficulties and hardship at school (Dovran et al., 2019). As well, a general population cross-sectional study concluded that negative school outcomes were associated with a higher ACE score and lower levels of protective factors (Robles et al., 2019). At the same time, parts of the analysis from the present study show a less clear-cut relationship between family-related problems and negative school outcomes, as youth from "Families with long-term unemployment" had higher probabilities of experiencing different family-related problems but did not have a higher risk of not being enrolled in further education. In comparison with "Low ACE families", this family type had higher probabilities of parental criminality, chronic diseases and mental disorders, as well as parents living separately, and, thus, the burden of problems in the families was potentially quite comprehensive. But, these young people were not at greater risk of dropping out of the educational system. This finding indicates that different types of family-related problems have different impacts on school performance and that PSUD may be an important factor with regard to the well-being of young people. Previous research on the impact of PSUD versus other ACEs has produced mixed results. Some studies have suggested that a dysfunctional family structure has the greatest impact on the well-being of young people irrespective of PSUD (Anda et al., 2002; Christoffersen and Soothill, 2003), while other studies have concluded that PSUD has independent effects (Jääskeläinen, 2016; Rognmo et al., 2012).

In the present study, the two family types that included PSUD ("Families with PSUD" and "High ACE families") had significantly lower school grade averages and a higher risk of no further enrollment compared with "Low ACE families", and the differences were more distinct between females from the four family types with regard to the latter outcome. Compared with males, females had significantly better school outcomes across the different types of families, except in "High ACE families", which had equally poor school outcomes for both females and males.

4.1. Strengths and limitations of the study

A major strength of this study was the combination of self-reports and register data, which allowed us to look at young people's school outcomes and parental problems not only at the time of the survey but also from the children's birth through their adolescence and early adulthood. Registers capture families, parents and young adults with more severe problems that are often rarer and more difficult to cover with survey studies (Brummer et al., 2021). However, register data are limited to those who use the services or receive some kind of benefit or punishment (Jääskeläinen, 2016). By also using survey data, the present study captured a more general group of families and parents who do not receive services but still have alcohol or drug problems. Differences between survey participants and non-participants in the distribution of social, mental and psychological problems (Christensen et al., 2015; Groves, 2006) can lead to bias and a potential underestimation of PSUD, but using register data on both participants and non-participants reduces this bias (Frederiksen et al., 2021). Combining register data and self-reports provides a more nuanced understanding of school performance among children with PSUD and other family-related problems.

A limitation in the present study's construction of family-related problems is that we do not know the extent of contact between the parent and child. For example, a parent could have a mental disorder and be very affected by it, but if contact with the child is very sparse, it may not have much impact on the child's life. However, parental problems may affect the child even when the parent is absent (Carbonneau et al., 1998). Another limitation is the lack of data on the timespan of PSUD and when it occurred in the young people's lives (Frederiksen et al., 2021). Furthermore, the retrospective nature of the self-reports together with the historical register data do not allow us to draw any conclusions about a causal effect of PSUD on school performance. Rather, the present study shows how PSUD and additional family-related problems compound the negative impact on school performance.

In addition, we had missing register data on several subsets of participants. Immigrants were more likely to have missing data than Danish participants, which may reflect that they had been living elsewhere during the time they graduated and thus would not have had data entered in the database. Other reasons for missing data could be that some young people attended schools that do not hold exams, and some young people may have been sick or institutionalized at the time of the exams.

4.2. Implications

This study demonstrates how PSUD and family-related problems are associated with poorer school outcomes. School attendance and success in school are important on many levels and have a major influence on the physical, psychological and social development of children and adolescents (Herke et al., 2020). But if school performance and retention in the educational system are impacted by family-related problems, including PSUD, this can lead to more inequalities, not only for the individual but also on a group level. Research has shown that PSUD can have an adverse impact during the formative years (Christoffersen and Soothill, 2003). The health and well-being of youth can be affected by structural factors, such as national wealth, income inequality and access to education (Viner et al., 2012). At the same time, research has also underscored the importance of protective factors, such as safe and supportive families, peers and schools. Protective factors in school can be positive school experiences, attendance at school, achievement and acknowledgement of success (Velleman and Templeton, 2016). The present study points to a need for a focus, not only in the schools but also in families and social welfare institutions, on protective factors in the social environment for young people who are in families with PSUD and additional family-related problems.

5. Conclusions

The present study investigated how a range of family-related problems, in particular PSUD, had an impact on young people's grades at graduation from compulsory school and further enrollment in education. Four groups of young people with varying levels of family-related

problems were identified. The results of this study show how young people who experience PSUD, both as the primary family-related problem as well as among multiple family-related problems, are at increased risk for negative school-related outcomes.

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Contributors

All authors are from the same university and the same department. All authors have participated in the research and/or article preparation. All authors have approved the final article.

Declaration of Competing Interest

None.

CRediT authorship contribution statement

Kirsten Søndergaard Frederiksen: Conceptualization, Data curation, Formal analysis, Methodology, Software, Writing – original draft, Writing – review & editing. **Morten Hesse:** Conceptualization, Formal analysis, Writing – review & editing. **Julie Brummer:** Conceptualization, Formal analysis, Writing – review & editing. **Mads Uffe Pedersen:** Conceptualization, Funding acquisition, Investigation, Project administration, Resources, Supervision, Writing – review & editing.

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Supplementary materials

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Problematic parental substance use, childhood family structures and adverse outcomes in young adulthood

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Declarations of interest

None.

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Abstract

Aim

To investigate the association between childhood family structures (intact/non-intact families, problematic parental substance use (PSU) and years living with a parent with a problematic substance use (SU)) and adverse outcomes during adolescence and young adulthood (ages 15-20 years).

Methods

The study population included 9,770 young people (aged 15-25 years) from samples drawn for two national surveys in Denmark 2014-2015. Using register data five types of childhood family structures (Intact/non-intact, PSU and years of living with the respective parent) and the following adverse outcomes in young adulthood were constructed: not in education, employment or training (NEET); any hospital admissions; mental disorders; and criminality. Using binary logistic regression models the relationships between family structure and the outcomes were firstly analyzed and secondly subcategories of these outcomes (employment status, causes for hospital admission, diagnoses for disorders and types of crime).

Results

Young people from intact families with PSU had higher odds of the different long-term adverse outcomes compared with intact families without PSU, and similar odds of the outcomes compared to non-intact families without PSU. The highest odds of adverse outcomes were found among young people from non-intact families who lived with a parent with a problematic SU for less than five years.

Conclusions

Living in intact families protected against adverse outcomes in young adulthood, and if PSU was present, the odds of adverse outcomes increased. The expected relationship between years living with PSU and higher odds of adverse outcomes in young adulthood was not supported. Awareness should be raised in health services, educational and legal institutions about young people from non-intact families with PSU.

Introduction

Having a parent with a problematic substance use (SU) has been shown to have a significant impact not only on childhood experiences but also on outcomes in adolescence and adulthood (Brummer et al., 2021; Raitasalo & Holmila, 2017; Ramstedt et al., 2021; Velleman & Templeton, 2016). But what role does family structure play in this association? Is it better for a child to live in an intact family that includes the parent with problematic SU, or to live only with the parent who does not have a problematic SU?

These types of questions take as their starting point different perspectives on the relative importance of family dissolution versus problematic parental substance use (PSU). PSU and how it affects a family as a whole should be seen as an interplay with other problems, which are more often present in families with PSU compared with families without PSU, such as higher risk of parental separation, more frequent economic problems, as well as higher risk of parental mental health problems (Frederiksen et al., 2022; Holst et al., 2020; Jääskeläinen et al., 2016; Kuppens et al., 2020; Waldron et al., 2013). Family environments as well as parenting styles vary, but research found tension, conflicts and harsh parenting to be more frequent when PSU also is present (Templeton et al., 2009; Velleman & Templeton, 2007, 2016). Children are at increased risk of traumatic memories if the childhood was characterized by a dysfunctional family environment with tension and conflicts (Haugland et al., 2021; Järvinen, 2015).

Difficulties extend outside the family environment, as children from families with PSU more often experience difficulties and hardship at school (Johnson et al., 2017; Ramstedt et al., 2021) and have poorer academic outcomes (Berg et al., 2016; Brook, 2010), and have a higher risk of mental disorders, substance use problems, hospitalizations, criminality as well as lower educational outcomes (Brummer et al., 2021; Christoffersen & Soothill, 2003; Park & Schepp, 2014; Smith & Wilson, 2016). The diversity and differences in life circumstances as well as in the level of family-related problems have been shed light on by different studies. Jääskeläinen et al. (2016) identified five different types of families with remarkable differences in PSU and other difficulties: the drinking father, the absent drinking father, the drinking mother, the drug

using mother and broken families. However, this study did not explore how types of families, for instance, having a drinking father versus an absent drinking father were linked with different outcomes in the child's later youth or adulthood (Jääskeläinen et al., 2016). A Danish study of the association between parental alcohol problems and internalizing problems among high school and vocational school students found the association was not stronger if the young person lived with the parent with alcohol problems (Pisinger et al., 2016). This study, however, did not investigate the direct link between cohabitation and problems in youth, and only looked at one outcome, internalizing mental health problems.

Previous research has demonstrated a range of different consequences for children who have experienced PSU, but children from separated or divorced families are also at an increased risk of some of the same consequences, such as problematic use of substances (Hope et al., 1998; Sadler et al., 2017; Waldron et al., 2014) and anxiety or depression (Otowa et al., 2014; Strohschein, 2005). Given that children with PSU more often experience family dissolution compared with children without PSU, the question is how do these two risk factors interplay? Prior studies have, on the one hand, shown that parental separation and divorce can have quite a considerable impact for some children in adulthood, such as increasing the risk of mental health problems (Chase-Lansdale et al., 1995; Strohschein, 2005), problematic use of substances (Hope et al., 1998) and poor academic performance (Sadler et al., 2017). Sadler et al. (2017) included paternal alcohol problems in the analysis of academic performance, but concluded that separation was more strongly associated with high school non-completion. A substantial number of studies have investigated whether PSU or parental divorce/separation more strongly predict outcomes like substance use, sexual debut, and quality of interpersonal relationships with parents (McCutcheon et al., 2018; Waldron et al., 2014; Windle & Windle, 2018). An Australian study based on a sample of children of twins concluded that early substance involvement was primary predicted by parental separation and that parental alcohol and cannabis dependence, including genetic risks, were not predictive in most models (Waldron et al., 2014).

Critique of two-parent households as the gold standard for healthy child development has raised awareness of how new types of nontraditional family structures are becoming progressively more prevalent (Ford-Gilboe, 2000; Shaw et al., 2019). Divorce and parental separation are becoming more and more common with the increasing divorce rates, which Amato (2000) claims to be one of the most dramatic changes in family life during the 20th century. In Denmark, the divorce rate was 1-2% at the end of the 19th century, but, 100 years later, the rate had increased to 44% (Vallgårda, 2021). This development means a greater social acceptance of divorce and family dissolution, and researchers have argued that adults thrive and children develop just as well in a variety of family structures (Amato, 2000; Strohschein, 2005).

Aim of the study

This present study aimed to investigate the association between of childhood family structure and outcomes during young adulthood (ages 15-20 years). Family structures included information about intact/non-intact families, PSU and the number of years of living with the parent with SUD. Outcomes were: not being in education, employment or training (NEET), hospital admissions, mental disorders and criminality.

Three different hypotheses were formed: 1. that living with both parents during childhood would protect against adverse outcomes; 2. that having a parent with a problematic SU would increase the risk of adverse outcomes; and 3. that the longer a child or young person lived with the person with the problematic SU during childhood and adolescence, the higher the odds for adverse outcomes would be.

Methods

Procedure and Sample

In 2014 and 2015, two national sample surveys (YouthMap surveys) were conducted in Denmark among youth aged 15-25 years (Pedersen et al., 2017). Of the initial random sample of 10,414 young persons, 5,755 participated (response rate of 55.3%). The survey data was linked with nationwide register data on both the young people and their parents from the time of the youth's birth up to 2015/2018.

The study population for the present study included the 9,770 young people from the survey samples who were also registered in the Danish Civil Registration System (Pedersen, 2011) (the remaining 644 young people with missing register data about family structure during childhood were mostly immigrants and likely with their parents in another country). The Danish Civil Registration System was used to identify the parents of the study population, as well as the family structure (intact/non-intact) and years of living with each parent in the first 15 years of the young people's lives.

Exposure

Problematic parental substance use (PSU)

The measure of PSU was a combination of self-reported and register-based PSU. Participants in the two surveys were asked whether or not their parents had (or had had) a problematic alcohol or drug use. The sub-question "Which parent?" (response options: "Father", "Mother", "Both", "Do not want to answer", "Don't know") identified the respective parent(s) with a problematic SU. Register-based PSU was defined based on whether or not a parent had a substance-related contact in a hospital, criminal justice, prescription, alcohol and drug treatment, or cause of death register (from 1989 - or the year the register was established if it was after 1989 - until 2015; see Table 1 in Supplementary material). For further information, see Frederiksen et al. (2021) and Frederiksen et al. (2022). Out of the study population of 9,770 young people, 1,884 were identified as having PSU, either by survey or register data (19.3%).

Years living together with the parent with problematic SU

Data from the Danish Civil Registration System identified which parent the child lived with during each year, from birth up to and including the child's 15th birthday (Pedersen, 2011). Using this information, five family structures with varying durations of living with a parent with SU were defined as follows:

1) Intact family all 15 years, without PSU ("Intact/-PSU")
2) Intact family all 15 years, with PSU ("Intact/+PSU")
3) Non-intact family, without PSU ("Non-intact/-PSU")
4) Non-intact family with PSU, living 0-4 years ("short period") with the parent with a problematic SU ("Non-intact/+PSU, brief")
5) Non-intact family with PSU, living 5-15 years ("long period") with the parent with a problematic SU ("Non-intact/+PSU, long")

The distinction between "short" and "long" periods of living with the parent with SU (groups 4 and 5) was made based on the median number of years (median=4) living with the parent with SU in non-intact families.

Outcome variables

Adverse outcomes related with living with a parent with SU were defined as those occurring during ages 15-20. The outcomes included NEET; hospital admissions; criminal convictions except traffic offences; and mental disorders.

Not in education, employment or training (NEET)

Information on receipt of social benefits, work and education was obtained from Danish registers on personal labor market affiliation (Petersson et al., 2011). Social benefits included unemployment benefits and early retirement but not leave benefits like State Education Support or parental leave. Receiving social benefits at age 20 years defined the young people in the category NEET. In the primary analysis, the

variable was dichotomized (not NEET/NEET). In a secondary analysis, the group not included in NEET was further investigated using two subgroups: 1) working and 2) enrolled in education. Each variable was dichotomized (Not working/Working; Not in education/In education).

Hospitalizations

The National Patient Register (NPR) (Lynge et al., 2011) contains records of admissions into all hospitals in Denmark, both private and public, and covers inpatient, outpatient, and acute & emergency care. In the first analysis, hospital admissions from ages 15-20 years were dichotomized (No hospitalizations/Hospitalizations). In a secondary analysis, the specific cause of the admission was included in order to distinguish if the admission was related to health problems (illness as the cause), mental problems (indicated by suicide attempts) or social problems (indicated by violence). The following causes of admissions were included: 1) illness (without any external cause), 2) accident, 3) violence, 4) suicide attempt and 5) "other cause" (Schmidt et al., 2015). Each was dichotomized in the analysis.

Mental disorder diagnoses

Information on the young people's mental disorder diagnoses during ages 15-20 years was drawn from the Psychiatric Central Register (Mors et al., 2011; Sahl Andersen et al., 2011). The PCR covers all hospital-based psychiatric care in Denmark, similar to the NPR. The first analysis investigated the odds of any mental disorder diagnosis, and the outcome was dichotomized (No mental disorder/Mental disorder). Subsequent analyses examined different types of diagnoses using the following three subgroups, which were constructed based on prevalence using International Classification of Diseases (ICD-10) codes (World Health Organization, 2004): anxiety disorders (F4-diagnosis), behavioral and emotional disorders with onset usually occurring in childhood and adolescence (F9-diagnosis) and "other disorders" (all other F-diagnoses). The subgroups were each dichotomized (No diagnosis/One or more diagnoses), and an individual could be

included in one or more of the subgroups if they had been diagnosed with more than one type of disorder during ages 15-20 years.

Criminality

Criminality was defined as any registration of a conviction in the Danish Central Crime Register during ages 15-20 years (Ravn, 2001). Traffic offences were excluded. In the first analysis, criminality was dichotomized (No criminality/Criminality). Secondary analyses included information on the type of crime: property crimes (e.g., burglary), drug-related crimes (e.g., possession and distribution) and "other offences". Each was dichotomized (No/Yes).

Ethics

The invitations to participate in the two YouthMap surveys included a description of the purpose of the study, information about voluntary participation, and a statement that all confidentiality and privacy requirements were met. Participants indicated their informed consent by completing the survey. The two survey studies as well as the present study were registered with the Danish Data Protection Agency.

Statistical analysis

A descriptive analysis examined the distribution of the different family structures and the outcomes. Next, the associations between family structure and four adverse outcomes (i.e., receipt of social benefits, hospitalization, mental disorders, and criminal conviction) were investigated using binary logistic regression models, with young persons from intact families without PSU as the reference group. Another logistic model was used in a follow-up analysis with non-intact families without PSU to investigate in particular the differences between intact families with PSU and non-intact families without PSU.

In the second part of the analysis, logistic regression models investigated the four outcomes in more detail. The relationship between family structure and odds of being employed or enrolled in education was analyzed. In the area of health consequences, hospital admissions were divided into four categories based on the reason for the contact, and the relationships with the different family structures were analyzed. Subgroups of mental disorder diagnoses were analyzed to shed light on whether some family structures were associated with an increased risk of particular diagnoses. Different types of criminalities were analyzed to determine whether different family structures were associated with increased risk of conviction for different reasons.

All analyses controlled for sex, ethnicity (Danish origin vs. immigrants/descendants) and parents' highest level of education (primary education only vs. any additional education). The analyses were conducted with STATA 16 (StataCorp., 2019).

Results

Distribution of types of families and outcomes

The distribution of family structures was as follows: 4,273 (43.7%) young people in *Intact/-PSU*; 471 (4.8%) in *Intact/+PSU*; 3,613 (37.0%) in *Non-intact/-PSU*; 717 (7.3%) in *Non-intact/+PSU, brief*, and, lastly, 696 (7.1%) in *Non-intact/+PSU, long*.

Concerning the outcomes, 436 of the young persons (4.5%) were in the category NEET when they were 20 years old, and 6,811 (69.7%) had one or more hospital admissions during ages 15-20 years. Between ages 15-20, 887 (9.1%) had a mental disorder diagnosis, and 1,114 young people (11.4%) were convicted of one or more crimes.

Association between family structures and adverse outcomes in young adulthood

The relation between family structure, including years living with a parent with SU, and the study outcomes is illustrated in Figure 1. *Intact/-PSU* was used as the reference group, and the analysis explored whether young people from the other family structures had increased odds of the different adverse outcomes.

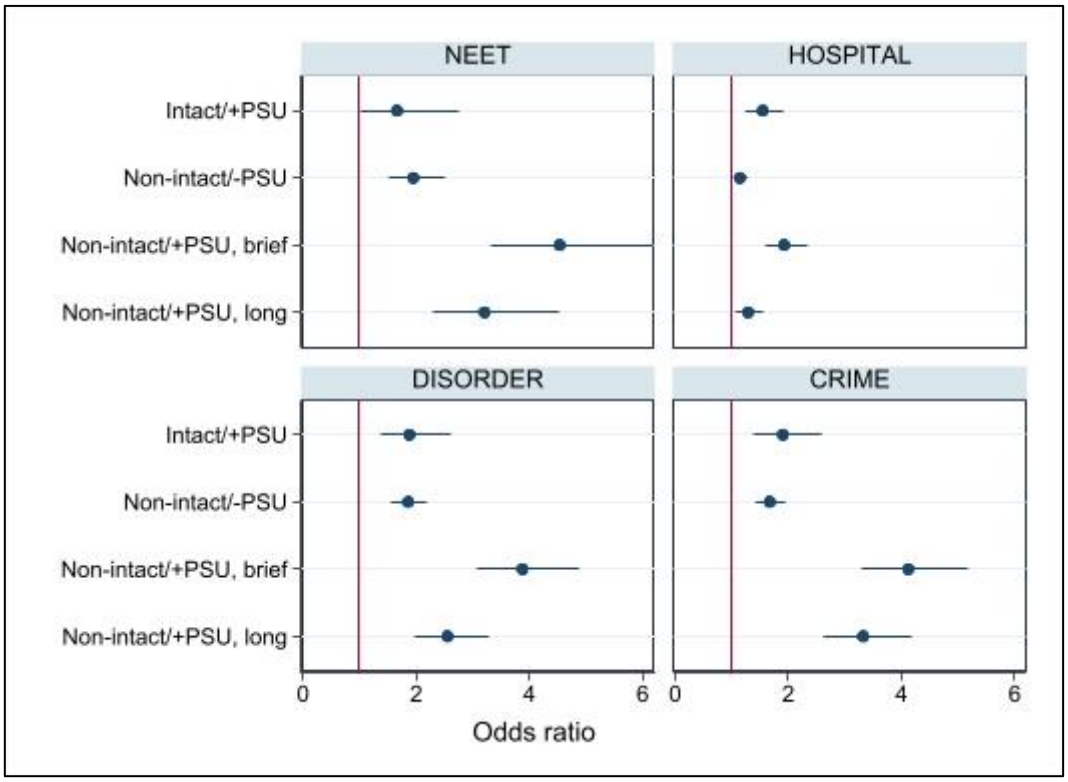

Figure 1: Family structures and odds ratio for adverse outcomes at age 15-20 from a logistic regression using "Intact families without PSU" as reference group (n= 9,770)[1]

Young persons from *Intact/+PSU* had a higher odd of NEET (OR=1.66, p=0.049; 95% CI 1.00-2.74), hospitalization (OR=1.55; p<0.001; 95% CI: 1.24-1.93), mental health disorders (OR=1.88; p<0.001, 95% CI: 1.36-2.60) and criminality (OR=1.90; p< 0.001; 95% CI: 1.39-2.60) compared with the reference group, *Intact/-PSU*. Young persons from *Non-intact/-PSU* had a higher odd of NEET (OR=1.95; p<0.001; 95% CI 1.51-2.51), hospitalization (OR=1.15; p=0.006; 95% CI: 1.04-1.26), mental disorders (OR=1.86; p<0.001, 95% CI: 1.57-2.20) and being convicted of a crime (OR=1.67; p<0.001; 95% CI: 1.42-1.95), compared with young

[1] Notes: *Intact/-PSU*: Youth who had grown up in intact families without problematic parental substance use. *Intact/+PSU*: Youth who had grown up in intact families with problematic parental substance use. *Non-intact/-PSU*: Youth who had grown up in non-intact families without problematic parental substance use. *Non-intact/+PSU, brief:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for four years or less. *Non-intact/+PSU, long:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for five or more years. *NEET:* not in education, employment or training (only for 20-year olds); *HOSPITAL:* hospital admission; *DISORDER:* diagnoses for mental disorders; *CRIME:* convictions for crime (excl. traffic offences). All models adjusted for sex, ethnicity other than Danish and parents' higher education than primary school

persons from *Intact/-PSU*. The follow-up analysis using a logistic model with *Non-intact/-PSU* as the reference group showed no significant differences between *Intact/+PSU* and *Non-intact/-PSU* except hospital admissions which were higher for Intact/+PSU (OR=1.35; =0.008; 95% CI: 1.08-1.69).

Young persons from *Non-intact/+PSU, brief* had the highest odds of NEET (OR=4.54; p<0.001; 95% CI 3.33-6.18), hospitalization (OR=1.93; p<0.001; 95% CI: 1.59-2.34), mental disorders (OR=3.88; p<0.001, CI: 3.08-4.89) and criminality (OR= 3.33; p<0.001; 95% CI: 2.64-4.19) compared with the reference group. Lastly, young persons from *Non-intact/+PSU, long* had higher odds of NEET (OR=3.21; p<0.001; 95% CI 2.28-4.52), hospitalization (OR=1.29; p=0.005; 95% CI: 1.08-1.55), mental disorders (OR=2.55; p<0.001; 95% CI: 1.98-3.29), and criminality (OR=3.33; p<0.001; 95% CI: 2.64-4.19) compared to the reference group.

Social benefits, education and employment

The odds of being enrolled in education did not significantly differ between young persons from intact families (+/- PSU) but were significantly lower for young persons from the three non-intact families and especially low for young people from *Non-intact/+PSU, brief* (OR=0.63; p<0.001) and from *Non-intact/+PSU, long* (OR=0.61; p<0.001) (Table 1).

Table 1: Logistic regression for being in education or working when 20 years old, comparing the five family structures, reporting odds ratios (OR), p-values and 95% confidence intervals (CI) (n=9,770)[2]

	In education	**Employed**
Intact/-PSU	Reference	Reference
Intact/+PSU	OR=0.92 p=0.368 CI: 0.76-1.11	OR=1.04 p=0.719 CI: 0.85-1.27
Non-intact/-PSU	OR=0.90 p=0.017 CI: 0.82-0.98	OR=0.89 p=0.015 CI: 0.81-0.98
Non-intact/+PSU, brief	OR=0.63 p<0.001 CI:0.53-0.74	OR=0.83 p=0.041 CI:0.70-0.99
Non-intact/+PSU, long	OR=0.61 p<0.001 CI:0.52-0.72	OR=1.08 p=0.382 CI:0.91-1.28

The odds of being employed were not significantly different for the young people from *Intact/ +PSU* (OR=1.04; p=0.719) and *Non-intact/+PSU, long* (OR=1.08; p=0.382) families compared with young people from Intact/-PSU families. The odds of being employed were lower for young people from *Non-intact/-PSU* (OR=0.89; p=0.015) and *Non-intact/+PSU, brief* (OR=0.83; p=0.041) families.

Causes of hospital admission

A total of 6,811 young people had one of more admissions during their 15-20 years, and for some of these young people they occurred in more than one of the causes for a visit at the hospital (Table 2). Accidents were the most frequent cause of hospital admission, as 4,177 young people had one or more admissions in

[2] **Notes:** Notes: *Intact/-PSU*: Youth who had grown up in intact families without problematic parental substance use. *Intact/+PSU*: Youth who had grown up in intact families with problematic parental substance use. *Non-intact/-PSU*: Youth who had grown up in non-intact families without problematic parental substance use. *Non-intact/+PSU, brief:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for four years or less. *Non-intact/+PSU, long:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for five or more years. All models adjusted for sex, ethnicity other than Danish and parents' higher education than primary school

relation to accidents (4,177/6,811; 61.3%). Illness was the second most frequent cause of admission (1,815/6,811; 26.7%). The remaining causes of hospitalization were violence, suicide attempts, and "others" (1,514/6,811, 22.2%).

Table 2: Logistic regression for the cause of hospital admission during ages 15-20 years comparing the five family structures, reporting odds ratios (OR), p-values, and 95% confidence intervals (CI) (n=9,770)[3]

	Illness n=1,815	**Accidents n=4,177**	**Violence n=337**	**Suicide attempts n=85**	**Other n=1,514**
Intact/-PSU	Reference	Reference	Reference	Reference	Reference
Intact/+PSU	OR=1.45 p=0.003 CI: 1.13-1.85	OR=1.24 p=0.027 CI: 1.03-1.51	OR=1.76 p=0.024 CI: 1.08-2.87	OR=2.28 p=0.145 CI: 0.75-6.91	OR=1.09 p=0.543 CI: 0.83-1.43
Non-intact/ -PSU	OR=1.50 p<0.001 CI: 1.33-1.69	OR=1.0 p=0.481 CI: 0.94-1.13	OR=1.58 p<0.001 CI: 1.23-2.04	OR=2.99 p<0.001 CI: 1.63-5.47	PR=1.26 p<0.001 CI: 1.11-1.43
Non-intact/ +PSU, brief	OR=2.42 p<0.001 CI: 2.01-2.91	OR=1.60 p<0.001 CI: 1.36-1.88	OR=3.29 p<0.001 CI:1.51-3.25	OR=4.95 p<0.001 CI: 2.34-10.46	OR=1.67 p<0.001 CI: 1.36-2.04
Non-intact/ +PSU, long	OR=1.83 p<0.001 CI: 1.51-2.23	OR=1.35 p<0.001 CI: 1.14-1.58	OR=2.22 p<0.001 CI: 1.51-3.25	OR= 5.41 p<0.001 CI: 2.58-11.31	OR=1.40 p=0.002 CI: 1.13-1.74

Compared to young persons from *Intact/-PSU families*, the odds of hospitalization due to illness were higher for young persons from *Intact/+PSU* (OR=1.45; p=0.003), *Non-intact/-PSU* (OR=1.50; p<0.001), *Non-intact/+PSU, brief* (OR=2.42; p<0.001), and *Non-intact/+PSU, long* (OR=1.83; p<0.001) families. The odds of accident-related admissions were only significantly higher among persons from *Non-intact/+PSU, brief* (OR=1.60; p<0.001) and *Non-intact/+PSU, long* (OR=1.35; p<0.001) families compared with young persons

[3] **Notes:** *Intact/-PSU*: Youth who had grown up in intact families without problematic parental substance use. *Intact/+PSU*: Youth who had grown up in intact families with problematic parental substance use. *Non-intact/-PSU*: Youth who had grown up in non-intact families without problematic parental substance use. *Non-intact/+PSU, brief:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for four years or less. *Non-intact/+PSU, long:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for five or more years. All models adjusted for sex, ethnicity other than Danish and parents' higher education than primary school.

from *Intact/-PSU families*. There were also higher odds of hospitalizations due to violence and suicide attempts among young people from non-intact families, with the highest increased odds among the two PSU-families ("Non-intact/+PSU, brief/long").

Types of mental disorder diagnoses

A total of 887 young people received a mental disorder diagnosis between ages 15-20 years. Primary or secondary F4-diagnoses for "anxiety, dissociative, stress-related, somatoform and other nonpsychotic mental disorders" were the most frequent (358/887; 40.4%), followed by F9-diagnoses (primary or secondary) for "behavioral and emotional disorders with onset usually occurring in childhood and adolescence" (240/887; 27.1%). "Other" disorder diagnoses primarily consisted of F3-diagnoses for "mood (affective) disorders" and Z0-diagnoses for "persons encountering health services for examinations" ("other" diagnoses in total 594/887; 67.0).

Table 3: Logistic regression for types of mental disorders during ages 15-20 years, comparing the five family structures, reporting odds ratios (OR), p-values, and 95% confidence intervals (CI) (n=9,770)[4]

	Anxiety disorders (F4) n= 358	**Childhood/adolescence Behavioral and emotional disorders (F9) n= 240**	**Other disorders n = 594**
Intact/-PSU	Reference	Reference	Reference
Intact/+PSU	OR=1.18 p=0.598 CI:0.64-2.18	OR: 1.93 p=0.061 CI: 0.97-3.86	OR: 2.14 p<0.001 CI: 1.48-3.09
Non-intact/-PSU	OR=2.16 p<0.001 CI: 1.65-2.82	OR=2.52 p<0.001 CI: 1.77-3.59	OR=1.84 p<0.001 CI: 1.50-2.25
Non-intact/+PSU, brief	OR=4.25 p<0.001 CI: 3.02-5.97	OR=7.63 p<0.001 CI: 5.11-11.39	OR=3.36 p<0.001 CI: 2.55-4.44
Non-intact/ + PSU, long	OR=2.68 p<0.001 CI: 1.82-3.96	OR=3.55 p<0.001 CI: 2.19-5.75	OR=2.23 p<0.001 CI: 1.63-3.05

Young people with an anxiety disorder diagnosis were more likely to be from any of the three non-intact family types (Table 3), with the highest odds among young people from *Non-intact/+PSU, brief* (OR=4.25; p<0.001), which was also the group with highest odds of having a childhood and adolescent behavioral and emotional disorder diagnosis (OR=7.63; p<0.001) and other diagnosis (OR=3.36; p<0.001).

[4] **Notes:** *Intact/-PSU*: Youth who had grown up in intact families without problematic parental substance use. *Intact/+PSU*: Youth who had grown up in intact families with problematic parental substance use. *Non-intact/-PSU*: Youth who had grown up in non-intact families without problematic parental substance use. *Non-intact/+PSU, brief:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for four years or less. *Non-intact/+PSU, long:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for five or more years. All models adjusted for sex, ethnicity other than Danish and parents' higher education than primary school.

Types of criminality

Property crimes (22.4%) were the most common type of crime for which the young people were convicted and drug-related crimes, including possession (11.0%). A final category of "other" offences accounted for 28.6% of the convictions.

Table 4: Logistic regression for types for criminality during ages 15-20 years, comparing the five family structures, reporting odds ratios (OR), p-values and 95% confidence intervals (CI) (n=9,770)[5]

	Property n=527	**Drug-related n=260**	**Other n=674**
Intact/-PSU	Reference	Reference	Reference
Intact/+PSU	OR= 2.37 p<0.001 CI: 1.56-3.60	OR=1.98 p=0.028 CI:1.08-3.64	OR=1.43 p=0.086 CI: 0.95-2.16
Non-intact/-PSU	OR=1.75 p<0.001 CI: 1.38-2.21	OR= 1.90 p<0.001 CI: 1.392.61	OR=1.46 p<0.001 CI:1.20-1.78
Non-intact/+PSU, brief	OR= 4.52 p<0.001 CI:3.35-6.10	OR= 4.11 p<0.001 CI:2.72-6.21	OR=3.69 p<0.001 CI: 2.82-4.83
Non-intact/+PSU, long	OR= 4.39 p<0.001 CI:3.25-5.94	OR= 2.98 p<0.001 CI:1.89-4.69	OR=2.78 p<0.001 CI: 2.09-3.70

Odds of convictions for the different offences were higher among all the other groups when comparing each group with intact families without PSU, but highest among young people from non-intact families with PSU (Table 4).

[5] **Notes:** *Intact/-PSU*: Youth who had grown up in intact families without problematic parental substance use. *Intact/+PSU*: Youth who had grown up in intact families with problematic parental substance use. *Non-intact/-PSU*: Youth who had grown up in non-intact families without problematic parental substance use. *Non-intact/+PSU, brief:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for four years or less. *Non-intact/+PSU, long:* Youth who had grown up in a family with problematic parental substance use and lived with the parent with problematic substance use for five or more years. All models adjusted for sex, ethnicity other than Danish and parents' higher education than primary school.

Discussion

We hypothesized that living with both parents during childhood would protect against adverse outcomes, and this was supported by the analysis, which showed higher odds of adverse outcomes for all family structures compared with the reference group of intact families without PSU. Young people from non-intact families (both with and without PSU) had particularly higher odds of the different outcomes. We also hypothesized that having a parent with problematic SU would increase the odds of adverse outcomes, which was also supported by the analysis, as young people from intact families with PSU had higher odds of NEET and hospital admissions, mental disorders and criminality compared with young people from intact families without PSU. At the same time, young people from non-intact families without PSU had similar outcomes compared with peers from intact families with PSU, and the follow-up analysis using non-intact families without PSU as the reference group did not show any significant differences between the two family structures, except higher odds for hospitalization among *Intact/+PSU*. This could indicate that PSU (in intact families) has the same influence as family dissolution, or at least PSU only increases the likelihood of different adverse outcomes if it is present in families with other problems and conflicts leading to separation/divorce. But as the present study did not include qualitative information about family dysfunction, this is only a conjecture.

The hypothesis that living with a parent with problematic SU for longer periods during childhood would be associated with worse outcomes was not supported by the results. Compared with the reference group, the highest odds of different adverse outcomes was observed among young people from *Non-intact/+PSU, brief families*, not among young people from *Non-intact/+ PSU, long families*. Furthermore, the secondary analysis showed that young people from *Non-intact/+ PSU*, brief families had higher odds of not being employed or enrolled in education, having an accident-related hospitalization, having an anxiety disorder diagnosis, as well as other kinds of mental disorder diagnoses, and being convicted of property, drug-related, and other crimes compared to the reference group, *Intact families without PSU*. An explanation for

the significantly higher odds of adverse outcomes among this group of young people could be the early timing of the family dissolution. There is some evidence that the risk of adverse outcomes is higher for young people who experienced parental divorce in childhood compared with those who experienced later parental divorce (Hope et al., 1998), but other studies have not supported this finding (Amato, 2000; Strohschein, 2005). Another explanation could be the level of family dysfunction and of the severity of SU. Higher levels of family dysfunction and more severe SU may contribute to a decision to separate quite shortly after the child's birth. Thus, the level of family functioning during childhood may be more important than whether the child lives with the parent. In families with a lot of conflict and problems, the parent with problematic SU may still have an important impact on the child, even though they do not live together. This is supported by studies demonstrating that parental problems have an effect on externalizing behaviors over time and that family functioning mediates the relationship (Finan et al., 2015; Park & Schepp, 2014). The importance of including the parent-child relationship, disruptive social changes and family conflict into account in the analysis was also demonstrated by an Icelandic study, which showed that the higher risk of adolescent cigarette and alcohol use among those with parental divorce was explained by the family environment (Kristjansson et al., 2009). And it is likely that it is instability in the family structure, and not the structure itself, that is associated with adverse outcomes (Bzostek & Beck, 2011; Shaw et al., 2019). However, in some contexts, the family structure may have the opposite impact. For instance, Shaw et al. (2019) studied justice-involved children in Florida and found a lower risk of past-30 day opioid misuse among children living in single-parent households compared with those in two-parent and grandparent-only households.

Other factors, that could be important when examining the adverse outcomes in young adulthood of PSU include the type (alcohol vs. illicit drugs) and severity of the SU. Kuppens et al. (2020) conducted a meta-analysis of the longitudinal relationship between PSU and child well-being, and concluded that recreational alcohol use was as harmful as tobacco use and AUD, while parental drug use had the strongest effect on child well-being. In the present study, information about substance type was only available for some of the

measures (e.g., drug vs. alcohol-related diseases or disorders), but this could be an interesting and relevant aspect to incorporate in future analysis.

In the present study, we expected to find a dose-response relationship between years living with PSU and adverse outcomes. Instead, the results showed that other factors in the family relations influenced the situation in young adulthood. In a prior study based on the same population, we found that four groups of families could be identified depending on the severity and complexity of different parental problems, including PSU (Frederiksen et al., 2022). In the present study, the aim was to investigate PSU as a separate risk factor in more detail to determine whether greater exposure to the parent with problematic SU was associated with poorer outcomes for the child. But this seems not to be the whole picture, and other factors also contribute.

Limitations

As mentioned in the Methods section, the measure of PSU only captured if the parent had a problematic SU at a point during the young person's life before the surveys were conducted. The measure of living with (or apart from) the parent with problematic SU during childhood was based on register data indicating whether or not the parent and child lived together each year and does not necessarily indicate the number of years living with PSU. That is, this does not mean that the parent was necessarily using substances during the exact years when the child was living with the parent with PSU. The survey data did not include information about the duration of PSU. For instance, a young person may have lived together with their father all 15 years, and the father started having obvious problems with drinking when the young person was 10 years old, and some alcohol-related diagnoses may not coincide with the time of drinking, such as alcohol-related liver disease, which may only occur after many years of heavy drinking.

Another limitation is a lack of information about family dysfunction, family relations, and conflicts. The surveys did cover some aspects of these issues (e.g., questions about parental support and conflict), but

survey data would only provide information about the participants and not the non-participants, a group which is more likely to have experienced severe PSU (Frederiksen et al., 2021).

Implications

The study showed how PSU can be related with adverse outcomes, especially in combination with other problems like early parental divorce and a short period of living with the parent with problematic SU. Further investigations of young people from different kinds of family structures are needed to clarify if it is the level of family dysfunction which is the dominant factor. When social welfare and healthcare professionals are in contact with young people, it is important that they not only consider PSU, but also the interplay with family environment, dysfunction and relations and how this affects the well-being of the young persons. A tool to support this dialogue could be an interesting subject for future research, not only to facilitate the discussion with the children involved and other family members but also to focus on the impact of the substance use problems in the family and how it lead to psychological and physical symptoms for the rest of the family. Some methods have already been developed like the 5-step Method by Copello et al. (2010), by which counsellors can provide relevant information, discuss social support and facilitate contact with other sources of specialist help. Another method is Community Reinforcement and Family Training (CRAFT) (Smith & Meyers, 2004), which is a program teaching the family members to changes their own behavior and target problems in different aspects of their lives as well as getting the individual with problematic SU into treatment or to reduce their substance use.

Furthermore, when PSU is detected, preventive interventions should direct attention towards decreasing the risk of NEET and mental disorders, as well as the risk of criminality. The higher odds of hospital admissions among young people with PSU also suggest that hospitals could be an appropriate setting to conduct screenings for PSU to ensure these young people receive proper help.

Conclusion

The odds of adverse outcomes in young adulthood related with childhood family structures were lowest among young people from intact families with PSU compared with intact families without PSU. The highest odds of adverse economic, health, mental health, and criminal justice problems were found among young people from non-intact families living with a parent with SU for 0-4 years. These results demonstrate the importance of taking into account the interaction between different aspects of family structure and PSU when considering long-term outcomes for children.

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