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Mogens Nygaard Christoffersen

ATTEMPTED SUICIDE AND COMPLETED SUICIDE AMONG YOUNG PEOPLE:

RISK AND PROTECTIVE FACTORS IN A PROSPECTIVE REGISTER BASED STUDY

RESEARCH DEPARTMENT OF CHILDREN AND FAMILY

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**Attempted suicide and completed suicide among young people:
Risk and protective factors in a prospective register based study¹**

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Abstract

The study explore risk factors associated with the onset of suicidal behavior in young people aged 15 to 24. The study survey possible risk factors and protective factors in order to evaluate if altering the conditions of children's upbringing, structural factors, geographical segregation, or individual resource deficits could reduce their suicidal behavior (first time suicide attempts and completed suicides). These issues are being examined using data gathered during a 10-year longitudinal study of two births cohorts of more than 145,000 young people born in 1966 or 1980. In the Nordic welfare model it is an ambition to level-out inequalities and give children the same opportunities despite parental income or educational resources. The paper focuses on suicidal behavior as an extreme indicator of individual disadvantage and social disintegration in order to disentangle groups of risk factors and their contribution to the number of first time suicide attempts and suicides among teenagers and young adults.

A discrete-time Cox-model is used to analyze associations between the relatively rare response events and the relatively rare risk factors in order to find the most significant precursors of suicide and first-time suicide attempts and estimate the risk factors' attribution to the total number of early onset of suicidal behavior. Series of risk factors were included in the logistic regression model covering the following areas: 1) disadvantaged parenting e.g. parental substance abuse, parental mental illness, domestic violence, parental suicidal behavior, battered-child-syndrome, child in care, family separation, and teenage motherhood. 2) Structural factors relating to the family during adolescence e.g. educational qualification of parents, parental employment status and poverty. 3) The geographical segregation e.g. rented housing vs. self-owner 4) Individual resource deficits e.g. youth unemployment, school level, poverty, psychiatric disorder, imprisonment, substance abuse (drug addiction, and alcohol abuse), and sever physical diseases in the preceding year before the first suicide attempt or suicide.

Following the 1966 and the 1980 birth cohorts in the age span 15 to 24 years reveal that risk of suicidal behavior had increased with 30 percent. The increase in suicidal behavior may be explained by increase in poor parenting (child abuse and neglect, child in care), and poor parental support (more separations) together with structural factors related to the family during adolescence (e.g. parental unemployment, increased income inequality). An increased part of the youth was exposed to following risk factors: poverty, being incarcerated, having mental illness and substance abuse problems, which all were precursors of suicidal behavior. Considerable part of the increase in suicidal behavior is caused by constrains on the young girls, even when other risk factors were taken into account.

¹ An earlier version of the paper was presented at the 25th World Congress on Suicide Prevention in Montevideo 27-31 October, 2009.

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Summary

The main question is the following: suicide is seen as a private solution to personal problems, but what if *some* of the suicides could be seen as a consequence of structural changes in society?

A marked increase in youth suicide rates in a number of countries has caused a growing research interest. Attempted suicide is the most common cause of hospital admissions in the young people 15-34 years old, and suicide is among the most common cause of death in this age group. In Denmark the estimated suicide rate for the 15 to 24 years old has *decreased* during the last 20 years from 12 to 6 per. 100,000 persons. But at the same time the annual rate of attempted suicides has *increased* from 200 to 300 per. 100,000 persons – at least according to statistics in a single region.

In the present study we will focus on the early onset of suicidal behavior. We define suicidal behavior as first-time suicide attempts or completed suicide among 14 to 24 years old. We compare adolescents born in 1966 to adolescents born in 1980 and we find a 30 percent increase in suicidal behavior from 11.1 to 14.7 per 1,000 persons between the two birth cohorts.

The knowledge we gain from collocating of theories about suicidal behavior to data about first-time suicide attempts as well as early suicides could be useful when formulating an action plan to prevent the early onset of suicidal behavior. We categorize theories into six paradigms each with its own explanation and potential relevance to prevention of suicidal behavior. The first paradigm is based on *genetics* and biological risk factors: the presence of a family history of suicidal behavior is to be a predictor of suicidal behavior among adolescents. The second paradigm focuses on *parenting* and disadvantages during the formative years providing the background for low self-esteem, hopelessness and low degree of resilience. The third paradigm focuses on the *structural level* of for example, unemployment, educational level and degree of polarization between rich and poor people. All are factors that are obvious beyond immediate control of the family. The fourth paradigm links suicidal behavior to *norms and values* in the local society and for example how media can influence suicidal behavior. The fifth paradigm explains suicidal behavior by their *present individual resources*: lack of education, poverty, substance abuse, severe somatic disease, mental illness, homelessness, incarcerations, and institutionalized persons. The sixth paradigm emphasizes the importance of the *contemporary situation and opportunities* instead of individual background. Restricted access to means of suicide is the key issue in this paradigm.

A long list of nationwide registers is used to include risk factors associated with the mentioned paradigms - linked together on the bases of personal identity numbers. The suicidal behavior is based on hospital admissions and inpatient records; we are presumably including the most severe suicide attempts and nearly all suicides from the 'Causes of Death Register'.

A discrete-time Cox model of the two birth cohorts followed from their 15th to 24th birthday including all children born in 1966 and in 1980. The model includes age, series of risk factors, and an interaction term which is a product of the risk factors and the birth cohort term. The counterfactual reductions are simulated as a way to grasp the influence from risk factors. We

estimate the number of first-time suicide attempts and suicides that would have occurred if a specified risk factor has been eliminated.

The study confirms earlier findings that the presence of a family history of mental illness and suicidal behavior are predictors of adolescents' suicidal behavior. Indicators of poor parenting: child abuse and neglect, child in residential care, are also significant risk factors preceding the suicidal behavior. These results must be applied with some caution because the method of filing child abuse and neglect has changed between the two birth cohorts. Structural factors such as parental lack of vocational training, parental long-term unemployment or exposure to poverty are all associated with an increased risk of suicidal behavior among adolescents the following years. Individual resource deficits such as youth unemployment, short schooling, not graduated, somatic handicap, incarceration, psychiatric disorder, substance abuse are all precursors of suicidal behavior. Especially the girls are in a greater risk of suicidal behavior than boys – also when other risk factors are accounted for.

The increased in suicidal behavior between the two birth cohorts may be explained by increased number of adolescents exposed to poor parenting and poor parental support (more separations) together with structural factors related to the family during adolescence (parental unemployment and poverty). An increased party of the youth was exposed to incarceration psychiatric disorder and substance abuse. The increase in education and decrease in youth unemployment between the two birth cohorts were associated with a reduction in suicidal behavior but these resilient factors could not compensate for increased disadvantages.

The results point to further research in at least four prevention strategies:

1. Results call for programs that reduce the number of children exposed to disadvantaged parenting practices.
2. Strategies that focus on organizing and extend the educational system (changing the educational system's effects on self-esteem), public education campaigns, unemployment policy, and equalizing tax system.
3. Many suicides in juvenile confinements could be avoided through suicide prevention policy.
4. Substance abuse and mental disorder treatment, treatment of depressions, social support, and coping skills, could be strategies in a suicide prevention program.

The present study includes only certain prevention strategies. Many other strategies have already proven to be effective. Effective prevention strategies include for instance restricted access to firearms, restricted access to barbiturates, dextropropoxyphen, paracetamol, salicylate or domestic gas and car exhaust with high content of carbon monoxide.

Introduction

A marked increase in youth suicide rates over the last 30 years in a number of countries (United States, Great Britain and Australasia) has caused a growing research interest in risk factors examining the extent to which social, family, personal and environmental factors contribute to suicide risk in young people and adolescents (Diekstra & Garnefski, 1995; Fergusson et al., 2000). Attempted suicide is the most common cause of hospital admission in young age group (15 to 34 years), and suicide, next to accidents, is the most common cause of death in this age group (Nordentoft et al., 1993).

A variety of methods has been used to estimate influence of risk factors on the onset of young adult's suicidal behavior including autopsy studies, epidemiological studies of suicide attempts and longitudinal studies examining predictors of suicide. Although, there is cross-national variability in the prevalence of suicidal behavior, strong consistency in the characteristics and risk factors for these behaviors is also found (Nock et al., 2008). Knowledge of risk and protective factors are useful both when assessing suicide risks and in forming a national strategy for suicide prevention, goals and objectives for action (Australian Institute of Family Studies, 1999; Eriksson & Bremberg, 2006; Mitchell, 2000; National Suicide Review Group (Ireland), 2005; Nordentoft, 2007; Palmer, 2007; Public Health Service, 2001; Sundhedsstyrelsen, 2004), although, it has been argued that repeated attempts to refine prediction to the extent that it would be of clinical value have failed (Goldney, 2000).

Theories about suicide can be guidance for finding risk and protective factors. But each theory has its own dead angles with inconceivable problems and questions not to be asked. Durkheim's theory about societies with low degree of social integration (anomie) or high degree of fatalism is an example of structural stressors and their effect on the individual (Durkheim, 2002; Durkheim, 1978). Durkheim studied the suicide rates in various societies or regions on the aggregated level without being concerned with the personal reasons why individual commits suicide. He didn't expect to find adequate information on the individual level to explain the variable level of suicide rates between countries (or regions).

While these theories struggle with the ecological fallacy (Robinson, 1950) - that is these characteristics of society may not be retrieved on the individual level that is the individual's sense of community, Durkheim's theories from a century ago have been of great inspiration of other theories and research in suicidal behavior (Durkheim, 1897).

Contrary to Durkheim's method the present study intend to study suicidal behavior on the individual level but including structural factors such as the individual's position within the present structure of society in order to explore if changes of society e.g. level of unemployment influence youth suicidal behavior.

Previous studies

Reviews of suicidal behavior in young people disclose adverse socio-demographic factors, disadvantage parenting during childhood, young people's exposure to stress and adversity, and psychiatric morbidity (Beautrais, 2003). For instance, previous research have shown associations between a range of socio-demographic factors (education, unemployment, income and residential changes) and risk of suicidal behavior in adolescents (Beautrais et al., 1996; Christoffersen et al., 2003a; Dubow et al., 1989; Petronis et al., 1990). Both childhood adversity

(parental separation, poor parental relationship, parental violent behavior, alcohol problems, and imprisonment, physical and sexual abuse, in care during childhood), social disadvantage and psychiatric morbidity contributed significantly to risk of serious suicide attempts (Allebeck & Allgulander, 1990; Beautrais et al., 1996; Christoffersen et al., 2003a; Fazel et al., 2008; Fergusson et al., 2000).

We will impose a structure on theories of suicidal behavior and categorize the theories into six paradigms each with its own explanation of suicidal behavior and potential relevance to prevention of suicide and attempted suicide.

1. Disadvantaged parenting: parental child rearing methods

The first paradigm focuses on parental child-rearing methods and disadvantages during the formative years as providing the background for low self-esteem, hopelessness and low degree of resilience. Some studies have been focusing on parent-child relationship and parenting to explain why some young adult have a high resilience and other have a high degree of hopelessness (Adams et al., 1994).

Traumatic circumstances during upbringing such as parental drug or alcohol abuse, family history of suicide, separation (death of a parent) and problematic parenting (and consequently placement outside the home in residential care); the low self-esteem could partly be due to abuse and neglect partly due to their feeling of failure at school manifest itself in difficulty concentrating and being bullied (Christoffersen, 1996; Egeland, 1983). According to Erikson one of the cruelest methods of suppression is the threat of isolation and exclusion of the comradeship among the children (Erikson, 1965; Erikson, 1977). Psychological maltreatment from the parents may also be one of the factors that appears to produce the most destructive effects (Egeland & Erickson, 1987; Erickson & Egeland, 1987). It is assumed that loss of self-esteem and self-destructive behavior among adolescents might be a consequence of various forms of insulting and humiliating parental behavior which may occur relatively frequently when parents are under severe stress. The association to bully and being bullied could be strongly connected to depression symptoms and the linkage has to be explored further (Klomek et al., 2009).

A sustained pattern of verbal abuse and harassment by the parents results in damaging a child's self esteem (Garbarino, 1987). Parental emotional abuse is found in association with offspring's self-harm, eating disorders and school problems (Christoffersen & DePanfilis, 2009; Doyle, 1997).

Roberts and Hawton find that psychiatric disturbances and marital breakdown was strongly associated with the combination of child abuse and suicidal behavior (Roberts & Hawton, 1980). Lack of parental support and being verbally abused by their parents is more frequently seen among adolescents who had committed suicide (Kjelsberg et al., 1994). Although an abusive and neglectful environment may hold the key to suicidality among adolescents, we have only limited knowledge about the consequences of psychological maltreatment for adolescents' suicidal behavior. A retrospective Danish study showed an increase in suicidal ideation and suicide attempts in children who had been in care during adolescence and still higher risks if they had been battered, neglected or sexually abused (Christoffersen, 1994; Christoffersen, 1996). A series of studies has found associations between histories of sexual abuse during childhood and the risk of suicidal behavior among young people (Beautrais, 2000; Brodsky & Brent, 2008; Christoffersen, 1994; de Wilde et al., 1992; Fergusson et al., 2000; Fergusson & Lynskey, 1996; Garnefski et al., 1992; Garnefski & Diekstra, 1997; Ystgaard et al., 2004).

The literature yields a generally consistent account of childhood and family adversity as a risk factor for suicide and attempted suicide (Beautrais, 2000). Suicidal children experienced significantly greater amount of stress, chaotic and disruptive family events which resulted in losses and separations from important people (Cohen-Sandler et al., 1982). In general, exposure to childhood adversity such as poor parent-child attachment, psychological maltreatment, physical and sexual abuse and neglect making independent contributions to risk of suicidal behavior. The young people who had attempted suicide had experienced more turmoil in their families. A number of major life events including separation of parents, a change of caretaker, change in living condition, change of residence and repeating a class during the preceding year has been found to be a precursor of increased risk of attempted suicide in adolescents (de Wilde et al., 1992).

In terms of suicide reduction, the focus is on early developmental prevention, for instance child rearing methods (Cohn & Daro, 1987) and the necessity of implementation of anti-bullying programs in schools and kindergartens (McElearney & Stephenson, 2008; Tattum, 1990). In particular, programs that reduce the number of children exposed to disadvantaged parenting practices (Beautrais et al., 1996). Since parental alcohol abuse is associated to problematic parenting, the paradigm gives also rise to national programs targeting the alcohol consumption in the population. Some researchers argue, that early interventions targeted towards disadvantaged children have much higher returns than later interventions (Heckman, 2006).

2. Structural factors relating to the family during adolescence

The second paradigm focuses on the structural level of for example unemployment, poverty since parental disadvantaged position in society are often seen as precursors of abuse and neglect (Garbarino, 1992; Krishnan & Morrison, 1995). In Denmark suicides among adolescents aged 15 to 19 years have been related to parental unemployment (Christoffersen et al., 2003a; Krarup, 1988; Sommer, 1987; Vange, 1986). The levels of unemployment, the educational level in the population, or the degree of polarization between rich and poor people are factors that are obvious beyond immediate control of the family, although the individual parent will blame himself/herself for being unemployed, poor or marginalized (Sennett & Cobb, 1972).

Parental low socioeconomic status (SES), poverty and educational under achievement were most at risk for offspring's suicidal behavior (Andrews & Lewinsohn, 1992; Beautrais et al., 1998c; Bucca & Fele, 1994; Dubow et al., 1989; Fergusson, 1995; Fergusson et al., 2000; Gould et al., 1996). It is not fully understood whether there is a causal link between unemployment and suicidal behavior, and it is suggested that the association between unemployment and suicidal behavior reflects other correlated factors that contribute to risks of both unemployment and suicidal behavior. Psychiatric disorder could both increase risk of suicidal behavior and increase the risk of unemployment according to the 'healthy worker selection' processes (Agerbo, 2005; Beautrais et al., 1998b; Li & Sung, 1999; McMichael, 1976; Sheikh, 2000).

In suicide preventions strategies focus is on changing these structural risk factors e.g. organize and extend the educational system, public education campaigns, equalizing tax system, or unemployment policy.

3. The geographical segregation paradigm – norms and values in community

The third paradigm links suicidal behavior with characteristics of the local community and only to a lesser extent to individual characteristics (Durkheim, 1978; Durkheim, 2002). Social control is exercised via the community and the internalization of the norms and values. According to the theory, a society with low degree of integration tends to have a relatively high frequency of suicides according to the theory (Bille-Brahe, 2000). First and second generation immigrants may be influenced by other norms and values that are protecting against suicidal behavior, while certain cultural and religious beliefs that suicide is a noble solution of a personal dilemma (Hjern & Allebeck, 2002; Public Health Service, 2001).

On the one hand, exposure to suicide does not result in an increased risk of suicidal behavior among friends and acquaintances, but it has a relatively long impact in terms of increased incidence of depression, anxiety, and PTSD (Brent et al., 1996). On the other hand, this paradigm emphasizes how media can play an active role in the prevention of suicide owing to the fact that how media report on suicide cases can influence other suicides (Cheng et al., 2007; Schmidtke & Häfner, 1989; Schmidtke & Häfner, 1988; Schmidtke & Schaller, 2002; Schmidtke & Schaller, 2000).

In terms of suicide reductions this paradigm emphasizes community prevention, a perspective oriented toward social control and integration, together with a focus on media's influence on norms and values, instead of aiming at changing the motivation and predispositions of individuals in high risk groups.

4. Individual resource deficits

The fourth paradigm explain suicidal behavior by their present individual resources, e.g. lack of education, poverty, substance abuse (alcohol or drug abuse), severe somatic disease, mental illness, ongoing or previous psychiatric treatment, homeless, prisoners, institutionalized persons, and long-term unemployment (Agerbo, 2003; Beautrais et al., 1998a; Brønnum-Hansen et al., 2005; Christoffersen et al., 2003a; Fazel et al., 2008; Harris, 1997; Nordentoft & Wandall-Holm, 2003; Qin et al., 2006; Stenager & Stenager, 2000).

For teenagers school problems (e.g. failed a grade, suspended from school, dropped out of school, neither work nor school/college) is found to be a significant risk factor for youth suicidal behaviour (Gould et al., 1996). Non intact families, poor communication with the father, or father trouble with the police also is associated with increased risk of suicidal behaviour (Gould et al., 1996).

There have been longstanding debates over the extent to which confounding factors that are associated with both unemployment and suicidal behavior count for the association between unemployment and suicidal behavior (Beautrais et al., 1998b; Fergusson et al., 2001; Fergusson et al., 2007). Both series analyses of aggregated data have shown correlation between unemployment and suicidal behavior e.g. (Kimenyi & Shughart, 1986), and also individual-level studies have been documented the association between youth unemployment and suicidal behavior, consistently. The interpretation of these findings have been questioned and it has been suggested that the presence of other disadvantageous features may have increased the risk of unemployment and also increased the risk of suicidal behavior (Beautrais et al., 1998b; Beautrais, 2003; Fergusson et al., 2001).

In a longitudinal birth cohort study in 87,000 individuals followed until their 27th birthday, risk of suicide attempts was found to increase after *long-term youth unemployment* (more than 21 weeks during a calendar year) when adjusted for other confounding factors (Christoffersen et al.,

2003a). These results were confirmed in a recent review of socio-economic adversity contribution to development of suicidal behavior. Within exception of unemployment, no linkage was found between macro-social and macro-economic factors and suicide (Collings & Beautrais, 2005). This was again confirmed in a longitudinal study after adjustment of confounders, young people exposed to *six or more months of unemployment* had 1.4 to 1.7 higher risk of suicidal behavior than those not exposed to unemployment (Fergusson et al., 2007). Still, further research must disentangle influence from parental unemployment, from youth unemployment in order to find the familial pathways to early onset suicide attempts and suicides.

Family history of suicide, psychiatric disorder, and substance abuse has been identified as risk factors for suicide and attempted suicide in adolescents and young adults (Agerbo et al., 2002; Donovan, 1999; Egeland, 1985; Kjoller & Helweg-Larsen, 2000; Klerman, 1987; Linkowski, 1985; Mann, 1987; Mitterauer, 1990; Shafii, 1985). A Danish study among 15 to 24 year old student who had experienced suicide in the family had a risk of committing suicide that was three times as high as other students (Jessen et al., 1996a).

Mental health problems are generally the most significant risk factor together with exposure to adverse life events associated with the onset of suicidal behavior. Studies of young people making suicide attempt or dying by suicide show consistently higher rates of psychiatric disorders (Beautrais et al., 1996; Brent, 1995; Fergusson et al., 2000; Garrison et al., 1991). Virtually all mental disorders (except mental retardation and dementia) have an increased risk of suicide (Harris, 1997).

An association between substance abuse and dependence and suicidal behavior has also been found for young people. In a review Annette Beautrais finds that the strongest risk factors for youth suicide are mental disorder in particular, affective disorder and substance use (Beautrais, 2000). Psychiatric problems is often seen together with alcohol or drug abuse, antisocial behavior and learning difficulties in association with suicidal behavior. Marttunen and colleagues characterize most adolescent suicides as endpoint of long-term difficulties, and argue that all suicidal tendencies among adolescents should be taken seriously (Allebeck & Allgulander, 1990; Andrews & Lewinsohn, 1992; Beautrais et al., 1996; Brent, 1995; Bukstein, 1993; Christoffersen et al., 2003a; Fergusson, 1995; Lesage et al., 1994; Marttunen, 1991; Marttunen & Lonnqvist, 1992; Shaffer et al., 1988).

Compared to mental illness, completed suicide and suicide attempts in connection with somatic disorder have received less attention and consequently the knowledge is sparse. In general it is found that patients with somatic disorder had an increased risk of suicidal behavior (e.g. cancer, neurological diseases multiple sclerosis, stroke, spinal cord lesions, epilepsy, heart and lung diseases, rheumatologic diseases). An increased risk is well known in elderly people and a Danish study found that severe impairment or chronic disease is a risk factor in adolescents and young adults (Brønnum-Hansen et al., 2005; Christoffersen et al., 2003a; Stenager, 1996; Stenager & Stenager, 2000).

Until now there has not been any comparable Danish national research conducted regarding the extent of juvenile suicide in confinements, although the problem has caused great concern in other countries (Alessi et al., 1984; Mace, 1997; Memory, 1989; Rohde et al., 1997). Suicides is the leading cause of death in jails and suicide rate in prison is estimated to be 40 percent greater than that of the general population (Hayes, 1988; Hayes, 1997). In accordance with other studies, a Danish study found an increased risk of suicidal behavior in adolescents and young adults who had been imprisoned, even when other known risk factors were taken into account (Christoffersen et al., 2003a). In Denmark, persons taken into custody are sometimes held in

solitary confinement, even if this is known to increase the risk of psychiatric disorders and suicidal behavior sometimes being observed (Andersen et al., 2000; Sestoft et al., 1998). The most important risk factor in prisoners being occupation of a single cell (Fazel et al., 2008).

A combination of vulnerable individuals in hostile surroundings may also increase the risk of suicide or suicide attempts. This is the case in many prisons where strategies for suicide prevention must include both factors external and internal to prisons. The offence may produce a level of remorse, fear or shame associated with elevated risk of suicides. Especially prisoners in prison for the first time are more liable than others to commit suicide (McHugh & Snow, 2000). Many of known risk factors for suicidal behavior in adolescents and young adults are expected to be prevalent in youth confined in juvenile facilities. Studies of juvenile suicides in custody in Denmark are impeded because experience indicate that almost all suicides can be averted with proactive jail administration (Hayes, 1988; Hayes, 2009).

Depression is the single biggest psychiatric risk factor for deaths by suicide in youths (Brent et al., 1999) and findings from pharmacoepidemiologic studies show an association between increased use of antidepressants and decline in suicide rate owing to the fact that greater detection and treatment of depression with antidepressants protects against completed suicide (Brent, 2009). Quasi-experimental studies in Sweden and Hungary showed a decrease in suicides in regions where general practitioners underwent extensive training in detection and treatment of depression, compared with control regions, even when the importance of alcoholism in suicides was unanticipated and not addressed (Rutz, 2001; Szanto et al., 2007). In spite of country variation in rates, risk factors for suicidal behavior are common in six European countries, Bernal and colleagues suggest that population prevention programs should be focused on major depression and alcohol dependence (Bernal et al., 2007).

Strategies within this paradigm will for instance be social support and coping skills, treatment of underlying psychiatric disorder, problem solving and cognitive behavioral therapy, anger management, treatment counselors to identify and intervene with alcoholics, drug and alcohol abuse treatment, changing environmental factors that encourage alcoholism e.g. increasing alcohol taxes and effective clinical care for mental, physical, and substance use disorders (Hawton & James, 2005; Murphy et al., 1992; Murphy, 1992; Public Health Service, 2001).

Suicide risk factors accumulate in some cases which call for a combined effort targeting multiple risk factors Conner and colleagues argue that suicide prevention efforts in alcoholics must include a focus on depression as well as other interpersonal factors, if they are to be successful (Bernal et al., 2007; Conner et al., 2003).

5. Situational approach and means restrictions

The fifth paradigm emphasizes the importance of the contemporary situation and opportunities as the most essential factor instead of individual background. A series of examples are illustrative of this method. The most famous example is the introduction of non-toxic domestic North Sea gas in the 1970s and in the introduction of mandatory catalytic converters was a pivotal factor when a drop in suicides was to be explained and study revealed that the reduction in suicide rates was not compensated by use of other methods (Kreitman, 1976; Nordentoft et al., 2006).

It has been shown that effective prevention strategies include for instance restricted access to hanging in psychiatric wards or prisons, restricted access to non-secured high places fencing bridges, restricted access to top of buildings, restricted access to firearms, restricted access to

barbiturates, dextropropoxyphen, paracetamol³, salicylate or domestic gas and car exhaust with high content of carbon monoxide (Brent, 2001; Brent et al., 1991; Brent et al., 1988; Brent et al., 1999; Hawton et al., 1996; Hawton et al., 2001; Lester, 1998; Nordentoft, 2007).

6. Genetic and biological factors

The previous risk-factor domains are not fully exclusive, for example are personality traits, genetics, biological factors not included in the first five paradigms. The presence of a family history of suicidal behavior is found to be a predictor of suicidal behavior in young people (Brent et al., 1999; Gould et al., 1996). This could reflect more general propensities of inheritance of psychiatric disorder, or genetic factors that may act to predispose suicidal behavior. Numerous abnormalities have been found in the serotonergic system in suicide attempters and completers. Twins studies and research attempts has been carried out to identify marker genes for suicidality for instance those involving serotonergic system (Beautrais, 2003; Mann et al., 2001).

Blumenthal and Kupfer (1988) argue that in early detection and treatment strategies these biological risk factors should be incorporated in connection with psychiatric diagnoses, psychosocial factors, life events, and chronic medical illness (Blumenthal & Kupfer, 1988).

In the present study we will try to take most of the known risk factors into account, but only few, if any studies, embrace all six paradigms in the attempt to make comparisons and find the most influential risk factors.

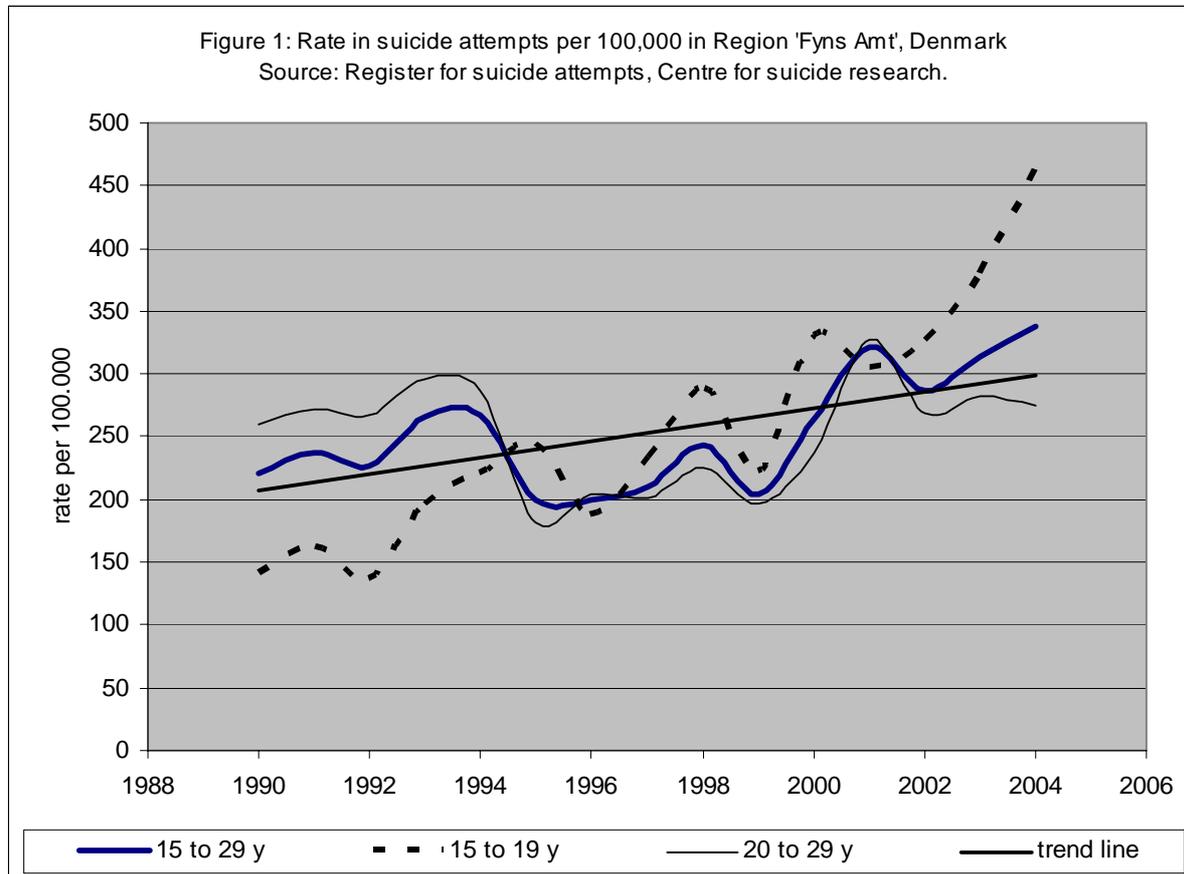
Since the present study is based on register data collected through the last 25 years on individual basis for the 1966 birth cohort and the 1980 birth cohort; it was possible to include information primarily from the first four paradigms in the list above, and consequently we will mainly make comparisons between risk factors within these paradigms. The intention is to explore if the paradigms and their accompanying risk factors have ability to explain early onset of suicidal behavior.

The development of suicidal behavior

Diekstra and Garnefski konklude that the present generations of adolescents and adults worldwide are a greater risk of developing suicidal reactions than the previous generation were (Diekstra & Garnefski, 1995). A possible way of explaining fluctuation in rates of suicide and suicide attempts could include analysis of risk factors from all the mentioned paradigms. Hawton and James (2005) suggest that the substantial rising suicide rates in 15-24 year old young men in some countries could be explained from the following risk factors: increased rates of family breakdown, increasing rates of substance misuse, increasing rate of depression, instability of employment, availability of means for suicide, media influence and awareness of suicidal behavior in other young people (Hawton & James, 2005). On the other hand, Gould conclude that the dramatic increase in youth suicide during the past three decades seems unlikely to be attributable to the increase in divorce rates (Gould, 1998).

³ It is known that there is a narrow margin between therapeutic effect and toxic effect for both dextropropoxyphen and paracetamol i.e. the therapeutic ratio is relatively large. The therapeutic ratio is a comparison of the amount of a therapeutic agent that causes the therapeutic effect to the amount that causes toxic effects.

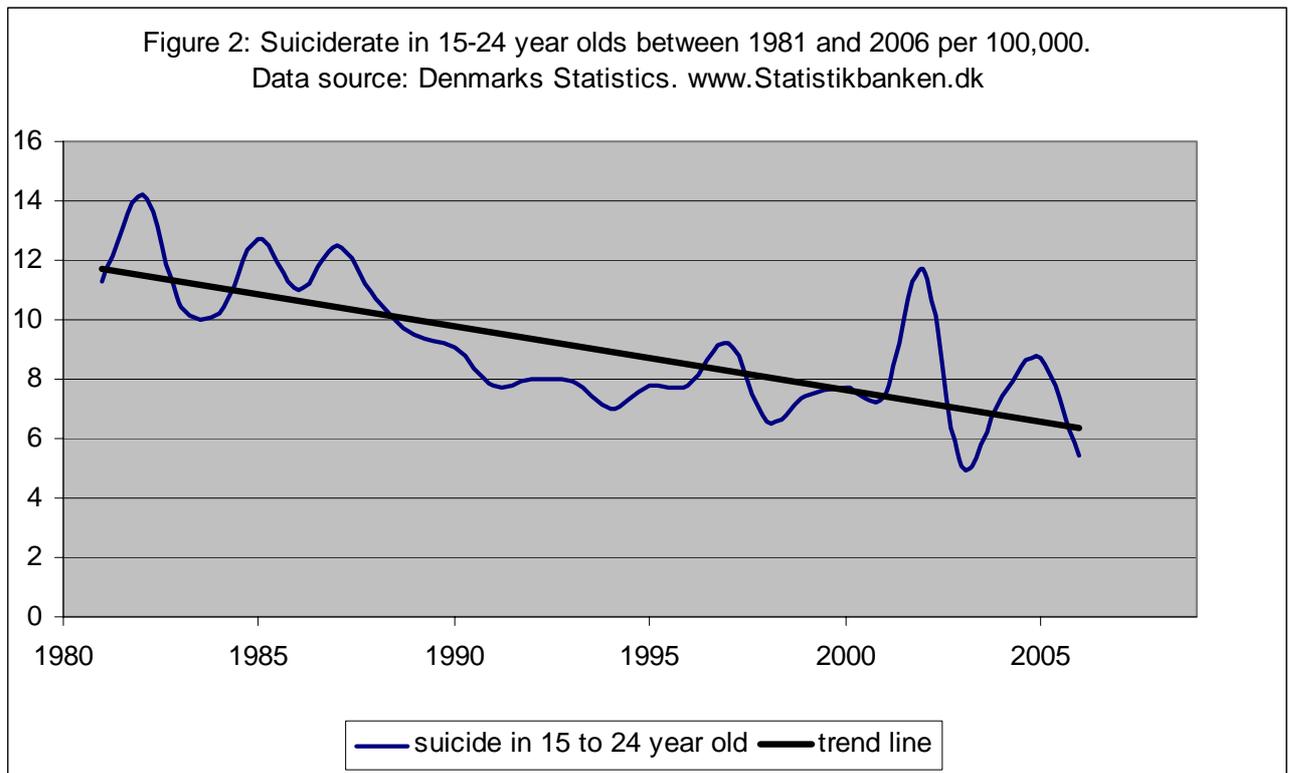
Diekstra and Garnefski identify five possible causal mechanisms: 1) increase in the prevalence of depressive disorder 2) increase in prevalence of substance abuse disorder 3) lowering the age of puberty 4) increase in the number of social stressors for youth 5) changes in attitudes towards suicidal behavior (Diekstra & Garnefski, 1995).



There is no published annual nationwide statistics on suicide attempts in Denmark, only statistics from a single region in Denmark 'Fyns Amt' as a part of the World Health Organization/EURO Multicentre Project on Parasuicide (Hulten et al., 2001; Schmidtke et al., 1996). The rate of youth suicide attempts has been monitored during 1990 to 2004 in 'Fyns Amt' and disclosed an increasing trend. The estimated mean rate increases from 200 per 100,000 persons to 300 per 100,000 persons in the age group 15 to 29 years (Figure 1). The statistics also include second time and third time attempts as well as following attempts.

A marked increase in youth suicide rates has been observed in a number of countries. The estimated mean suicide rate of adolescents (aged 15 to 19) has quadrupled from 2.7 per 100,000 persons in 1950 to 10.8 per 100,000 persons in 1992 (Hayes, 2000). A similar trend has not been found in Denmark. The estimated suicide rate in adolescents (aged 10 to 19) has decreased from 5 per 100,000 persons in 1950 to 3 per 100,000 persons in 1992 (Christoffersen, 2001; (Statistics Denmark, 09)).

Figure 2 reflects annual statistics on suicides according to the nationwide death causal register in Denmark. While suicide attempts in adolescents and young adults increased by about 50 percent during the year span from 1990 to 2004 (Figure 1), quite an opposite trend is registered for suicides. The estimated suicide rate for 15 to 24 years olds has decreased during the years 1981 to 2006 from 12 to 6 per 100,000.



In a longitudinal register study it is argued that the general population in Denmark has experienced positive changes in risk factors over the past 20 years and these changes might have contributed to the decline of suicide rate in the general population. The positive changes are reduced availability of lethal suicide means, better somatic and psychiatric treatment of suicide attempts, increased social and cultural stability in society and more focus on prevention are all preventive factors that is suggested as explanations for the declining suicide rate (Qin et al., 2006).

The present paper focus on the early onset suicide behavior defined as first time suicide attempts or completed suicide and in this context suicide attempts will count for most of the cases. It is a mere hazards that some suicide attempts develop into completed suicides while some of the completed suicides were only completed by misfortune and could as well instead have been a sole attempt. Many attempters make only one attempt and they have no certain knowledge whether the chosen method is fatal or not. The knowledge we gain from studying first suicide attempts as well as early suicides could be useful when formulation of an action plan to prevent the early onset of suicidal behavior.

From Figure 1 and 2 it is obvious that Denmark show the same increasing trend in suicidal behavior for teenagers and young adults as is found in other European countries. Since rates of

attempted suicide and suicide rates in young adults covariates, the recent increase in attempted suicide could herald a further increase in suicide rates according to WHO/EURO Multicentre Study of Parasuicide (Arensman, 2008; Hawton et al., 1998). However, the most recent studies do not support these assumptions. The average suicide rate for males in the age group 15-24 was 11.0 per 100,000 in 15 countries combined. Most of the countries have shown a downward trend since 2000 (Värnik et al., 2009).

Studies of suicides in adolescents face specific methodological problems because it is particularly difficult to distinguish between accidents and deliberate self-inflicted harm in adolescents. Moreover, inter country comparisons have been difficult because of variations in methods of recording. Finally, estimating the early onset of suicidal behavior has methodological difficulties, separately; and Danish researchers argue that suicides in adolescents is underrepresented in statistics or at least subject to uncertainty (Bille-Brahe, 1997).

Data and statistical methods

The history of individuals or group's history can be analyzed as series of life-events. When you leave school, graduate, marry, and start a family, become a pensioner, and eventually die. Sociologists try to predict, and explain these events (Allison, 1982). Why had some groups of people tried drugs why others haven't? Why had some tried to kill themselves as adolescents or young adults, before they even had started their adult life?

We have chosen to focus on the first suicide attempt or completed suicide because it has been found that attempted suicide is the best predictor of future suicide (Hulten et al., 2001). Deliberate self-harm has been chosen as one of the outcome measures in order to get more information about incidence that only by chance has not developed into completed suicide. In order to gain knowledge of the living condition of the teenagers and young adults, we focus on the previous years before the suicide attempt or completed suicide and compare with their contemporaries of their own age.

A series of studies based on interview with high school students disclosed a large variance in numbers of suicide attempts, mainly because the answers were particularly sensitive to how the questions were formulated, and secondarily because of variations in attrition bias or selection bias. Incidence of suicide attempts varied from 2 percent to 15 percent in the age group 14 to 20 years (Bjerke et al., 1992; Jessen et al., 1996a; Jessen et al., 1996b; Mishara, 1976; Mocicki, 1989; Widmer, 1979). None of the mentioned studies include information of medical treatment or hospital admission as a result of the suicide attempt. Meehan and colleagues has estimated the rate between self reported suicide attempts and attempts resulting in hospital admission as ten to one. They conclude that self-reported attempted suicide provides little information concerning the seriousness of the attempt (Meehan et al., 1992).

The present study address only severe suicide attempts which lead to hospital admissions. In these cases, the completed suicide and suicide attempts involved an assessment from a third party who is a medical expert with no prior knowledge of the persons or their families. Consequently, only severe suicide attempts will be included and many suicide attempts which receive no medical attention will be lacking from the register based data base.

Outcome measurements of suicidal behavior: First time suicide attempts and completed suicides.

	Outcome factor: suicidal behaviour
Attempted suicide	Self-inflicted harm according to hospitals admissions. The definition of suicide attempts also included behavior that conformed to the following three conditions: (i) Suicide attempts that had led to hospitalization, (ii) assessment of the trauma being an act of self-mutilation according to the international statistical classification of injuries when discharged from hospital, (iii) the trauma had to be included in a specified list of traumas traditionally connected with suicide attempts: cutting in wrist (carpus), firearm wounds, hanging, self-poisoning with drugs, pesticide, cleaning fluids, alcohol or carbon monoxide. Included is also intentional self-harm according to hospitals admissions in a psychiatric ward.
Suicide	Suicide according to the Causes of Death Register.

Risk is as a probability for an event (or outcome) within a specified population. In the present study the outcome is first time suicide attempt or suicide. The outcome is binary – either it occurs or it does not occur. To make the terminology simple, we use the term risk also when the outcome could be considered positive. We then define a risk factor (beta) as a correlate that is shown to precede the outcome of interest according to Kraemer and colleagues (Kraemer & Lowe, 2005).

A statistical model has been developed with purpose of exploring these types of life-events. The statistical model is the discrete-time Cox model developed by Allison (1982). It has demonstrated its usefulness when studying other demographic event histories (Arjas & Kangas, 1992; Breslow, 1992; Christoffersen et al., 2007; Hoem & Hoem, 1992).

We want to know in what way life have been different for the adolescents and young adults who commit suicide or make a suicide attempt. Our purpose is to gain some knowledge on the onset of suicidal behavior. All children born in 1966 or 1980 are followed from 15 to 24 years. We will compare the situation for the adolescents with suicidal behavior with their contemporaries who haven't made any such attempts. The controls (years at risk) were constructed by members of the total birth cohort who have not experienced the event in focus i.e. committed a suicide or suicide attempt. Subject were excluded from the case group and the controls after the first attempt or if they had died or emigrated. Pooling all non-event years of all individuals, the controls were made up of all the non censored person-years (Allison, 1982).

Information selected from the population-based registers used in the Danish cohort study.

Population statistics	gender, age, marital status, address	1980-2005
Population and Housing Census	self-owner, rented housing	1980-2005
Immigrants	nationality of parents, native country	1980-2005
Medical register on vital statistics	cause of death, suicide	1979-2005
Employment statistics	branch of trade, unemployment	1980-2005
Education statistics	grades, vocational training	1981-2005
Social assistance act statistics	children in care, preventive care	1977-2005
Labour Market Statistics	occupation, unemployment	1985-2005
Crime statistics	violation, adjudication, imprisonment	1980-2005
Income compensation benefits	social benefit, duration	1984-2005
Income statistics tax register	income	1980-2005
Fertility Database	no. of siblings, parity, link to parents	1980-2005
National inpatient register	ICD-8/10 diagnoses (somatic)	1977-2005
National psychiatric register	ICD-8/10 diagnoses (psychiatric)	1979-2005

When we use the general population samples as a control group we have a good standard of reference and it also provides the possibility of generalizing the results to all the adolescents; however, we can only generalize to the birth cohort born in 1966 and 1980, since the relevant risk factors may have changed in the following years.

The nationwide registers used were the following: Population Statistics, Medical Register on Vital Statistics, Causes of Death Register, Population and Housing Census, Unemployment Statistics, Education Statistics, Social Assistance Act Statistics, Income Compensation Benefits, Labour Market Research, Fertility Research, Criminal Statistic Register, National Patient Register, Danish Psychiatric Nationwide Case Register and Medical Birth Register. Personal identity numbers were initially used to link information for each individual born in 1966 or born in 1980 together with the information about their parents. Later, the personal identity numbers were erased from the database for security and ethical reasons.

The collected data has two attributes of particular interest:

- 1) Data are registered prospectively that is information gathered in calendar year 't+1' has no influence what so ever on data filed in calendar year 't'.
- 2) Data are collected independently from series of agencies viz. agency A is ignorant of previous register data filled in by agency B.

The available event history data contains information on events that fell within a calendar year during 1980 until January 2006. Individuals' event history is broken up into a set of discrete time units (age group 15, 16, 17 ...24) in which an event either did or did not occur⁴. The data is analysed solely for suicide or suicide attempt. Each individual is observed until time t , at which point an event occurs or the observation is censored either because it was outside the age limits, because of death, or the individual is lost for observation for other reasons. Consequently, individuals were excluded from the case group and controls after the first event. Pooling the non-censored years of all individuals, the person-years made up the controls. The controls (years at risk) were constructed by the total birth cohort of 87,008 and 58,724 persons, respectively⁵. The number of non-censored person-years varies depending on the event in focus and the birth cohort.⁶ The analysis is carried out for the compiled person-years.

We assume that time takes only positive integer values ($t=15,16,17,\dots,24$) and we examine n independent individuals ($i=1,2,3,\dots,n$) while the observed explanatory variables x_{it} may take on different values at different discrete times. Only lagged values of explanatory variables are included.

P_{it} is the conditional probability that an event occurs at time: age t , given that it has not already occurred. α_t is a set of constants for each age group. This logistic regression function

⁴ When the discrete time unit is a calendar year, it is difficult to use continuous-time methods, since more than one individual experience an event in the same time interval. We will therefore apply a discrete-time model, which treats each individual's history as a set of independent observations. Earlier findings show that the maximum likelihood estimator can be obtained by treating all the time units for all individuals as though they were independent, when studying *first-time* events (Allison, 1982; Clayton & Hills, 1993; Rothman & Greenland, 1998).

⁵ The study includes only children born 1966 or 1980 who were present according to registers first of January 1980 or 1994, respectively.

⁶ The numbers at risk were $N=862,343$ and $N=579,602$ person-years, when analyzing birth cohort 1966 and birth cohort 1980, respectively.

specifies how the hazard rate depends on time and the explanatory variables⁷ can be written in logit form (Allison, 1982):

$$\log \frac{P_{it}}{1 - P_{it}} = \alpha_i + \beta x_{it} + \delta C_{80} + \varphi C_{80} x_{it}$$

Treatment of all teenagers and young adolescents as a coherent group may seem problematic, because the age group 14 to 16 is expected to experience a much different position compared to 23 to 25 year old persons. Therefore a dummy variable for each age group under observation is created to estimate the parameters (alpha). Each age group will have their own initial level (α_i). Thus, a kind of age-standardisation is incorporated into the model.

The 1966 birth cohort and the 1980 birth cohort are analysed together in order to test any significant differences between the two birth cohort which have lived in the period 1981-1990 and 1995-2004, respectively, when the birth cohorts were 15 to 24 years old. But differences between the two birth cohorts may occur. Though, a variable is introduced in order to capture these differences. C_{80} is a dummy variable equal to 0 if a person is born 1966, and equal to 1 if a person is born in 1980. This variable will be used to test the overall differences between the two birth cohorts. The interaction between the risk factors and the birth-cohort is captured in the product $\varphi C_{80} x_{it}$, which gives additional information if the variables from the 1980 birth cohort add any significant extra information explaining the outcome. This term will be used to test if any of the risk factors had undergone a change between the two birth cohorts.

Maximum likelihood estimators for the regression models are then calculated on the basis of pooling all the time units over all individuals.⁸

Diagram illustrating the varying impact of the three different types of risk factors.

Age of case:	Type	15	16	17	18	19	20	21	22	23	24
Suicide attempt or suicide (out-come)		0	0	0	0	0	0	1			
Unemployment > 21 weeks (Type I risk factor)	I	0	0	0	1	0	0	0			
poverty (<40% of median income)	II	0	0	0	1	1	1	1			
Parental unemployment (Type II risk factor)	II	0	1	1	1	1	1	1			
Substance abuse of a parent (Type III risk factor)	III	1	1	1	1	1	1	1			

Source: (Christoffersen et al., 2003b).

⁷ The risk factor or the explanatory variables (beta) are defined in Appendix.

⁸ The log-likelihood function L of the data may thus be written as

$$\log L = \sum_{i=1}^N \sum_{j=1}^{t_i} y_{ij} \log \left\{ \frac{P_{ij}}{1 - P_{ij}} \right\} + \sum_{i=1}^N \sum_{j=1}^{t_i} \log(1 - P_{ij})$$

while y_{it} is a dummy variable equal to 1 if a person experiences an event at time t , otherwise zero (Allison, 1982).

The controls are constituted by the person-years under risk of an event (e.g. first time suicidal behaviour viz. suicide or first time suicide attempt) in the chosen ages from fifth teen to twenty four years. The over all exposure to risk factors among adolescents and young adults is presented in Table 3 and 5 in the column labelled: ‘% of controls’ (i.e. % of non-censored person-years).

The individual risk factors are divided into three types for the purposes of the study (Diagram). Risk factors of type I identify the presence of that factor in the previous year. So, for example, the subject being unemployed more than 21 weeks when the subject was aged 18 will act as a risk factor when the subject is 19 – the following calendar year. Risk factors of type II, in contrast, act on the following year and all subsequent years, and are considered to be indicative of a change of state of the subject. So, if the subject had been in care when the subject was aged 14, then this places the subject in the “out-of-home” category from 14 onwards or the family had experienced poverty (<40 % of median income) when the child was 18 years old (Diagram). Finally, the type III risk factors are those that are taken to be indicative of a lifestyle throughout the risk period. So, a mother admitted to a hospital with an alcohol related disease is taken to be indicative of family alcohol abuse or substance abuse throughout the childhood or adolescence of the subject, and this becomes a risk factor for all years in the study period.

The purpose of the present analysis is to locate relevant risk factors and describe both the strength (odds ratio) of different risk factors and the overall exposure of risk factors. In order to evaluate the risk factors’ contribution to the number of suicides and first time suicide attempts in adolescents and young adults, attributable fractions (AF) are calculated⁹ (Greenland & Drescher, 1993; Greenland, 2008). We have additionally simulated the counterfactual reduction (CFR) of the number of suicides and suicide attempts that would have occurred if the risk factor has been eliminated. Counterfactual simulations applying estimated parameters are carried out in order to quantify how many of the total number of events are linked to a given risk factor. The principle is described in the Appendix B ((Hussain, 02)).

⁹ Attributable fractions (AF) express the reduction in incidence of suicidal behavior that would be achieved if the population had not been exposed at all, compared with the current exposure pattern, according to Greenland and Drescher (1993).

Results

The population based birth cohort study explores risks for first time suicide attempts and completed suicides. In the present study we have decided to explore suicidal behavior (serious suicide attempts or completed suicide). Although, suicide attempts in many ways differ from completed suicide, most suicide attempts have an unknown high risk of proven to be fatal and the adolescents neither have the knowledge nor ability of rational calculation of the probability of survival.

Table 1. Suicidal behavior (first time suicide attempt or suicide) in children born 1966 or 1980 followed until their 25th birthday.

Age	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1966	•	•	•	•	•	41	55	75	89	109	181	134	105	86	78
1980	7	16	18	47	60	64	75	83	113	92	110	96	87	89	54

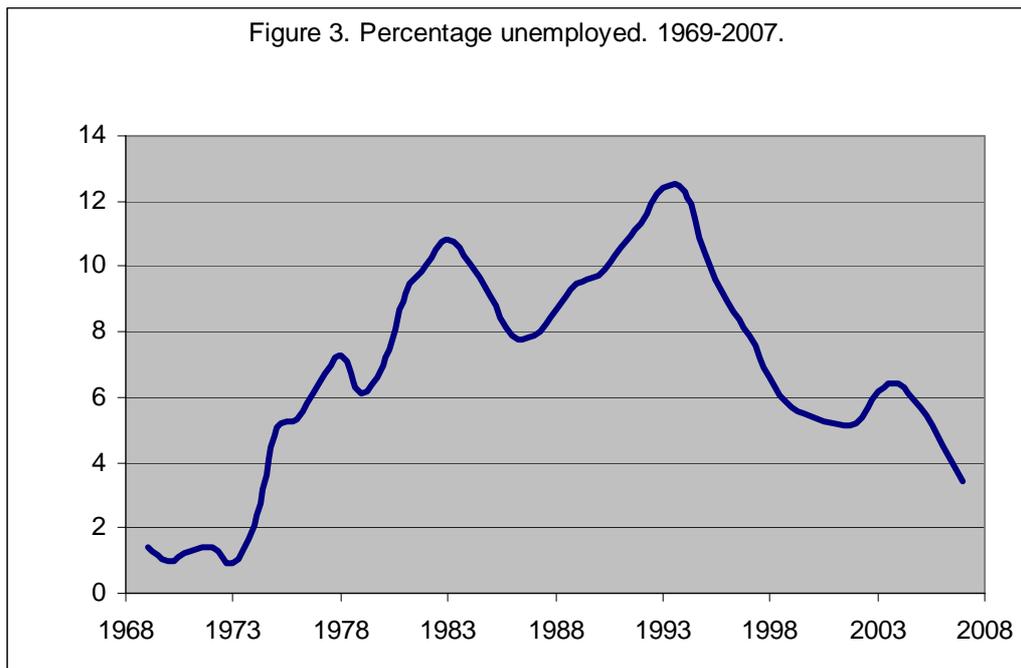
Note: Birth cohort 1980 registered for age 7: 14 cases; for age 8: 8 cases; for age 9: 5 cases. Total for birth cohort 1966 for age group 15 to 24: N=953; for birth cohort 1980: 863. The total N=1,816 for both birth cohorts. Suicides and suicide attempts for adolescents younger than 15 years were not applicable (•) for the 1966 birth cohort.

The study shows a significant increase in suicidal behavior among adolescents and young adults aged 15 to 24 years (Table 1). Children born in 1966 (N=87,008) were victims of suicide attempts or completed suicide in 11.1 per thousand while this was the case for 14.7 per thousand in children born in 1980 (N=58,724)¹⁰. The observed 30 per cent increase is mainly a result of an increase in risks of suicide attempts in teenagers during the last 15 years. The result confirms the trend observed in a single region 'Fyns Amt' (Figure 1). However, the nationwide figures do not show as large increase as the results that were observed in 'Fyns Amt', the deviation could be a result of differences in ways of statistical accounts or selection bias.

A natural experiment

The 1966 birth cohort lived through 1981 to 1990 while they were teenagers and young adults less than 25 years old. The 1980 birth cohort lived their years of youth in another period from 1995 to 2004. The comparison between the 1980 birth cohort and the 1966 birth cohort gives an opportunity to explore a natural experiment and study how unemployment influence parents' parenting and also influence children's transition from adolescence into adulthood. It is in the beginning of employment career, persons are in the most vulnerably and sensitive situation, because the newcomers are most at risk of being sacked when a crisis is imminent, but the young adults are at the same time the first to be employed in time of prosperity (Hansen, 1987a; Hansen, 1987b).

¹⁰ The study includes only children born 1966 or 1980 who were present according to registers first of January 1980 or 1994, respectively.



Source: Statistics Denmark.

The parents of the children born in 1966 had established themselves in the labor market during a period while unemployment was at a very low level but the parents of the children born in 1980 had entered the labor market when unemployment was at the highest level. For about 16 percent of the 1966 birth cohort one or both parents had experienced at least 21 weeks unemployment during a calendar year while this was observed for half of the families in the 1980 birth cohort (Table 2 and 3).

Quite the opposite picture emerges when we follow the children born in 1966. They had to enter the labor market while unemployment was at the highest level (Figure 3 and Table 2), while the children born in 1980 entered a labor market with rapidly decreasing unemployment. About 9 percent of the non-censored person years for 1966 birth cohort had experienced long term unemployment (more than 21 weeks during a calendar year). This was only the case for 3.5 percent of the birth cohort 1980.

Table 2. Long term unemployment for offspring and their parents.

Birth cohort 1966 and 1980 followed in age group 15 to 24 years. % of non-censored controls person years.

	Birth cohort 1966	Birth cohort 1980
Youth unemployment > 21 weeks (Type I)	9.2	3.5
Parental unemployment >21 weeks (Type II)	16.4	55.7

Note: Type I: youth exposed to long term unemployment the previous year. Type II: one or both parent exposed to long term unemployment at least one of the previous years.

The parents of the birth cohort born in 1980 were confronted with unemployment at a high level and their children had to establish themselves while unemployment was diminishing to a relatively low level. This natural experiment gives an opportunity to analyze whether parental unemployment while their offspring were growing up or whether youth unemployment was the most influential factor for early onset of suicidal behavior.

1. Parental child rearing methods

The result evidence the importance of child abuse and neglect during adolescence as a significant risk of later suicidal behavior, even when other risk factors were included in the analyses. Child abuse and neglect or the battered child syndrome according to hospital admissions increased the risk for later suicidal behavior (Table 3, 4 and 5). Similar findings were registered for another indicator of poor parenting (child taken into care or 'looked after children'). In the stepwise final model indicators of poor parenting (e.g. child in care) increased the risk of suicidal behavior 60 to 90 percent, especially, child abuse and neglect ('battered child syndrome') increased the risk about 200 percent (OR=2.1) in both separately and compiled for the 1980 and the 1966 birth cohort, adjusted for the other risk factors.

Fortunately, only few children are exposed to these risk factors and therefore these risk factors can only partly explain the early onset of suicidal behavior in teenagers and young adults. Attributable fractions¹¹ for the 1966 birth cohort and the 1980 birth cohort were: AF=6 to 10 percent, respectively. The long term perspective seems to be serious for the few children exposed to these risk factors. The estimated counterfactual reductions are 203 and 111 for children in care and for child abuse and neglect, respectively. Theoretically could the number of first time suicide attempts or suicides be reduced by these numbers if poor parenting could be eliminated.

Family pathway to offspring early-onset suicidal behavior is found to include parental history of suicide attempt, sexual abuse and self-reported depression (Brent et al., 2002; Brent & Mann, 2006; Melhem et al., 2007). Parental mental illness or parental suicidal behavior could both indicate a genetic disposition to predispose suicidal behavior. At the same time, these risk factors could be a strain and disadvantage in the family with less supportive parents. The present study do not have the power to disentangle these processes, but the results support previous findings that the presence of a family history of suicidal behavior or psychiatric illness is a significant precursor of adolescents' onset of suicidal behavior. Further research is needed.

A previous study of 120 suicides found an association between separation/divorces and offspring's completed suicide, but it was concluded that separation/divorces could not account for changes in youth suicide rates, because the relatively small impact of separation/divorce was diminished after accounting for parental psychopathology (Gould, 1998). Similar results were found analyzing the 1966 birth cohort (Table 3).

Contrary to these findings, results from the 1980 birth cohort indicates, that family separation or teenage motherhood lead to less resourceful parenting and in both cases the risk of early onset of offspring's suicidal behavior is significantly increased with 30 to 40 percent (OR=1.3-1.4) even when including other risk factors (e.g. parental mental illness) in the stepwise regression model for 1980 birth cohort (AF=12 percent). In the compiled model (table 5) family separations significantly increase the risk of suicidal behavior with 20 percent (OR=1.2 and CFR=153). If a

¹¹ Attributable fractions (AF) express the reduction in incidence of suicidal behavior that would be achieved if the population had not been exposed at all, compared with the current exposure pattern (Greenland & Drescher, 1993).

child is exposed to family separation the subsequent risk of suicidal behavior seemed to be constant between the two birth cohorts. The risk factor contributes to an increased number of suicidal attempts and suicide because many more adolescents are exposed to this risk factor.

2. Structural factors relation to the family during adolescence

The educational level or the level of unemployment is structural risk factor, similar to the degree of income inequality in a society. Income inequality in society has increased during the years 2002 to 2006 (Danmarks Statistik, 2009; Deding & Gerstoft, 2009) and the present study reflect this development (table 3 and table 5) where 16.7 percent of the children born in 1966 had some time during their adolescence experienced poverty (<40% of median income) while this was the case for 31 percent in children born 1980. Family poverty was associated with an increased risk of suicidal behavior among adolescents (OR=1.2 and CFR=110).

Educational qualification of the parents seems to build a protective factor against suicidal behavior, while parental unemployment increase the risk of first time suicide attempts or completed suicide in their offspring as teenagers and young adults. In the compiled model adolescents have 20 percent increased risk of suicidal behavior compared to the adolescents who were not exposed to parental long term unemployment (OR=1.2 and CFR=127).

The parents of the 1966 birth cohort were established on the labor market while employment possibilities were prosperous. The parents of the 1980 birth cohort were newly established while unemployment was at the highest level in society. Their offspring were exposed to parental unemployment during childhood to a high level. These children in this birth cohort had 30 percent higher risk of suicidal behavior than children who were not exposed to this risk factor, even when other confounding factors were included in the stepwise regression model (OR=1.3).

The families of the 1966 birth cohort were less influenced by parental unemployment because fewer families were exposed to parental unemployment. The compiled model disclosures that children, who were exposed to long-term parental unemployment, had the same risk of suicidal behavior, whichever year they were born (Table 5). There are no significant changes in the risk of suicidal behavior among adolescents exposed to parental long term unemployment, but society has changed between the two birth cohorts and more than half of the adolescents born in 1980 had been exposed to this risk factor while only 16 percent among the 1966 birth cohort had experienced parental unemployment.

Another Danish study had found that not being fully employed (unemployed or labor market marginalization) is associated with a twofold to threefold increased relative risk of death by suicide, but the association disappeared when psychiatric illness were taken into account (Agerbo, 2005). The findings in the present study show that parental disability pension also increases the risk of adolescents' suicidal behavior, but the association vanish when other risk factor (e.g. parental mental illness, parental suicidal behavior, parental unemployment) were included in the regression analyses.

3. The geographical segregation paradigm – norms and values in community

The present paper has only access to sparse information on indicators of characteristics of the local community, social control via the community, and the degree of integration. As regards the 1980 birth cohort results shows that living in a disadvantaged area seems to increase the risk of suicidal behavior, even when other risk factors were taken into account (OR=1.5). The register of

disadvantaged areas was not established for the 1966 birth cohort, but living in rented housing (not self-owner) indicate an increased risk of suicidal behavior for the 1966 birth cohort but not for 1980 birth cohort when other known risk factors were included in the regression model (OR=1.2).

Although, international comparison rates of recorded parasuicide¹² varied significantly across Europe, it is a general finding that recorded rates of parasuicides are higher for women than for men (Schmidtke et al., 1996). The present paper is dealing with suicidal behavior which includes serious suicide attempts and completed suicides and no gender differences were found for the 1966 birth cohort. An increased tendency in suicidal behavior between 1966 birth cohort and the 1980 birth cohort was partly explained by more young girls making suicide attempts (adjusted OR=1.7). In the compiled model the risk of suicidal behavior among girls had increased significantly between the two birth cohorts (table 5).

4. Individual resource deficit

While parental long term unemployment explained a large part of adolescents' suicidal behaviour for the 1980 birth cohort this was not the case for 1966 birth cohort. The opposite pattern is discovered when studying the long term youth unemployment among the adolescents in focus. The 1966 birth cohort had experienced a high level of unemployment when they were going to enter the labour market and this situation seems to have significant influence on their risk of suicidal behaviour, when other known risk factors were taken into account (OR=2.1). When the 1980 birth cohort was entering the labour market unemployment was low and falling; in consequence, the risk of suicidal behaviour was lower but still significant (OR=1.3). The compiled model discloses that the risk of suicidal behaviour among adolescents exposed to long term youth unemployment has decreased between the two birth cohorts. The reduced youth unemployment had influenced suicidal behaviour in two ways: a smaller number are exposed to this risk factor and those, who are exposed, experience a significant smaller risk.

Income inequality in society has increased between the two birth cohorts. While 8 percent of the 1966 birth cohort experienced to be relatively poor (<50% of median income), 13.8 percent of the 1980 birth cohort had this experience. While relative poverty was not correlated with suicidal behaviour in the 1966 birth cohort this was the case in the 1980 birth cohort. In the latter birth cohort, results show that the risk of subsequent suicidal behaviour was 20 percent higher than in youth who was not exposure to relative poverty (OR=1.2) in the compiled model (table 5). More young people are exposed to this risk factor and those who are exposed are showing a higher risk of suicidal behaviour.

Many more of the birth cohort in 1980 graduated than youth born in 1966 and those who graduated had a lower risk of suicidal behaviour than those who did not graduate. The risk of suicidal behaviour for the adolescents, who did not continue their education after the 9th grade, was the same.

Exposure to series of individual resource deficits such as having a severe handicap, psychiatric disorder, having a substance abuse (drug or alcohol) or being incarcerated show the same pattern. 1966 birth cohort were less exposed to these risk factors than the 1980 birth cohort.

¹² Parasuicide was defined as 'an act with non-fatal outcome, in which an individual deliberately initiates a non-habitual behaviour that, without intervention from others, will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognized therapeutic dosage, and which is aimed at realizing changes which the subject desired via the actual or expected physical consequences' (Schmidtke et al., 1996).

While these risk factors accounted for 5.6 percent of the suicidal behaviour in the 1966 birth cohort, the corresponding attributable fraction (AF) was estimated to about 10 percent of the suicidal behaviour in the 1980 birth cohort (Table 3). The risk of suicidal behaviour among adolescents who had psychiatric disorder according to hospitals admissions had decreased significantly (table 5). Many more adolescents are being treated and the results seem to be improved the outcome is that a smaller proportion of the treated adolescents attempt or commit suicide. Still the odds ratio of adolescents with psychiatric disorder were estimated to seven (OR=7.8) in the compiled model for both births cohort, but significantly lower for the 1980-birth cohort than for the 1966-birth cohort.

In the 1966 birth cohort 0.6 percent experienced mental illness and admitted to a psychiatric ward. Their risk of suicidal behaviour were estimated to 7 times higher than their contemporaries (adjusted OR=7.4). In the 1980 birth cohort 3.1 percent were treated at a psychiatric ward while their risk of suicidal behaviour were 3.1 (adjusted OR=3.1). The improvement may be a result of more and less serious psychiatric illness is treated to day than earlier and/or treatment has improved and reduced the risk of suicidal behaviour.

Conclusions

Following the 1966 and the 1980 birth cohorts in the age span 15 to 24 years reveal that risk of suicidal behavior (first time suicide attempts and suicides) had increased with 30 percent from 11.1 per thousand to 14.7 per thousand.

This increase could be explained in two different ways. Firstly, the risk factors strength (odds ratio) could have increased for one or more risk factors, and secondly, the proportion of adolescents exposed to the influential risk factors could have increased between the two birth-cohorts, and thirdly, a combination could have caused the increased trend in the suicidal behavior.

The overall differences between the two birth cohorts were tested and the result is that the strength of the risk factors (odds ratio) has been constant during the decades, at least was the δC_{80} dummy variable not significant different from zero. The interaction between the risk factors and the birth-cohort is captured in the product $\varphi C_{80} x_{it}$, and 6 interaction effects were found (table 5). This term was used to test if any of the risk factors had undergone a change between the two birth cohorts and we found that 3 risk factors showed a significant increased odds ratio while other 3 risk factors showed a decreased strength (odds ratio). These changes could not explain the increased suicidal behavior under the model.

The increase in suicidal behavior may be explained by increase number of adolescents exposed to poor parenting (child abuse and neglect, child in care), and poor parental support (more separations) together with structural factors related to the family during adolescence (e.g. parental unemployment and family poverty). These results must be applied with some caution because the method of filing child abuse and neglect has changed between the two births cohorts.

An increased part of the youth was exposed to following risk factors: poverty, being incarcerated, having mental illness and substance abuse problems. Considerable part of the increase in suicidal behavior is caused by constrains on the young girls.

The increase in education (more graduated) and the decrease in exposure to youth unemployment between the two birth cohorts was associated with a decrease in suicidal behavior. These resilient factors could not compensate for the increased disadvantages.

Intergenerational transfer of parental mental illness, suicidal behavior had not undergone any significant changes between the two birth cohorts. The number of children exposed to these factors had been on the same level in the two birth cohorts in focus.

Family background (child abuse and neglect, child in care, family separation) are associated with succeeding increased risk in suicidal behavior in youth aged 15 to 24 years. Accordingly structural factors in the family (unemployment, poverty) also play a role together with individual resource deficits.

Since parental unemployment and offspring's unemployment wasn't linked together, analyses made it possible to disentangle these risk factors. A high level of parental unemployment accounted for 14 percent of suicidal behavior in offspring. In the 1966 birth cohort a similar high level of youth unemployment accounted for 9 percent of youth suicidal behavior. The historic time with changing high or low unemployment seem to influence the risk of suicidal behavior both through parental unemployment risk and their offspring's own experiences of youth unemployment.

Discussion

In the Nordic countries youth suicide and suicide attempts is recognized as a serious public health problem. Attempted suicide is the most common cause of hospitals admission in young age group (15 to 34 years), and suicide, next to accidents, is the most common cause of death in this age group (Nordentoft et al., 1993). Altering the conditions of children's upbringing, structural factors, geographical segregation, or individual resource deficits could reduce the early onset of suicidal behavior.

In the Nordic welfare model it is an ambition to level-out inequalities and give children the same opportunities despite parental income or educational resources. The distribution of influential risk factors has undergone changes during the last 15 years. The dissolution of families, child abuse and neglect, parental unemployment, youth poverty, youth confinement and substance abuse are associated with an increased risk between the generation born in 1966 and the generation born 1980. Although, other positive influential factors improved e.g. youth education and youth employment between the two generations, an increase in suicidal behavior was observed in the age group 15 to 24 years. It is difficult to evaluate the influence from the registered number of child abuse and neglect because the method of filing child abuse and neglect has changed between the two births cohorts. These results must be applied with some caution because.

There is a generally consistent account of childhood and family adversity as risk factors for suicidal behaviour and the consistent findings that intergenerational transferences of mental illness or suicidal behaviour highlights the need for better somatic and psychiatric family treatment of suicide attempts.

Though with the reservation that some of the increased numbers of child abuse and neglect emanate from changed registration praxis, the findings that child abuse and neglect, and poor parenting are all linked to an increased risk of offspring's suicidal behaviour, calls for programs that reduce the number of children exposed to disadvantaged parenting practices for instance child rearing methods, and social support and coping skills.

Structural disadvantages may have an influence on parenting. There is strong evidence that reductions in states' welfare benefit levels increase cases of neglect, higher levels of

maltreatment and the numbers of children in out-of-home care (Paxson, 2001; Paxson & Waldfogel, 2003). Accordingly, parental unemployment as a precursor of physical abuse and maltreatment of their children is still to be found even after taking account of existing risk factors (Christoffersen, 2000; Christoffersen & DePanfilis, 2009).

Structural factors e.g. parental unemployment or the offspring's experience of growing youth unemployment, poverty and negative educational achievements are all associated to their risk of suicidal behaviour and here prevention strategies focus on organizing, extending and change the educational system's effects on self-esteem, public education campaigns, equalizing tax system, or unemployment policy.

The present study corroborates the earlier findings that suicidal behaviour in juvenile confinements is significantly higher than in their contemporaries. Although, only few young people are incarcerated, the risks of suicidal behaviour are doubled when held in confinement. Many of these suicide attempts and suicides could be avoided through a suicide prevention policy e.g. staff training, ongoing assessment, communication etc. (Hayes, 1988; Hayes, 1997).

The findings that substance abuse often in combination with depression and other mental disorders are risk factors of suicidal behaviour among young people emphasize the need for greater detection and treatment of depression with antidepressants, social support and coping skills, treatment counselors to identify and intervene with young alcoholics or drug addicts, changing environmental factors that encourage alcoholism and effective clinical care for mental disorders.

We have gone through the four paradigms and found that each of the paradigms included risk factors that independently contributed to our understanding of early onset of youth suicidal behaviour. Could there be a single common denominator for these risk factors? Clearly we can't answer this question on the basis of the present study. Future research must be activated, we can only speculate about this issue but the findings are pointing in direction of social psychological processes in the families, peer groups in combination with structural constraints and their influence on offspring's early onset of suicidal behaviour.

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Table 3. Risk factors before first time suicide attempts or suicide 15 to 24 years old persons born 1966 or 1980.

Adjusted odds ratio based on the final stepwise logistic regression model.

Risk factors included	Type	Suicide attempts or suicide 1966 birth cohort (N=953)			Suicide attempts or suicide 1980 birth cohort (N=863)		
		% of Controls Person-years	Adjusted OR	Attributable Fraction AF %	% of Controls Person-years	Adjusted OR	Attributable Fraction AF %
PARENTAL CHILD REARING METHODS							
<i>Intergenerational transfer</i>							
Parental mental illness	III	12.8	Ns		12.8	1.3	3.7
Parental suicidal behaviour	II	4.3	1.7	2.9	4.1	1.5	2.0
<i>Family background</i>							
Parental substance abuse	III	9.7	Ns		8.7	Ns	
Domestic violence	III	4.2	1.4	1.7	8.2	Ns	
Child abuse or neglect	II	0.8	2.1	0.9	5.4	2.1	5.6
Child in care ('looked after children')	II	5.7	1.9	4.9	7.0	1.6	4.0
Mother teenager	II	8.2	Ns		4.0	1.4	1.6
Family separation	II	25.0	Ns		38.6	1.3	10.4
STRUCTURAL FACTORS RELATING TO THE FAMILY DURING ADOLESCENCE							
<i>Educational qualifications of parents</i>							
Mother has no vocational qualification	I	87.5	Ns		73.8	Ns	
Father has no vocational qualification	I	85.3	Ns		78.8	Ns	
<i>Parental employment and poverty</i>							
Parental unemployment > 21 weeks	II	16.4	Ns		55.7	1.3	14.3
Poverty (<40% of median income)	II	16.7	1.3	4.8	31.0	Ns	
Parental disability pension	II	9.0	Ns		14.3	Ns	
GEOGRAPHICAL SEGREGATION							
Rented housing (not self-owner)	I	40.3	1.2	7.5	44.1	Ns	
INDIVIDUAL RESOURCE DEFICITS							
Unemployment > 21 weeks	I	9.2	2.1	9.2	3.5	1.3	1.0
Not graduated	II	68.5	1.7	31.5	57.9	2.0	36.7
Poverty (<50% of median income)	I	8.1	Ns		13.8	1.4	5.2
Incarcerated	I	0.4	2.1	0.4	1.7	1.8	1.3
Severe handicap	I	0.6	3.1	1.2	1.8	Ns	
Psychiatric disorder	II	0.6	7.4	3.7	3.1	3.1	6.1
Substance abuse	II	0.3	2.1	0.3	2.6	2.0	2.5
Being a girl	II	48.8	Ns		48.9	1.7	24.7

Note: 'Ns' stands for: 'Not significant'. * 0.05-level; ** 0.01-level; *** 0.0001-level. Type I: exposed to risk factor the previous year. Type II: exposed to risk factor at least one of the previous years. Type III: risk factor observed for at least one of the years under investigation. The total number of suicide or first time suicide attempts in 1966-birth cohort and the 1980-birth cohort is 953 and 863, respectively; the number of person-years is 862,343 and 579,602, respectively. And the total number person-years is 1,441,945.

Table 4: Risk factors before first time suicide attempts or suicide.

Unadjusted and adjusted odds ratio based on the final stepwise logistic regression model.

Risk factors included	Type	Suicide attempts or suicide 1966 birth cohort			Suicide attempts or suicide 1980 birth cohort		
		Number Suicide or first-time suicide attempts	Un- adjusted OR	Adjusted OR	Number suicide or first-time suicide attempts	Un- adjusted OR	Adjusted OR
PARENTAL CHILD REARING METHODS							
<i>Intergenerational transfer</i>							
Parental mental illness	III	204	1.9***	Ns	241	2.7***	1.3**
Parental suicidal behaviour	II	102	2.7***	1.7***	115	3.6***	1.5***
<i>Family background</i>							
Parental substance abuse	III	165	1.9***	Ns	183	2.8***	Ns
Domestic violence	III	89	2.4***	1.4**	169	2.7***	Ns
Child abuse or neglect	II	47	6.6***	2.1***	171	4.4***	2.1***
Child in care ('looked after children')	II	229	5.2***	1.9***	244	5.2***	1.6***
Mother teenager	II	109	1.4*	Ns	90	2.8***	1.4 **
Family separation	II	360	1.8***	Ns	531	2.5***	1.3***
STRUCTURAL FACTORS RELATING TO THE FAMILY DURING ADOLESCENCE							
<i>Educational qualifications of parents</i>							
Mother has vocational qualification	I	84	0.7**	Ns	137	0.5***	Ns
Father has vocational qualification	I	96	0.7**	Ns	104	0.5***	Ns
<i>Parental employment and poverty</i>							
Parental unemployment > 21 weeks	II	269	2.0***	Ns	644	2.3***	1.3**
Poverty (<40% of median income)	II	267	1.9***	1.3**	400	1.9***	Ns
Parental disability pension	II	162	2.1***	Ns	241	2.3***	Ns
GEOGRAPHICAL SEGREGATION							
Rented housing (not self-owner)	I	499	1.6***	1.2**	476	1.6***	Ns
INDIVIDUAL RESOURCE DEFICITS							
Unemployment > 21 weeks	I	290	4.3***	2.1***	94	3.4***	1.3*
Graduated	II	187	0.5***	0.6***	186	0.4***	0.5***
Poverty (<50% of median income)	I	119	1.6***	Ns	205	1.9***	1.4***
Incarcerated	I	37	10.8***	2.1***	67	5.0***	1.8***
Severe handicap	I	29	5.0***	3.1***	31	2.0***	Ns
Psychiatric disorder	II	117	24***	7.4***	159	7.2***	3.1***
Substance abuse	II	62	20.5***	2.1***	100	4.9***	2.0***
Being a boy	II	480	Ns	Ns	376	0.7***	0.6***

Note: 'Na' stands for: 'Not applicable' while 'Ns' stands for: 'Not significant'. * 0.05-level; ** 0.01-level; *** 0.0001-level. Type I: exposed to risk factor the previous year. Type II: exposed to risk factor at least one of the previous years. Type III: risk factor observed for at least one of the years under investigation. The total number of suicide or first time suicide attempts in 1966-birth cohort and the 1980-birth cohort is 953 and 863, respectively; the number of person-years is 862,343 and 579,602, respectively.

Table 5. Risk factors before first time suicide attempts or suicide 15 to 24 years old persons born 1966 or 1980. Estimations of counterfactual reductions based on the total database.

Adjusted odds ratio based on the final stepwise logistic regression model.

Suicide attempts or suicide 1966/1980 birth cohort (N=1,816)						
Risk factors included βX_{it}	Type	% of controls person- years	Adjusted OR	Counter- factual reductions* CFR	% of Controls Person- years 1966	% of Controls Person- years 1980
PARENTAL CHILD REARING METHODS						
<i>Intergenerational transfer</i>						
Parental mental illness	III	12.8	1.3	88	12.8	12.8
Parental suicidal behaviour	II	4.2	1.5	75	4.3	4.1
<i>Family background</i>						
Child abuse or neglect	II	2.6	2.1	111	0.8	5.4
Child in care ('looked after children')	II	6.3	1.8	203	5.7	7.0
Mother teenager	II	6.6	Ns		8.2	4.0
Family separation	II	30.5	1.2	153	25.0	38.6
STRUCTURAL FACTORS RELATING TO THE FAMILY DURING ADOLESCENCE						
<i>Educational qualifications of parents</i>						
Father has no vocational qualification	I	82.7	1.2	243	85.3	78.8
<i>Parental employment and poverty</i>						
Parental unemployment > 21 weeks	II	32.2	1.2	127	16.4	55.7
Poverty (<40% of median income)	II	22.4	1.2	110	16.7	31.0
GEOGRAPHICAL SEGREGATION						
Rented housing (not self-owner)	I	41.8	Ns		40.3	44.1
INDIVIDUAL RESOURCE DEFICITS						
Unemployment > 21 weeks	I	6.9	2.2	210	9.2	3.5
Not graduated	II	64.2	1.9	687	68.5	57.9
Incarcerated	I	0.9	2.0	50	0.4	1.7
Severe handicap	I	1.1	3.1	40	0.6	1.8
Psychiatric disorder	II	1.6	7.8	239	0.6	3.1
Substance abuse	II	1.2	2.0	78	0.3	2.6
Being a girl	II	48.8	1.2	129	48.8	48.9
INTERACTION EFFECTS: CHANGES FROM 1981-1990 TO 1995-2004: THE 1966- VS. THE 1980-BIRTH COHORT						
$\phi C_{80} X_{it}$						
δC_{80} Born in 1980 vs. 1966	III	40.2	Ns			
Poverty (<50% of median income)-1980	I	5.6	1.2	38		
Unemployment > 21 weeks-1980	I	1.4	0.58	+67		
Severe handicap-1980	I	0.7	0.41	+44		
Mother teenager-1980	II	1.6	1.4	26		
Psychiatric disorder-1980	II	1.2	0.38	+246		
Being a girl-1980	II	19.7	1.4	144		

Note: *) Counter factual reductions are defined in appendix B. Type I: exposed to risk factor the previous year. Type II: exposed to risk factor at least one of the previous years. Type III: risk factor observed for at least one of the years under investigation. The total number of suicide or first time suicide attempts in 1966-birth cohort and the 1980-birth cohort is 953 and 863, respectively; and the total number adolescents were 1,816. The total number of person-years is 1,441,945.

Appendix A: Risk factors and their definitions

PARENTAL CHILD REARING METHODS	
Parental mental illness	Intergenerational transfer One or both parents admitted to a psychiatric ward according to the Danish Psychiatric Nationwide Case Register.
Parental suicidal behavior	Parents' suicide attempts according to the National Patient Register and the Danish Psychiatric Nationwide Case Register or suicide according to the Causes of Death Register. Included is also intentional self-harm according to hospitals admissions.
Parental substance abuse	Family background Alcohol abuse or drug abuse (see following page)
Domestic violence	Battered adults according to hospitals admissions or parents convicted of a violent crime. Parent exposed to assault, inflicted hams undetermined intent. Victims of violence, which led to hospitalization and professional assessment of the injury being willfully inflicted by other persons. <i>Parent convicted for violence</i> : The Criminal Statistic Register includes persons convicted for violence. This category comprises a wide range of criminal behavior of various degrees of seriousness: manslaughter, grievous bodily harm, violence, coercion and threats. This category does not include accidental manslaughter in combination with traffic accidents, or rape, which belongs to the category of sexual offences.
Child abuse or neglect	(World Health Organization, 1967): Adolescents being victims of violence, abuse or neglect, which led to hospitalization and professional assessment of the injury being willfully inflicted by other persons. After 1/1 1994 (World Health Organization, 1992): maltreatment syndromes (T74 & Y07.1), negative life events (Z61), neglect and abandonment (Z62 & Y06.1).
Child in care ('looked after children')	The child is in care at home placement according to the children's acts section or the child is not living together with the parents but in an institution or in a foster home according to the population based register of social assistance to children in care.
Mother Teenager	The mother had been a teenager herself when she gave birth to a child.
Family Separation	Family dissolution includes information on all children who had experienced divorce, separation and the death of a parent before they were 18 years old. The Danish Central Population Register (CPR) includes information that connects all children to their parents whether they are married or not.
STRUCTURAL FACTORS RELATING TO THE FAMILY DURING ADOLESCENCE	
No vocational qualification (mother/ father)	Educational qualifications of parents Vocational training: All persons who have a vocational training (bricklayer, carpenter, dentist, lawyer, or teacher in a kinder garden). This does not include semi-skilled worker. Information is based on Education statistics or the educational classification module which is population-based, including schooling and educational training for the highest education achieved by the person in focus.
Parental unemployment >21 weeks	Parental employment and poverty The number of days unemployed (more than 21 weeks) during a calendar year according to registers of Income Compensation Benefits, Labor Market Research, and Unemployment Statistics. Parental unemployment for one or both parents.
Poverty	Family income was less than 40% of median income in one of the previous years. The poverty status of an individual is decided by the level of consumption possibilities which are approximated by equivalent disposable income defined as disposable income corrected for household composition and size. Here, gross income is the sum of labor earnings, asset flows, imputed value of owner occupied housing, private transfers and public transfers such as sickness benefits, unemployment insurance benefits, pensions and social assistance. Asset flows include income from rent, dividends and value of house ownership. In this study the income concept is equivalent annual household income after transfers and taxes*.
Parental disability pension	One or both parents receiving disability pension (registers of Income Compensation Benefits).

GEOGRAPHICAL SEGREGATION	
Rented housing	Disadvantaged area The house or flat is rented (not self-owner).
INDIVIDUAL RESOURCE DEFICITS	
Unemployment > 21 weeks	The number of days unemployed (more than 21 weeks) during a calendar year according to registers of Income Compensation Benefits, Labor Market Research, and Unemployment Statistics.
Not graduated	Ever been in high school (or graduated to university)
Poverty (<50% of median level)	Present family income less than 50% of median income the previous year.
Incarcerate	Imprisonment and Convicted violations of The Danish Criminal Code (Høyer et al., 1999).
Severe handicap	Adolescents and young adults who had been hospitalized within the observation period for a severe handicap or chronic disease, other than mental handicap and psychiatric disease. Diagnoses included severe diseases of a chronic nature from all organ systems. Examples could be cancers, inborn errors, birth defects, cerebral palsy, and long lasting damages after head injuries necessitating hospitalization, epilepsy and sequelae after meningitis.
Psychiatric disorder	Admitted to a psychiatric ward according to the Danish Psychiatric Nationwide Case Register (Munk-Jørgensen & Mortensen, 1997).
Substance abuse	Drug abuse or alcohol abuse (se below)
Drug abuse	Addiction or poisoning by drugs according to hospitals admissions. Mental and behavioral disorder due to use of drugs (e.g. opioids, cannabinoids, cocaine). Dependence on morphine was not included if chronic pain-giving diseases were observed, too. E.g. rheumatoid arthritis and allied conditions, displacement of intervertebral disc, vertebrogenic pain syndrome, or cancer.
Alcohol abuse	According to hospital admissions the following diagnoses were expected to be associated with long-term alcohol abuse: Alcoholic psychosis, alcoholism, oesophageal varices, cirrhosis of liver (alcoholic), chronic pancreatitis (alcoholic), delirium, accidental poisoning by alcohol. Mental and behavior disorder due to use of alcohol.

Note: * The square root of the number of family members is the applied equivalence scale, thus the elasticity of the equivalence scale with respect to household size is ½. A number of international comparisons of poverty and inequality applies scales in this range, see e.g. (Atkinson et al., 1995; Buhmann, 1988; Förster, 1994). The poverty line is 40 per cent of the current year's equivalent income median. This is calculated on the basis of a representative 3 per cent sample of the whole population. Individuals with income less than the poverty line are defined as poor. In EU publications the 60 per cent of median poverty line is utilized, so applying the 40 per cent line means that we here look at severe poverty.

Appendix B. Estimation of the counterfactual reduction (CFR) by M. Azhar Hussain¹³.

Counterfactual simulations applying estimated parameters are carried out in order to quantify how many of the total number of events are caused by a given risk factor. We use a slightly modified version of the methodology applied in Hussain ((Hussain, 02)). First a base simulation is run where each teenager i in the sample keeps her actual characteristics X_i , and then the probability of the event taking place $P(Y=1)$ is simulated. The characteristics can be divided into the risk factor of interest d_i and other characteristics X_i^* , thus $X_i = [X_i^* d_i]$. The probability is defined as

$$P(Y_i = 1) = \frac{e^{\alpha + \beta^* X_i^* + \beta_d d_i}}{1 + e^{\alpha + \beta^* X_i^* + \beta_d d_i}}$$

α is the estimated intercept term and β^* is a vector of estimated parameters representing effects of risk factors, except risk factor d_i , whose effect is represented by β_d . Then a counterfactual simulation is run where the risk factor d_i is assumed to be non-existing, thus $d_i = 0$. The probability of the event in the counterfactual case is

$$P(Y_i^* = 1) = \frac{e^{\alpha + \beta^* X_i^*}}{1 + e^{\alpha + \beta^* X_i^*}}$$

The actual (n) and counterfactual number (n^*) of events is thus

$$n = \sum_{i=1}^N P(Y_i = 1) \qquad n^* = \sum_{i=1}^N P(Y_i^* = 1)$$

where N is the sample size. The reduction in the number of events if a risk factor was eliminated is then $n - n^*$.

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