

**THE ASSOCIATION BETWEEN
SINGLE-PARENT FAMILY
BACKGROUND AND
PHYSICAL MORBIDITY,
MORTALITY, AND CRIMINAL
BEHAVIOUR IN ADULTHOOD**

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OULU 2001



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Academic Dissertation to be presented with the assent of the Faculty of Medicine, University of Oulu, for public discussion in the Väinö Pääkkönen Hall of the Department of Psychiatry, on April 20th, 2001, at 12 noon.

OULUN YLIOPISTO, OULU 2001

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Manuscript received 22 March 2001
Manuscript accepted 27 March 2001

Communicated by
Professor Hasse Karlsson
Professor Riittakerttu Kaltiala-Heino

ISBN 951-42-5941-6 (URL: <http://herkules.oulu.fi/isbn9514259416/>)

ALSO AVAILABLE IN PRINTED FORMAT
ISBN 951-42-5940-8
ISSN 0355-3221 (URL: <http://herkules.oulu.fi/issn03553221/>)

OULU UNIVERSITY PRESS
OULU 2001

Sauvola, Anu, The association between single-parent family background and physical morbidity, mortality, and criminal behaviour in adulthood

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2001

Oulu, Finland

(Manuscript received 22 March 2001)

Abstract

The proportion of single-parent families has increased in the last few decades world-wide, mostly due to high divorce rates. Also in Finland growing numbers of children spend part of their childhood in single-parent families. The aim of this study was to investigate in a longitudinal perspective, the possible long-term effects of the childhood family structure on psychological, physical and criminal outcomes of an offspring during adulthood.

A large, prospectively collected general population birth cohort (n= 11 017), the Northern Finland 1966 Birth Cohort, was used as a study population. This database provided the information on childhood family structure of cohort members with additional information of sociodemographic factors of the family and of the child. Information concerning physical and psychiatric illnesses were gathered from the Finnish Hospital Discharge Register (FHDR). Death certificates and the information from national crime registers were also obtained.

Females with a single-parent family background were more commonly hospital-treated (61.3 % vs. 56.7 %) for any physical condition than females with a two-parent family background. For males such difference in overall physical illness was not found. Both females and males from single-parent families had more commonly been hospital-treated for some diagnoses in the ICD-category of "injury and poisoning" than had other cohort members. Furthermore, females from single-parent families had also more commonly been treated due to pregnancy-related conditions such as induced abortions. During the follow-up time (16 to 28 years of age) 117 (90 males, 27 females) cohort members had died. Males with single-parent family background exhibited an increased mortality risk, especially due to suicides (OR=2.5, 95% CI 1.1-5.8, adjusted for psychiatric hospital diagnosis, parental social class).

Criminality was more common among both males and females from single-parent families compared with other cohort members. The results showed that the risk of violent offending and recidivism was increased up to 8-fold if the cohort male member had been born and raised in a single-mother family over most of his childhood. Parental divorce also doubled the risk for both violent and recidivistic offending. Non-violent offences among males were associated only with parental death and divorce. Furthermore, drunk driving was more common among both males and females with single-parent background. Males who were born into single-mother families were at the highest risk of drunk driving offences in adulthood (OR=2.4, 95% CI 1.4-4.2, adjusted for maternal age, psychiatric hospital diagnosis, parental social class).

In this study it was shown that young adults with single-parent families in childhood experienced a more stressful pathway from late adolescence to adulthood. However, most of the offspring of single-parent families did well during the follow-up time. Strategies to promote the well-being of children and adolescents in single-parent families are of prime importance for preventive health care.

Keywords: follow-up study, suicide, criminality, drunk driving, single-parent family

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Acknowledgements

This work was carried out at the Department of Psychiatry, and at the Department of Public Health Science and General Practice, University of Oulu. I wish to express my warmest gratitude to Docent Juha Moring, M.D. Ph.D., the head of the Department of Psychiatry, Oulu University Hospital, for the facilities, help and financial support for my study. My sincere thanks to Professor (emerita) Paula Rantakallio M.D. Ph.D., Department of Public Health Science and General Practice, University of Oulu, for making it possible to use the valuable data, the Northern Finland 1966 Birth Cohort, as a study material.

I am most grateful to my supervisor Professor Matti Isohanni M.D. Ph.D., for his help and support during these years. He has warmly welcomed me to the Department of Psychiatry and introduced me to interesting world of research. I also would like to thank my other supervisors Docent Pirkko Räsänen M.D. Ph.D. and Ms Leena Väisänen M.D. Ph.D., for their endless support and encouragement. Pirkko has taught me a great deal of scientific research. She has constantly inspired me to carry on with my project, also during the hardest phases of my research work.

I also would like to thank Professors Marjo-Riitta Järvelin M.D. Ph.D., and Matti Joukamaa M.D. Ph.D. for their valuable collaboration on the original publications and their useful comments at different phases of my research work. Professor Erkki Väisänen, M.D. Ph.D., I thank for encouragement during the final phases of my work and his fruitful feedback for my thesis.

I wish to express my warm gratitude to the official referees of this dissertation, Professor Riittakerttu Kaltiala-Heino, M.D. Ph.D., Tampere School of Public Health, University of Tampere, and Professor Hasse Karlsson M.D. Ph.D., Department of Psychiatry, University of Turku. They have carefully reviewed the manuscript and given valuable advise and constructive criticism.

I would also like to thank the following coworkers, Ms Taru Mäkikyrö M.D. Ph.D., Ms Outi Koskinen M.D. Ph.D., Ms Pauliina Valonen M.D., Ms Helinä Hakko, Ph.D, Mr Jari Jokelainen M. Sc., Mr Jouko Miettunen M.Sc., for the important collaboration on the original studies. My thanks to Mr Juha T. Karvonen M.D., for his constructive comments on the manuscript of my thesis. Ms Kaisa Viilo B. Sc. and Mr. Risto Ilomäki, I thank for practical help preparing my thesis. I'm most grateful to Ms Minna Lakkapää for helping me in several practical details.

My sincere gratitude to Professor Benno Meyer-Rochow who made language revisions to the original publications as well as the final version of my thesis. I thank senior lecturer Bryan Dopp, M.A. for language revision to the original paper III.

The Alli Paasikivi Foundation and The Alma and K.A. Snellman foundation have supported my research work financially, and are gratefully acknowledged for the grants. Sigrid Juselius Foundation, Theodore and Ada Stanley Foundation and the Academy of Finland are also gratefully acknowledged for their financial support to the Northern Finland 1966 Birth Cohort -project.

Special thanks to my friend Ms Tiina Kesti, M.A, for reviewing the manuscript of my thesis and for being my dearest friend for all these years. Finally, I owe my dearest thanks to my husband Petteri Hyrynkangas for his bright attitude towards life and his patient support, during these years. He never lost his belief in my ability to accomplish this work.

Oulu, March 2001

Anu Sauvola

Abbreviations

CNS	Central nervous system
DF	Degrees of freedom
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders, Third edition, revised
FHDR	Finnish Hospital Discharge Register
IQ	Intelligence Quotient
ICD	International Classification of Diseases
MPA	Minor physical abnormality
OR	Odds ratio
RH	Relative hazard
95% CI	95% confidence interval

List of original papers

This thesis is based on the following original publications, which are referred to in the text by the Roman numerals I-V.

- I Sauvola A, Mäkikyrö T, Jokelainen J, Joukamaa M, Järvelin M-R and Isohanni M. The association of single-parent family background and physical illness in adulthood: a follow-up study of the Northern Finland 1966 Birth Cohort. *Scandinavian Journal of Public Health* 2000; 28: 95-101.
- II Sauvola A, Räsänen P, Joukamaa M, Jokelainen J, Järvelin M-R and Isohanni M. Mortality of young adults in relation to single-parent family background: A prospective study of the Northern Finland 1966 Birth Cohort. *European Journal of Public Health*, in press.
- III Sauvola A, Koskinen O, Jokelainen J, Hakko H, Järvelin M-R and Räsänen P. Family type and criminal behaviour of male offspring: The Northern Finland 1966 Birth Cohort study. Submitted for publication.
- IV Koskinen O, Sauvola A, Valonen P, Hakko H, Järvelin M-R and Räsänen P. Increased risk of violent recidivism among adult males is related to single-parent family during childhood: The Northern Finland 1966 Birth Cohort Study. *Journal of Forensic Psychiatry*, in press.
- V Sauvola A, Miettunen J, Järvelin M-R and Räsänen P. An examination between single-parent family background and drunk driving in adulthood: Findings from The Northern Finland 1966 Birth Cohort. *Alcoholism: Clinical and Experimental Research* 2001; 25: 206-209.

In addition, some unpublished data (mainly concerning criminality among females) have been included in this thesis.

1. Introduction

Human development cannot be properly understood without considering the importance of family in the child's development (Lidz 1983). The family is the key social institution which nurtures many of the socialisation processes of children. The two-parent family has traditionally been assumed to offer a better environment for the children's development than a single-parent family (Winnicott 1965, Lidz 1983, Amato & Keith 1991a). It has been argued that a child models him/herself after and identifies with the parent of the same sex, but regards the parent of opposite sex as basically a "love object", whose affection and approval are sought by identifying with the parent of the same sex (Lidz 1983).

The traditional two-parent family, in which the biological parents maintain their marital union and joint custody at least until the child reaches adulthood, has become rarer in modern Western societies. In the past few decades divorce rates have increased sharply world-wide and a large number of children experience parental separation and disruption of what should be a stable family. The legislation has changed and in Finland the new marriage law came into force in 1988. The dissolution of marriage is made easy and it has become socially more acceptable to become divorced. Nowadays 50 % of all marriages are estimated to end up in divorce (Statistics Finland 1999a). It has been estimated that more than half of all the children will spend at least some period of their childhood in a single-parent family environment, mostly with custody of the mother (Hernandez 1988, Bumpass & Raley 1995). This means also that many fathers live apart from their own biological children and that more and more men live with children to whom they are "social" but not biological fathers.

Increasingly, children are born either to single mothers or into families where the parents are cohabiting but are not legally married (Bumpass 1990, Statistics Finland 1999a, 2000). In Finland, 37.2 % of all the children were born out of wedlock in the year 1998 whereas in 1966 only 4.8 % of the children were born to unmarried mother (Statistics Finland 1999a). Illegitimacy was earlier considered to be deviant and socially condemnable and thus children born with the stigma of illegitimacy had to face numerous negative attitudes (Lambert & Streather 1980). However, the liberating attitudes towards the end of the 20th century have changed the family a great deal, and today about every tenth child is born to a mother who does not live in any permanent relationship (Kartovaara 2001).

For children the disruption of family life due to parental death or divorce represents an extraordinary upheaval of normal life. It may be followed by many other stressful experiences such as residential change, deterioration in the economic situation, diminished parental availability and perhaps parental discord and increased emotional problems (Wallerstein & Blakeslee 1989, Hetherington *et al.* 1998). Altogether this may complicate the psychological maturation process and the adjustment of children in single-parent families.

In addition to the acute stress, parental divorce may have detrimental impact on the life course of the offspring up to adulthood (Amato & Keith 1991b, Wolfinger 1998). Compared with those raised in intact two-parent families, adults who had experienced a parental divorce score lower values in psychological well-being, had more behavioural problems, experienced less education, achieved a lower job status, lower standard of living, lower marital satisfaction and an increased risk of being a single-parent or suffering from poorer physical health. However, most of the children who have experienced parental divorce nevertheless do grow up into well-adjusted adults (Amato & Keith 1991b).

The immediate effects of divorce and family disruption on children are better known than the possible long-term effects of living in single-parent families. Prospective follow-up studies, with data based on the general population, on the effects of living and growing up in single-parent families are few. Earlier studies of single-parent families were mostly done within the framework of psychoanalytical, sociological and qualitative observations. The purpose of this study was to examine in a prospective study-setting the potential long-term effects of having experienced a single-parent family in childhood with regard to physical morbidity, mortality and criminal behaviour in the offspring at adulthood.

2. Review of the literature

2.1. Definition of family

Generally, family can be seen as a group of people who have biological, emotional or legal ties to each other (McDaniel *et al.* 1990). In different cultures the term “family” may mean different things and a wide variation of families, usually people of two generations and two genders are involved (Lidz 1983, Jallinoja 2000). In the 1990s the sociological literature defined family as a unit in which at least one adult and a child lived together (Tolkki-Nikkonen 1992).

The concept of family has changed from the large extended family to smaller units, the nuclear family, and nowadays to even smaller single-parent families. Family was earlier seen as an institution, but nowadays, the family is based on the intimate relationship between two adults. If the relationship is not working, the family will probably be broken (Jallinoja 2000). However, in Finland married couples account for 66 % of all families with children under 18 and therefore this conventional form of family can still be considered to prevail (Statistics Finland 2000).

2.1.1. The single-parent family

The concept of the single-parent family is used when a family is formed of one custodial parent and a number of dependent children. In the past, death of a parent was more likely to disrupt families than was divorce (Amato 1994). Nowadays, a single-parent family is usually formed after parental divorce. Of all the single-parent families in Finland about 88 % are mother headed (Statistics Finland 2000). The increase of the proportion of children living only with their mothers is accounted for mainly by a rise in the proportion of children living with the divorced mother, although there has also been a dramatic rise in the proportion of children born to never-married mothers (Hernandez 1988, Bumpass 1990, Statistics Finland 1999a).

The amount and quality of contact with the non-custodial parent, usually the father, varies a great deal, some children losing the contact totally. It has been estimated that in

the United States 15 to 25 % of the non-custodial fathers maintain weekly visits even several years after the divorce (Thompson 1994). In a Finnish study it was found that most of the fathers (80 %) maintain regular visits at least monthly, but about 5 % of the children lost contact to their fathers permanently after divorce (Nieminen 1990).

2.1.2. The step-parent family

It has been estimated that most of the single parents remarry a few years after a divorce or death of a former spouse (Bumpass & Raley 1995, Piha 2000). However, in Finland the proportion of step-parent families has remained quite stable and stands now at about 8 % of all families with children (Statistics Finland 2000). A new family is formed with one parent and his/her biological children and a step-parent. Children, thus, receive a new "social parent". Sometimes both parents bring their children from the previous marriage to a new family and may even have new children together. Such families are still rare in Finland, the total being about 1% in 1998 (Statistics Finland 2000).

In studies from the United States it has become apparent that step-families have some sociodemographic differences compared with intact two-parent families. They had lower family incomes, the parents were younger and had lower levels of schooling than the parents of other families (Hernandez 1988).

2.1.3. Concept of parental loss and separation

In previous studies of the association of the psychopathology of offspring and family background, the concept of "parental loss or separation", has most often been used as an explanatory factor to predict a child's risk of psychiatric illness. Parental loss has included parental death, divorce or permanent separation, and the type of loss or reason for the single-parent family has not been clearly categorised in the earlier studies. The definition of separation is particularly problematic, ranging from permanent separation to periods of 3 months or less (Rutter 1981, Wells & Rankin 1991, Agid *et al.* 1999). The definitions of separation have not usually required that there is no contact between the child and the parent at all, it has only been stipulated that the parent is no longer living with the rest of the family. The upper age limit of the study subjects has also varied a lot, being generally 15 to 17 years of age (Agid *et al.* 1999).

Concepts of "family disruption", "childhood bereavement", "broken home", "non-intact family" and "non-standard family" have also been invoked when referring to families with only one custodial parent, be it due to divorce, separation, death, or mother never having been married (Dennehy 1966, Wadsworth 1979, Mednick & Kandel 1988, Isohanni *et al.* 1991). All of these facts may cause biases and difficulties in comparisons with the results of earlier studies.

2.2. Characteristics of divorce

The trends in cohabitation, marriage, and marital disruption are widely shared across Western industrialised societies. Evolution of our technological culture has altered the social context of family relations. Females have entered the work force, and fertility has markedly declined. Marriage as a cultural institution has reflected the changes that have taken place in our society (Bumpass 1990, Jallinoja 2000).

The trend of increasing divorce rates has virtually continued for more than 100 years (Bumpass 1990). The dramatic increase in the number of divorces since the 1950s seems now to have levelled off starting at the beginning of 1980 in the United States (Goldstein 1999). However, in Finland it seems that the trend of increasing divorce rates is still holding (Figure 1). In any event, the current level of divorce is high and it is assumable that the majority of recent first marriages will not last a life time, although a stable marriage remains the ideal (Bumpass 1990, Jallinoja 2000).

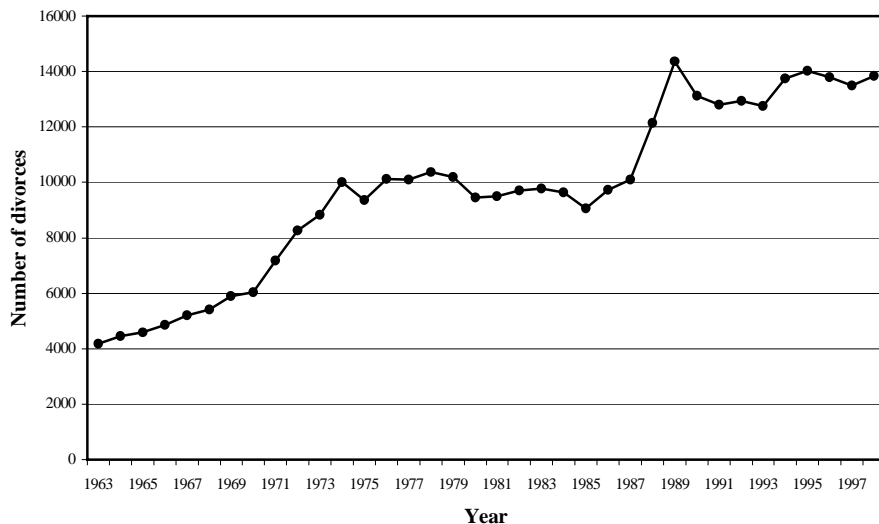


Fig. 1. The number of divorces per year in Finland (1963-1998) (Statistics Finland 1977, 1988, 1999a).

Different social circumstances, personal attributes and even genetic aspects may contribute to the risk of divorce. There is agreement across diverse studies that marital instability is associated with premarital cohabitation and pregnancy, young age at the time of marriage, economic hardship, high levels of residential mobility and growing up in a disrupted or divorced family (Wadsworth 1979, McLanahan & Bumpass 1988, McGue &

Lykken 1992, Amato 1994, Rodgers *et al.* 1997, Tucker *et al.* 1997, Tulisalo 1999). Furthermore, mental disorders, for example psychoses, depression and antisocial personality (Lahey *et al.* 1988, Kessler *et al.* 1999) as well as heavy drinking and drug use are strongly related to the higher divorce risk (Leonard & Rothbard 1999, Fu & Goldman 2000).

The vast majority of marriages ending in divorce, however, carry none of the above mentioned risk factors (McGue & Lykken 1992). It may be that an as yet unspecified personality characteristic of a parent might increase both the risk of divorce and a child's post-divorce maladjustment (Amato 1994). McGue and Lykken (1992) found in their twin-family study a significantly higher concordance for divorce among monozygotic twins compared to dizygotic twins. On the basis of this notion, they concluded that there exists a strong genetic component in the etiology of divorce, at least in the familial transmission of divorce. The researcher hypothesised that this genetic influence is mediated largely by inherited personality characteristics, such as impulsivity and moral conviction. Further they suggested that cultural factors influence the threshold for divorce while, within given culture, variations in underlying aggregate risk are strongly influenced by genetic factors.

2.3. Predictors of a child's post-divorce adjustment

Most children initially experience parental divorce as stressful and display disruptions in emotional, social and cognitive developments, but why some children continue to manifest divorce-related difficulties or develop behavioural or social problems long after the marital separation is mostly unexplained (Hetherington *et al.* 1985).

Kalter *et al.* (1989) presented six hypotheses to explain the ways how divorce may affect a child's development (Table 1). In statistical analyses the parental adjustment hypothesis received the strongest support. When the custodial parent is psychologically able to provide a loving effective parent-child relationship, children will be buffered from stresses the divorce can engender. If the custodial parent is deeply distressed by economic hardship, interparental hostility, and the role of being a single-parent without help and support, the child may be negatively affected (Kalter *et al.* 1989).

Table 1. Hypotheses explaining long-term effects of parental divorce on child development (Kalter et al. 1989).

Hypothesis	Explanation
Father absence	- the child needs a regular, ongoing, positive relationship with the father in order to develop into a well-adjusted person
Economic distress	- poverty accounts for various troubles of children of divorced single-mother families
Multiple life stresses	- an accumulation of multiple stressful circumstances (for example residential shifts, loss of job, remarriage) can cause adjustment problems
Interparental hostility	- parents who fight and blame each other stimulate anxiety and anger in their children, so that they may later copy aggression as a way of resolving problems
Parental adjustment	- a well-adjusted parent can continue to provide effective care, guidance and support for his/her children. The continuity of effective parenting is seen as facilitating a child's development into a healthy adult.
Short-term crisis	- turmoil of the initial marital disruption gradually diminishes, and a new equilibrium is achieved eventually.

Recently, Hetherington and her colleagues ended up in their review (1998) proposing five theoretical perspectives (i.e. individual vulnerability and risk; family composition; stress, including socioeconomic disadvantage; parental distress; and disrupted family process), which parallel the hypotheses of Kalter *et al.* (1989), to explain the links between divorce and a child's adjustment. They concluded that a transactional model of risks associated with marital transactions is most appropriate (Figure 2). For example, maternal depression does not necessarily have a direct effect on a child's adjustment, but instead the influence is mediated through family processes (i.e. mother's diminished ability to effective parenting). And yet, some variables moderate the relationship between other variables. Children with difficult temperaments (i.e. irresponsible, socially and psychologically immature) are expected to be more adversely effected by disruption in family life than children with easy temperaments. Thus, individual variables such as temperament can moderate the effects of the family process on a child's adjustment and well-being (Hetherington *et al.* 1998).

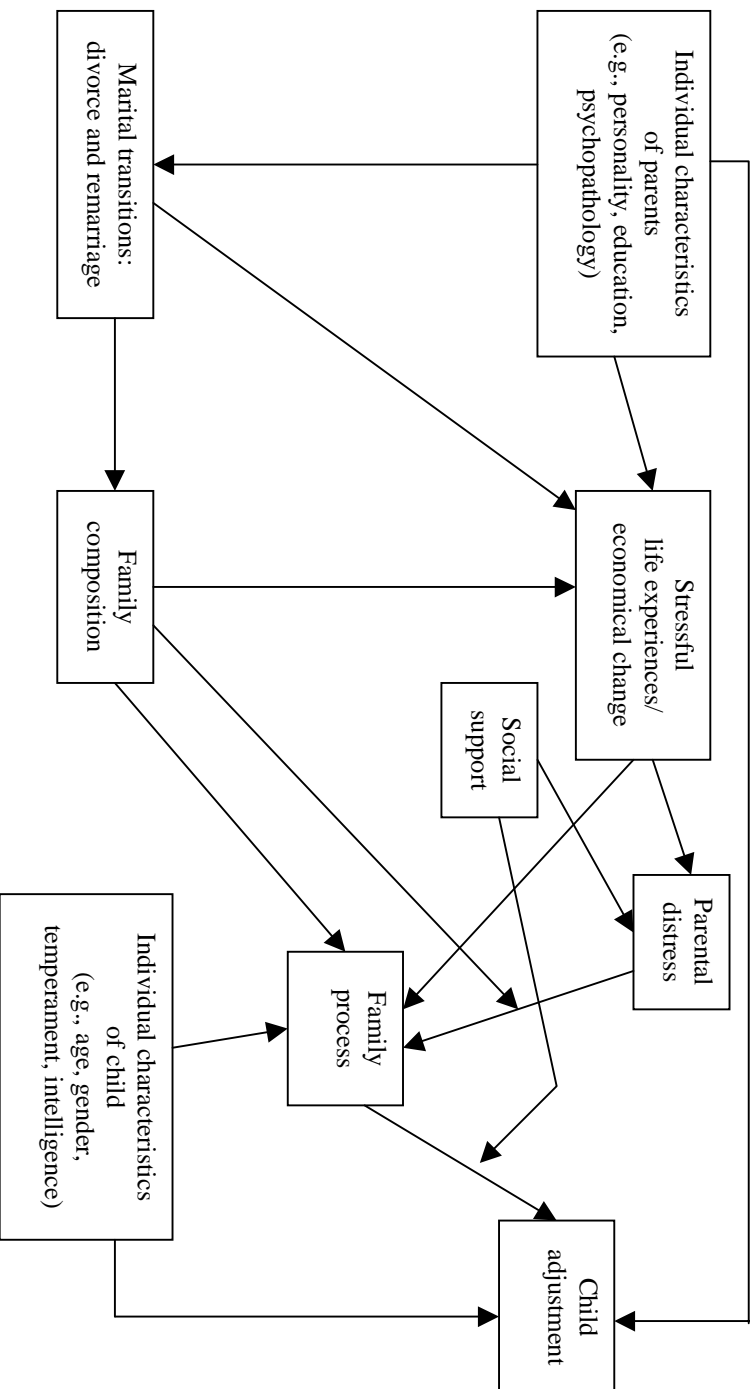


Fig. 2. A transactional model of the predictors of children's adjustment following divorce and remarriage (Hetherington *et al.* 1998).

It has been hypothesised that children whose parents later got divorced exhibited poorer adjustment even before the parental break-up (Block *et al.* 1986). Further, temperamentally difficult children might contribute to the risk of parental divorce and might also manifest psychological problems independently of the family background. This hypothesis received support from a follow-up study in which it was shown that particularly boys whose parents eventually got divorced, were more aggressive and exhibited problems with control of impulses years before the divorce. Moreover, they were seen as emotionally unstable, stubborn and restless (Block *et al.* 1986). This finding was replicated later in a large longitudinal study in the United Kingdom and the United States (Cherlin *et al.* 1991). The researchers concluded that much of the effect of parental divorce on children can be predicted by conditions (such as family difficulties, achievement levels, and behavioural problems of a child) that existed well before the break-up occurred.

2.4. Mental health problems among offspring of single-parent families

2.4.1. Mental health problems in childhood and in adolescence

Many earlier studies have pointed out the disadvantageous association between living in single-parent family and mental health problems and difficulties with adjustment in childhood (Schoettle & Cantwell 1980, Blum *et al.* 1988, Kranzler *et al.* 1990, Wadsworth *et al.* 1990, Feehan *et al.* 1995, Dunn *et al.* 1998, Luoma *et al.* 1999). The most severe adjustment and behavioural problems usually emerge during the two years following the divorce (Wallerstein & Blakeslee 1989) and the estimated negative effects of the divorce on the social adjustment are stronger for boys than for girls (Amato & Keith 1991a,b, Hetherington *et al.* 1985). However, the gender difference seems to be controversial (Amato & Keith 1991a). In conclusion, children of divorced families, on average, experience more problems and have a lower level of well-being than do children in continuously intact two-parent families (Amato & Keith 1991a).

Earlier in the Northern Finland 1966 Birth Cohort it was shown that children from single-parent families had more often psychiatric or psychosomatic disorders, such as enuresis, neurotic disorders, stuttering and conduct disorders, than other children (Moilanen & Rantakallio 1988). Especially children lacking a father throughout childhood (from birth to 14 years of age) were at high risk of child-psychiatric disorders. In another Finnish follow-up study it was found that depression was slightly more common among adolescents (from 16 to 22 years) from divorced homes when compared with adolescents from intact homes (Aro & Palosaari 1992, Tulisalo 1999).

In earlier studies it has been suggested that the negative effects in girls of parental divorce could be delayed and may emerge in adolescence and in young adulthood (Aro 1989, Wallerstein & Blakeslee 1989). Recent epidemiological studies also support the finding that emotional problems following a parental divorce may emerge after a certain delay, but affecting both genders (Chase-Lansdale *et al.* 1995, Kessler *et al.* 1997, Tulisalo 1999).

2.4.2. Mental health problems in adulthood

The possible relationship between parental loss in childhood and depression in adult life has intrigued psychiatrists since Freud's paper "Mourning and melancholia" (1957). Freud's ideas have stimulated numerous efforts to determine if there exists an association between parental loss and depression as well as other mental disorders (Dennehy 1966, Brown & Harris 1978, Roy 1981, 1985, Cederblad *et al.* 1988, Tennant 1988, Chase-Lansdale *et al.* 1995, Kendler *et al.* 1996, Agid *et al.* 1999, Draijer & Langeland 1999). Various mental health problems, depression, alcoholism and schizophrenia for example, have found to be more common among people with parental loss in childhood (Dennehy 1966, Brown & Harris 1978, Cederblad *et al.* 1988, Kendler *et al.* 1996, Agid *et al.* 1999). The findings are, however, controversial (Crook & Elliot 1980, Rodgers 1990, Furukawa *et al.* 1998, Mäkikyrö *et al.* 1998a).

In the Northern Finland 1966 Birth Cohort an elevated risk of hospital-treated non-psychotic mental disorders was found among individuals with single-parent family background (Mäkikyrö *et al.* 1998a). The risk of personality disorders was increased up to 4.8-fold (95% CI 1.9-12.5) among cohort members who lacked a father during the entire childhood (between 0 and 14 years). Parental divorce was associated with alcoholism (OR=3.7, 95% CI 1.7-8.1) and parental death with depressive disorder (OR=3.4, 95% CI 1.7-7.0). Single-parent family background was not statistically significantly associated with psychotic disorders of an offspring (Mäkikyrö *et al.* 1998a). The importance of the loss of a mother rather than the loss of a father has earlier been reported to be associated with later psychopathology (Brown *et al.* 1977, Agid *et al.* 1999). The effect of the parental loss due to permanent separation or divorce seems to be stronger on developing a major depression in adulthood than loss due to death (Rodgers 1994, Rodgers *et al.* 1997, Agid *et al.* 1999).

Recently O'Connor *et al.* (1999) concluded that parental divorce in childhood was indeed associated with depression in adulthood, but that these long-term effects of parental divorce on adult wellbeing were largely mediated by a combination of family atmosphere and life course patterns following the parental divorce. Also biological explanations, i.e. neurobiological changes in brain development due to stress in early life, have been proposed to explain the association between parental loss in childhood and vulnerability to later psychopathology (Agid *et al.* 1999).

2.5. The association of single-parent family background and physical illness

2.5.1. Physical illness in childhood and in adolescence

Several previous studies have suggested that children from single-parent families are likely to be in poorer health compared with other children (Wadsworth *et al.* 1983, Mauldon 1990, Montgomery *et al.* 1996). The risk of accidental injuries and infections, in particular, seems to be elevated among children from single-parent families (Moyes 1980,

Wadsworth *et al.* 1983, Roberts 1994, Fleming & Charlton 1998). The risk increase seems to vary from two- to over three-fold (Roberts 1994, Fleming & Charlton 1998). Low income, poor housing, lack of supervision as well as stress and insecurity of a single-parent in child rearing have been suggested as explanations of increased risk of accidents and hospitalisation of children in single-parent families (Wadsworth *et al.* 1983, Fleming & Charlton 1998).

Adolescents from single-parent families also had more somatic complaints (aches and pains, palpitations, nausea, dizziness, difficulties falling asleep, irregular bowel function, and heartburns) than other adolescents (Aro 1989, Aro & Palosaari 1992), but according to some studies the difference was apparent only for females (De Goede & Spruijt 1996). Furthermore, the risk of hospitalisation due to intoxication was found to be higher among adolescents (aged 11 to 16 years) from broken homes than adolescents from intact families (Kerfoot *et al.* 1996). On the other hand, reports do exist in which no association between family background and physical illness or hospitalisation of an offspring were noticed (Wingert *et al.* 1968, Brink & Vanderpool 1982).

2.5.2. Physical illness in adulthood

Epidemiological studies concerning the possible association between childhood family background and physical illness in adulthood are rather few in number. In a Swedish dataset of 4216 subjects, born in the years 1906-1951, information on health variables were gathered by questionnaires (Lundberg 1993). Data on living conditions during upbringing were gathered in 1968, and information on the status of health was collected in 1981, when the subjects were 30 to 75 years old. Illnesses were rated in four categories: a) being physically ill in general, b) having aches and pains, c) having circulatory illnesses or d) being mentally ill. These categories were formed on the basis of interview responses. The researchers concluded that having experienced a broken family during childhood was associated with a higher risk for both sexes of having problems with physical health in general as adults (the odds ratio varied from 1.35 general physical illness to 1.64 circulatory illness). Another Swedish follow-up study showed hospitalisation to be significantly more common among males with parental divorce in childhood compared with other males (Romelsjö *et al.* 1992). The most frequent diagnostic categories (ICD-8) were accidents, poisonings and injury, diseases of the digestive system and ill-defined conditions.

Parallel findings of an increased risk of physical illness among the adult offspring of single-parent families emerged in a recent case-control study by Agid *et al.* (1999). Subjects with early parental loss (due to parental death or permanent separation) reported statistically significantly more cases of physical illness than other subjects (45.8 % vs. 15.1 %, $p=0.01$) (Agid *et al.* 1999).

2.6. Mortality in relation to single-parent family in childhood

There is some evidence that the childhood family environment may have an effect on mortality rates throughout childhood to adulthood. Judge and Benzeval (1993) claimed that children (aged 10 to 15 years) of single-mothers had the worst mortality record of all social groups: they had a fourfold (95% CI 3.43-4.99) higher mortality risk compared with that of other children. Injuries were responsible for 60% of the deaths among the children of single-mothers. The researchers concluded that economical hardship, social and material deprivation are the key issues behind the increased mortality risk of those children (Judge & Benzeval 1993). Previously in the Northern Finland 1966 Birth Cohort it was shown that the perinatal mortality risk was increased among children of unmarried mothers (OR 1.73, $p=0.020$) (Rantakallio & Oja 1990).

Gould and her colleagues (1996) found in a psychological autopsy study that young suicide victims were about twice as likely to come from a non-intact family of origin (OR=1.9, 95% CI 1.1-3.3) than were the age-, sex-, and ethnically matched control participants. When parental psychopathology was accounted for, the association between separation and suicide somewhat diminished but did not disappear altogether (Gould *et al.* 1998). In a Finnish psychological autopsy study it was also shown that parental separation was one of the most common precipitants of suicides among adolescents between 13 to 19 years of age (Marttunen *et al.* 1993).

In the light of the earlier epidemiological studies it seems that the risk of premature mortality among the offspring of single-parent families is increased also in adulthood. In a Swedish study in which males, 18 to 20 years of age, at baseline were followed for 14 years, it was found that males with divorced parents had significantly higher mortality risks (RH 2.73, 95% CI 1.67-4.45) than other males (Romelsjö *et al.* 1992). Most of the deaths (79.0%) occurred due to accidents, poisonings or suicides. Stattin and Romelsjö (1995) pointed out that parental divorce was the most powerful predictor among five home-background related risk factors (parental chronic illness, parents' nervous disorders, parental divorce, father's heavy drinking, and low family income) of later premature mortality of young adult males.

Similar findings of an increased mortality risk of offspring with divorced parents have emerged from studies in the United States by Schwartz *et al.* (1995). These researchers followed a rather small sample of high IQ children from the year 1921 to 1991 and found that parental divorce before an offspring's 21st birthday was associated with a 44 % increase in mortality risk. Later in the same sample it was shown that there was a significant association between parental divorce and particularly death due to injury amongst males (RH 2.59, 95% CI 1.08-6.21) (Tucker *et al.* 1997). Further, a recent population-based study from the United States demonstrated that the proportion of female-headed households among the studied population (no spouse present due to any reason) was a strong predictor of premature mortality (Mansfield *et al.* 1999).

2.7. Criminal behaviour of the offspring of single-parent families

Family background of offenders has been a central topic in theories of delinquency in the 19th century (Wells & Rankin 1991). Earlier studies considered mostly juvenile delinquency, but nowadays the focus has shifted towards the more severe forms of criminality (i.e. violent criminality and recidivism) (Mednick & Kandel 1988, Raine & Mednick 1989, Raine *et al.* 1994, 1996).

2.7.1. Juvenile delinquency

Association between broken home and delinquency for both boys and girls has clearly been shown in several earlier studies (McDermott 1970, Offord *et al.* 1979, Wadsworth 1979, 1987, Hughes *et al.* 1991, Adler *et al.* 1995). Separation from a parent during the first years of life (between 0 to 4 years of age) was particularly strongly associated with severe offences (robbery, assaults) (Wadsworth 1979). Family background combined with other risk factors, such as perinatal complications, CNS impairments, substance use or psychiatric disorders, seems to be especially harmful (Hughes *et al.* 1991).

Wells and Rankin (1991) conducted a meta-analysis consisting of 50 different studies of broken homes and juvenile delinquency, which indicated that the prevalence of delinquency of offspring was 10 - 15 % higher in single-parent families than in intact families. However, the findings concerning family background and juvenile delinquency are inconsistent (Sokol-Katz *et al.* 1997).

2.7.2. Criminality in adulthood

There is some evidence that childhood family background is related to criminal offending in adulthood (Kolvin *et al.* 1988, Farrington 1995, Raine *et al.* 1994, 1996). In a British follow-up study of more than 1100 individuals, males from deprived families (i.e. marital instability, parental illness, poor domestic care, social dependency, overcrowding, poor mothering ability) had, by the age of 33, more often committed a criminal offence than other males of the same age. In addition, those who had committed their first offence before the age of 15 had more often (29.9 % vs. 9.0 %) experienced marital disruption of their parents (Kolvin *et al.* 1988).

Parallel findings have previously also emerged from the Northern Finland 1966 Birth Cohort. Males who were labelled "ill-fated" (i.e. had experienced a single-parent family in childhood, or whose parents were unemployed or received a disability pension) had committed registered crimes more often than other males (9.0% vs. 4.2%) by the age of 22 (Rantakallio *et al.* 1992a). In the Cambridge Study of Delinquent Development it was found that parental separation, as well as poor parental child-rearing behaviour and antisocial child behaviour, strongly predicted later criminality (Farrington 1995). Farrington (1995) further concluded that offending was only one element of a larger syndrome of antisocial behaviour that arose in childhood and persisted into adulthood.

Childhood family background combined with other risk factors appears to be particularly strongly associated with later criminality. Individuals (up to the age of 21) with minor physical abnormalities (MPAs) were prone to violent criminal acts when raised in unstable, non-intact families (Mednick & Kandel 1988). Furthermore, based on a Danish birth cohort of originally 4269 males followed from birth to early adulthood, it was found that family instability (unmarried mother, divorce, remarriage) together with early maternal rejection and perinatal risk factors, markedly increased the risk of an offspring to become a violent criminal (Raine *et al.* 1994, 1996). This biosocial risk group was responsible for 70 % of all crime committed in the entire sample. The criminal status was reassessed between the ages of 33 to 35 and additional support to the earlier findings was gained (Raine *et al.* 1997).

The association between repeated violent offending, i.e. violent recidivism and childhood family type, has received considerably less attention. It has been suggested that biological risk factors with adverse rearing conditions predispose individuals to violence and serious recidivistic crime (Raine & Mednick 1989). Recently it was reported that the childhood single-parent family in combination with learning disabilities was associated with repeated offending (Winter *et al.* 1997).

2.8. Single-parent family in childhood and alcohol-related problems in adulthood

2.8.1. Alcohol use in adolescence

Based on earlier observations involving the Northern Finland 1966 Birth Cohort it was noticed that drinking and having been drunk were more common among adolescents (14 years of age) with single-parent family background than other adolescents (Isohanni *et al.* 1993, 1994). The risk was especially elevated in cases of parental divorce or same-sex parental death (Isohanni *et al.* 1994). Another Finnish study also indicated that heavy drinking was twice as common among adolescents from divorced families compared with those from two-parent families (Aro 1989, Aro & Palosaari 1992).

2.8.2. Alcohol use in adulthood

According to some previous studies, particularly parental divorce seems to be related to later alcoholism amongst both men and women (Kuh & Maclean 1990, Mäkikyrö *et al.* 1998a, Wolfinger 1998). Kendler *et al.* (1996) used a twin-study to examine the association between childhood parental loss and alcoholism in women later in life. They found that parental divorce during childhood increased the risk for alcoholism in adulthood (OR=2.34, $p < 0.0001$). Furthermore they concluded that parental loss is a direct and significant environmental risk factor for the development of alcoholism in women, although the association may be partly due to genetic mechanisms.

The Swedish longitudinal Lundby-study established that men with several childhood risk factors, including parental separation, were at a higher risk of developing alcohol dependency than other males (Cederblad *et al.* 1988). In another longitudinal survey of a British birth cohort involving 17 000 individuals at the baseline (The National Child Development Study), it could be shown, however, that individuals from broken families (due to parental death or divorce) were not especially prone to heavy drinking in early adulthood up to 23 years of age (Eстаugh & Power 1991). Yet, in the same cohort mentioned above, an association between parental divorce and higher levels of alcohol consumption, heavy drinking and problem drinking (OR 1.29 to 1.90) by the age of 33 years was found (Hope *et al.* 1998). Tennant and Bernardi (1988) studied drug dependent subjects and normal controls and found that parental loss due to parental death or divorce had been more commonly experienced by alcoholics and narcotic addicts. Separation from the mother or both parents but not the from the father alone, were particularly important in the case of alcoholics.

However, the evidence of the negative consequences of parental loss on alcohol consumption in adulthood has remained unconvincing to this date. In several studies no association whatsoever between family background and high alcohol consumption in adulthood have been found (Sieber & Angst 1990, Furukawa *et al.* 1998). Although not specifically addressing the influence of early parental loss, Vaillant (1980) also found in his well-known long-term prospective study of Harvard University male students that the childhood environment could not predict a later proneness to alcoholism.

2.9. Summary of the reviewed literature

The family is the most important social institution; an institution that enables children to survive and develop into integrated, functioning persons by augmenting their inborn adaptive capacities. The traditional two-parent family has been assumed to be the ideal environment to promote healthy child development (Winnicott 1965, Lidz 1983). Family life has, however, markedly changed in the last few decades in western industrial countries. Divorce rates have increased, new family forms, such as step-parent families, have emerged and a large proportion of women decide to have children outside a permanent relationship. These changes have probably many as yet unknown, far-reaching effects on an individual level, and the society as well.

There is an enormous amount of literature on the effects of family structure on childhood, adolescent and adult psychological functioning and health (Brown & Harris 1978, Blum *et al.* 1988, Aro & Palosaari 1992, Chase-Lansdale *et al.* 1995, Dunn *et al.* 1998, Agid *et al.* 1999, Luoma *et al.* 1999, Tulisalo 1999). In the light of earlier studies it is clear that disruption of family life causes acute stress to all family members (Wallerstein & Blakeslee 1989, Hetherington *et al.* 1998) and it may also have disadvantageous long-term effects on the psychological well-being of the offspring (Kessler *et al.* 1997, O'Connor *et al.* 1999). A striking feature of the earlier research is, that it hardly focuses on adult physical health, mortality and criminality as outcomes of childhood single-parent family background. Moreover, these earlier findings are controversial (Amato & Keith 1991a,b, MacIntyre 1992). Based on some earlier studies it

can be hypothesised that living in a single-parent family in childhood may be a risk factor of developing somatic illnesses, premature mortality and criminal behaviour later in life (Wells & Rankin 1991, Romelsjö *et al.* 1992, Lundberg 1993, Farrington 1995, Raine *et al.* 1994, 1996, Tucker *et al.* 1997).

Many of the previous studies are based on restricted data samples; large epidemiological studies with general population data are almost non-existent. Another methodological limitation of the earlier studies is that categorisations of the different types of single-parent families were usually not made. In Finland there exists this far only one follow-up study which focuses on the long-term effects of parental divorce on the well-being of adolescents and young adults (Aro 1989, Aro & Palosaari 1992, Tulisalo 1999). However, the adulthood outcomes were not examined in that study design. The need for an epidemiological study of effects of the childhood family type on adult physical illness, premature mortality and criminality was the starting point of this study. By using a large general population birth cohort it was now possible to analyse various points of these associations at the epidemiological level and by using a well documented classification of different family types.

3. Aims of the present study

The purpose of the present study was to examine the association between childhood single-parent family and physical illness, mortality and criminality in adulthood by using a large, prospectively collected birth cohort.

The specific research questions are:

1. Is the childhood experience of single-parent family associated with physical illness in early adulthood? (I)
2. Are there any differences in the mortality risks among offspring of single-parent families compared with offspring from two-parent families? (II)
3. Does the single-parent family experienced in childhood have any association with later criminal behaviour? (III, IV)
4. Is the single-parent family background associated with later alcohol-related problems, namely drunk-driving? (V)

4. Material and methods

4.1. Study design: the Northern Finland 1966 Birth Cohort

The basis of this study was provided by an unselected, general population birth cohort of 12058 live births, the Northern Finland 1966 Birth Cohort, which covered 96.3 % of all children born in Northern Finland in the year 1966 (Rantakallio 1988). The original purpose of the Northern Finland 1966 Birth Cohort study was to describe and analyse the risk factors for perinatal deaths and low birth weight and the study was assembled by Professor (emerita) Paula Rantakallio. The majority of the cohort members are Finns (white Caucasians), less than 1% of the subjects being Lapps and Gypsies.

Data on the cohort members' families and personal characteristics were gathered at various ages, firstly during the pregnancy of their mothers at the antenatal clinics and at the time of birth in 1966, and then at follow-ups at various ages. Information of socio-demographic characteristics of mothers and the family such as educational level, occupation of the parents, housing conditions, social status and smoking habits of the mother was collected in the 24th to 28th gestational weeks during routine visits to the antenatal clinics. Details on the obstetric history prior to that time were also obtained. Information on the post-natal course of events was collected into forms at routine post-natal clinic visits. (Rantakallio 1969, Rantakallio 1988). Details on the collection of the data used in this thesis are presented in Figure 3.

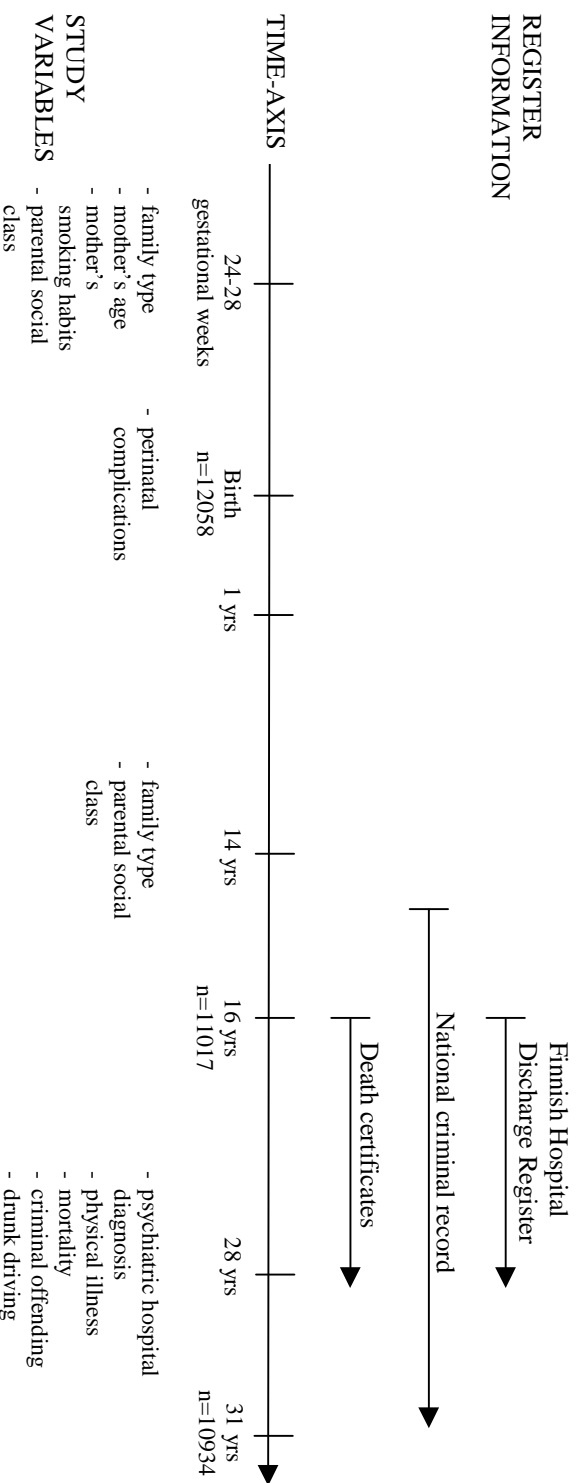


Fig. 3. The collection of data during the years 1966-1998, the Northern Finland 1966 Birth Cohort.

4.1.1. The follow-ups

The data were updated continuously from several registers, such as death registers, hospital discharge registers and criminal records. Data gathering continues to date and 3 follow-ups have been completed thus far (at ages 1, 14 and 31 years of age). The first follow-up was performed at the routine postnatal clinic visit at age 1 (1-year follow-up). Information on the growth, development and health status of the children at that time was gathered (Rantakallio 1988).

The second follow-up of the total cohort was between the end of 1980 and early 1981 (14-year follow-up). Postal questionnaires were sent out to each family to gather information on health, schooling and living habits, social situation of the family and family background variables (Rantakallio 1988, Järvelin *et al.* 1997). Since 278 of the children had died by the age of 14, the number of the cohort members alive at that time was 11780, of whom 82.9 % were still living in northern Finland; 10.7 % had moved to other parts of Finland and 6.5 % to other countries. Only 14 children had been totally lost for the follow-up by that age. Response rates on the children's and parents' inquiry was as high as 97 % (Rantakallio 1988).

The latest follow-up, the Northern Finland Health and Well-being Study, was conducted between years 1997 and 1998, when cohort members were 31 years old (31-year follow-up) (Sorri & Järvelin 1998). The response rate for the postal-questionnaire was 77 %.

The original papers I and II deal with the 11 017 individuals (5 636 males, 5 381 females) which were alive and living in Finland at the age of 16. From the original cohort 1 041 individuals were excluded due to emigration (n=757) or death (n=284) before the age of 16 (Rantakallio 1988). Original papers III, IV and V deal with 10 934 individuals (5 589 males, 5 345 females) due to the fact that some of the cohort members (n=83) refused to allow the use of their data in the 31-year follow-up.

4.2. Study variables

4.2.1. Childhood family type (I-V)

Family background was assessed by questionnaires in 1966 during mid-pregnancy and in the 1980 follow-up (Moilanen & Rantakallio 1988). Firstly, the mother was asked about her marital status during the visit at the antenatal clinic: 1) married, 2) divorced 3) widowed, or 4) never married. Secondly, at the 14 year follow-up the questionnaire was sent to the cohort member, but if he/she did not answer it was then forwarded to the custodial parent. The cohort member was asked if he/she has mother/father: 1) alive, 2) alive, but not living at home, 3) dead, or 4) unknown.

In this thesis families were divided into two- and single-parent families. For the single-parent families the following categorisation was used:

- (1) the mother was unmarried at the beginning of the study during pregnancy and remained so up to the time the child was 14 years old (n=163, 1.5 %),
- (2) the child was born to an unmarried mother who got married by the time the child was 14 years old (n=228, 2.1 %),
- (3) the mother was married at the beginning of the study during pregnancy but the mother, father or both parents had subsequently died before the child reached 14 years of age (n=707, 6.4 %),
- (4) the parents were married at the beginning of the study during pregnancy but they had become divorced or were permanently separated by the time the child was 14 years of age (n=989, 9 %) (Moilanen & Rantakallio 1988).

In the original papers I and II these subgroups were combined as one group of single-parent family background for the analyses. In the original data 18.9 % (n=2087) of the cohort members had a single-parent family background.

4.2.2. Physical illness (I)

The Finnish Hospital Discharge Register (hereafter FHDR) provided the information on all hospital-treated physical illnesses of the cohort members. The FHDR covers all mental, general and military hospitals as well as bed wards of local health centres nationwide. This register has been considered to be a reliable source of information for epidemiological research (Poikolainen 1983, Keskimäki & Aro 1991). For the present study all cohort members appearing on the FHDR at the age of 16 years or older until the end of year 1994 for any physical disease or symptom were identified. The FHDR comprises both personal and hospital identification codes as well as data on a patient's age, gender, length of the stay in hospital and main diagnosis at discharge together with 3 subsidiary diagnoses. Diagnoses are given by the attending physician. (Mäkikyrö *et al.* 1998b, Mäkikyrö 1998)

Diagnoses have been coded until the end of 1986 according to the International Classification of Diseases Eighth Revision (ICD-8) and after that from 1987 until the end

of the follow-up period 1994 according to ICD-9. All diagnoses of infectious diseases were re-categorised into a single group of infections (in detail, see Mäkikyrö 1998, Mäkikyrö *et al.* 1998b). Otherwise, the main categories of physical diseases were used as they appear in the ICD-8 and 9. Completely normal deliveries, appearing also in the FHDR, formed their own category, and were not counted as a physical illness. It was not possible to separate poisonings from the other adverse effect of drugs or other substances in the ICD-8 system, unlike the ICD-9 (Mäkikyrö 1998, Mäkikyrö *et al.* 1998b). The FHDR was also used as a source of information on mental disorders, as explained in detail later in this the thesis (page 38).

4.2.3. Mortality (II)

The information on a cohort member's death and the causes of the various deaths was collected from the Central Bureau of Statistics in Finland. The follow up period of this study was from the year 1982 up to the end of the year 1994. Death certificates were filled by the attending physician and they contain an ICD-diagnosis of the cause of death. In the cases of unexpected and sudden deaths, as well as in cases where the death is or is suspected to have been unnatural, a medico-legal investigation of the cause of death is conducted. The judgement of the cause of death is made by a medical examiner.

In the statistical analysis the deaths were categorised by the cause as: natural deaths, accidents, suicides and homicides (Table 2).

Table 2. The diagnostic codes of the causes of deaths among deceased cohort members between the age of 16 to 28 years of age.

Natural (n=25)	Unnatural (n=92)		
	Suicide (n=30)	Homicide (n=2)	Accident or trauma (n=60)
1510C, 1550A, 1918C, 2001-, 201--, 2051-, 2502B, 3039X, 324--, 3301-, 3303-, 3454X, 4309-, 4511A, 4660A, 4810A, 4859X, 4931B, 5552A, 5647A, 5901-, 6489X, 7108X, 7120-	E950A, E950D, E950F, E950H, E950I, E952A, E953A, E955A, E959A, E959B	E962B, E964B	8010-, 8030-, 8031-, 8070-, 8120-, 8540-, 8541-, 8611-, 8621-, 8640-, 8690-, 934--, 955--, 986--, 9941-, 9947-, 9948-, E800F, E801A, E801B, E801C, E801E, E801F, E802M, E810A, E849-, E890A, E893A, E901A, E910D, E912A, E9291

Among 11 017 cohort members, there were 117 deaths (90 males, 27 females) during the follow-up period from age 16 to age 28, yielding a crude mortality rate of 1.06%. This is the same as the total mortality rate in the whole of Finland (Räsänen *et al.* 1998)

4.2.4. Criminal offending (III, IV)

Data on crimes were collected from files, maintained by the Ministry of Justice, and at the time of this study available up to the end of 1998. This national register includes all criminal offences known to the police committed anywhere in Finland after the 15th birthday. The criminal record is wiped clean after every 10 years. However our original criminal data set included the years 1981-1992 and it was updated during the year 1999, covering the years 1993-1998. Thus we have complete criminal data covering the period 1981-1998.

Crimes were categorised as non-violent, violent or recidivistic violent offending. The category of violent crimes included: homicide, attempted homicide, assault, robbery, arson, sexual crime and violation of domestic peace. Severe traffic violations, crimes against property i.e. theft, fraud or treachery, disorderly conduct and illegal sale or possession of alcohol or narcotics were defined as non-violent crimes. (Tiihonen *et al.* 1997). Cohort members who had repeated registered violent crimes at least two times, were counted as recidivists.

A total of 607 (10.9 %) males and 72 (1.3 %) females had committed at least one crime during the follow-up time. Of the male criminals 34.9 % had committed at least one violent offence. Of the female criminals 12.5 % had committed violent offences. Out of the violent offenders, 46.2 % males and 44.4 % females had repeated violent offences at least two times i.e. were considered as recidivists.

4.2.5. Drunk driving (V)

To identify those cohort members who had registered drunk driving offences between 15 and 32 years of age (n = 432; 401 males, 31 females), the information from the national crime register maintained by the Ministry of Justice was used (up to the end of the year 1998). Random breath testing is used routinely and extensively in roadside surveys in Finland to control driving under the influence of alcohol. The legal alcohol limit for drivers is 50 mg/dL. Any person older than 15 years of age arrested for driving under the influence of alcohol becomes immediately registered in the national criminal register.

Those who had at least one registered drunk driving offence before the age of 21, were classified as early-onset drunk drivers. The subjects with the first drunk driving offence after 21 years of age were classified as late-onset drunk drivers. The classification of the onset age was based on the previous findings that alcoholics with early-onset age of drinking differ from the late-onset alcoholics. Early onset alcoholism is characterised by severity of problems and antisocial traits, a marker of which drunk driving may be (Johnson *et al.* 2000). Subjects with three or more registered drunk driving offences

during the follow-up time were classified as recidive drunk drivers.

4.3. Confounding variables

The confounding variables used in this thesis are presented in Table 3. More detailed descriptions of the variables are given in the following chapters.

Table 3. Confounding variables and their categorisation as used in the original papers.

Confounding variable	Original paper	Categorisation
Psychiatric hospital diagnosis	I-V	Yes/no
Maternal age	I	<27 vs. ≥27
	III-V	<20 vs. ≥20
Maternal smoking	III-IV	Yes/no
Perinatal complications*	III-IV	Yes/no
Parental social class	I,II	I,II, farmers vs. III, IV
	III-V	I-II vs. III-IV vs. farmers

* i.e. low birth weight (< 2500g), short gestation period (<37 weeks), or perinatal brain damage (low apgar score, neonatal convulsions, neonatal asphyxia, brain injury or intraventricular hemorrhage).

4.3.1. Psychological variables

4.3.1.1. Psychiatric hospital diagnosis (I-V)

Data on psychiatric hospital admissions (between 16 to 28 years of age) were collected from the Finnish Hospital Discharge Register. All diagnoses were validated for DSM-III-R criteria. The diagnoses were re-checked against clinical records by two senior researchers, who reached a consensus DSM-III-R diagnosis. Altogether 387 cases received a psychiatric diagnosis. Interrater reliability was insured in several phases, with good kappa value from 0.6 to 0.9. The validation process has been described in detail earlier (Isohanni *et al.* 1997). The diagnostic categories are presented in Table 4.

Table 4. The diagnostic categories with DSM-III-R codes of hospital-treated psychiatric disorders in the Northern Finland 1966 Birth Cohort.

Diagnostic categories	DSM-III-R code
Psychotic disorders	
Schizophrenia	295.10, 295.30, 295.90
Schizophrenia spectrum	295.40, 295.70, 297.10, 301.22
Other psychoses	291.00, 291.30, 293.00, 296.24, 296.34, 296.44, 296.70, 298.80, 298.90, 299.00, 299.80
Non-psychotic disorders	
Personality disorders	301.13, 301.50, 301.70, 301.81-301.83, 301.90
Psychoactive substance use disorders	303.90, 304.90, 305.00
Depressive disorders	296.22, 296.23, 296.31, 296.33, 300.40, 309.00, 309.28, 311.00
Anxiety disorders	300.00-300.02, 300.15, 300.23, 300.29, 300.30, 309.24
Other non-psychotic disorders	294.80, 300.90, 307.10, 307.40, 307.42, 307.60, 307.70, 309.40, 309.82, 310.10, 312.00, 312.20, 312.31, 313.81, 316.00

In this study, psychiatric hospital diagnosis was used as a confounding variable and was therefore dichotomised as “yes”, if a person had any above (Table 4) mentioned diagnosis (3.5 %) or “no”, when the study subject had no hospital-treated psychiatric disorder (96.5 %).

4.3.1.2. Maternal age (I, III-V)

The age of the mother at the time of the birth was obtained from the questionnaire filled in at the maternity clinic. In the original paper I, maternal age was dichotomised as under 27 years of age vs. 27 years of age or older (median age of the mothers 27 years, min 14 years, max 49 years). For the analysis in the original papers III, IV and V maternal age was dichotomised as under 20 years of age vs. 20 years or older (6.7 % vs. 93.3 %) since young motherhood is considered to be a putative risk factor for child’s a development and later criminality (Christ *et al.* 1990, Trad 1995, Räsänen *et al.* 1999).

4.3.2. Biological variables

4.3.2.1. Maternal smoking habits during pregnancy (III-IV)

Maternal prenatal smoking has earlier found to be associated with antisocial behaviour and criminality of offspring (Rantakallio *et al.* 1992b, Wakschlag *et al.* 1997, Brennan *et al.* 1999, Räsänen *et al.* 1999) and therefore maternal smoking was included as a confounder in statistical analyses of this study. Information on a mother's smoking habits was gathered firstly during her routine visit to the antenatal clinic in the sixth and seventh month of pregnancy. The mother was asked whether she had smoked during the last 12 months before pregnancy and whether she had changed her smoking habits in some way during the pregnancy. The amount of smoked cigarettes per day was also inquired. After delivery the mothers were again asked if they had smoked during the last 3 months of the pregnancy and if the smoking habits had changed (Rantakallio *et al.* 1992b). Maternal smoking was classified in this study as "yes" (14.6 %) if the mother smoked during the pregnancy (after the second month of the pregnancy), and "no" (85.4 %) if the mother did not smoke at all or quit before the pregnancy (Järvelin *et al.* 1997, Räsänen *et al.* 1999).

4.3.2.2. Perinatal complications (III-IV)

Previous studies have shown a link between perinatal risk factors and later criminality (Raine & Mednick 1989, Raine *et al.* 1994, 1997), but also controversial findings have been presented (Rantakallio 1992c). In this study information on the obstetric histories of the mothers and on the perinatal complications of the children were gathered by the midwives at the time of the delivery and the puerperal period from the hospital records of the maternity hospitals and paediatric units. Perinatal complications were defined to exist (7.4 %) if any of the following criteria were fulfilled: low birth weight (< 2500g), short gestation period (<37 weeks) or perinatal brain damage. Perinatal brain damage was defined as the occurrence of one or more of the following: low Apgar score (0 at 1 min, or <5 at 15 min), neonatal convulsions, neonatal asphyxia (based on blood gas analysis or clinical signs such as the need of extra oxygen or assisted ventilation), brain injury or intraventricular haemorrhage (Rantakallio *et al.* 1987, Järvelin *et al.* 1997, Jones *et al.* 1998). Children with CNS malformations, chromosomal aberration or hereditary CNS degeneration were excluded (Rantakallio *et al.* 1987).

4.3.3. Social variables

4.3.3.1. Parental social class (I-V)

Social class was determined by the father's occupation and its prestige (Sosiaaliryhmitys 1954, Rantakallio 1979, Mäkikyrö *et al.* 1997). It was assessed both in 1966 and 1980. Data recorded in 1980 were used in every paper of this study. In class I (11.4 %), the father's occupation had the highest prestige, and usually required academic education. Social class II (18.7 %) fathers were professionals with lower esteem and shorter education than those in class I. Class III (36.2 %) consisted of skilled workers. Unskilled workers and persons on a disability pension were in social class IV (21.5 %). Farmers formed social class V (12.0 %). When the father's occupational status was not known the mother's information was used.

4.4. Statistical methods

Cross-tabulation was used as a first part of data presentation and analysis. The degree of significance of the differences in the frequency tables was tested by the chi-square test or Fisher's exact test, whichever appropriate (Siegel & Castellan 1988).

Logistic regression analysis (Hosmer & Lemeshow 1989, Kleinbaum 1994) was used to predict the effect of the family background on the response (outcome) variable under study after adjusting for one or more confounding variables. The purpose of the logistic regression analysis was to demonstrate the effect of the family background on the response variable in a manner that other variables can be regarded as adjusted and standardised. The term response variable is used for measurements regarded as a main interest variable. A confounding variable is a factor that can cause or prevent the outcome of interest and is associated with the factor under investigation (Last 1995, Nieminen 1996). The final model obtained from the logistic regression analysis was reported using odds ratios (OR) - given as adjusted odds ratios - and their 95% confidence intervals (95% CI). The unadjusted odds ratios, i.e. the effect of family background on the response variable without controlling for any confounding variables, are provided in the original papers I and IV.

Table 5 shows, which response and confounding variables were used in logistic regression analyses in each of the original papers. The exact descriptions of these variables are presented in chapters 4.2 – 4.3. The confounding variables were selected based on previous knowledge of the risk factors for the response variable found in earlier the literature.

The statistical software used were the SPSS for Windows (Norusis 1994) and the SAS 6.12 for Windows (Gary 1990).

Table 5. The names of the response and confounding variables used to examine the effect of the family background in logistic regression analyses in original papers I-V.

Original paper	Response variable	Confounding variables
I	Physical illness	Psychiatric hospital diagnosis, maternal age, parental social class
II	Mortality	Psychiatric hospital diagnosis, parental social class
III	Criminality	Psychiatric hospital diagnosis, maternal age, maternal smoking during pregnancy, perinatal complications, parental social class
IV	Recidive criminality	Psychiatric hospital diagnosis, maternal age, maternal smoking during pregnancy, perinatal complications, parental social class
V	Drunk driving offence	Psychiatric hospital diagnosis, maternal age, parental social class

4.5. Ethical considerations

This study has been approved by the Ethics Committee of the Faculty of Medicine, University of Oulu on the 27th January, 1997 and on the 14th October, 1997 by the Postgraduate Research Committee of the Faculty of Medicine, University of Oulu.

Permission for gathering data for the entire Cohort was obtained from the Ministry of Social Welfare and Health Affairs in 1993. The research plan for the 31-year follow-up study design of the Cohort named the Northern Finland Health and Well-being Study (Sorri & Järvelin 1998) was under review by the Ethics Committee of the Faculty of Medicine, University of Oulu on June 17, 1996. During the 31-year follow-up, the cohort members have again been given a complete description of the study. They have an opportunity to refuse the use of their data at any point of the study, and if they do their data is excluded from the study .

5. Results

5.1. Physical illness of the cohort members with single-parent family background (I)

5.1.1. *Physical illness among males*

During the follow-up period (between 16 to 28 years of age) 68.9 % (n= 3 886) of all the male subject had been treated for at least one physical illness or complaint in a hospital ward. Of these males, 18.9 % (n= 733) had a single-parent family background. No significant differences in overall hospital-treated physical illnesses among males with single-parent families in childhood compared with males of two-parent family backgrounds were found (I: Table 1). However, males with single-parent family background had more commonly been treated for some diagnoses in the ICD-categories of “injury and poisoning“ (Table 6) and “other diseases of nervous system and sensory organs” (adj. OR 1.4, 95% CI 1.0-2.0) than males with two-parent family backgrounds. The category of the other diseases of nervous system included various disorders of the eye and the ear and disorders of the nervous system such as migraine, neuropathy or disorders of cranial nerves.

5.1.1.1. *The risk of injuries and poisonings*

The risk of fractures was about twice as high among males with a single-parent family background than in males with two-parent family background (Table 6). Other injuries were also slightly more common among males from single-parent families. The logistic regression analysis showed 2.2-fold risk of poisoning by psychotropic drugs among males with single-parent family background.

Table 6. Frequencies of hospital-treated injuries and poisoning among males with single- and two-parent family backgrounds (I: Table 1).

	Single-parent family (n=1047)		Two-parent family (n=4589)		Adjusted OR* (95% CI)
	n ^a	%	n ^a	%	
Injuries and poisonings					
Intracranial injuries	28	2.7	80	1.7	1.5 (0.9-2.3)
Poisoning by drugs	22	2.1	49	1.1	1.5 (0.9-2.6)
Poisoning by psychotropic drugs	19	1.8	27	0.6	2.2 (1.2-4.2)
Toxic effect of other substances	7	0.7	11	0.2	2.2 (0.8-5.9)
Fractures	77	7.4	202	4.4	1.7 (1.3-2.3)
Other	180	17.2	711	15.5	1.1 (1.0-1.4)

^a Number of cohort members appearing in the FHDR.

*Adjusted for psychiatric hospital diagnosis, maternal age and parental social class.

5.1.2. Physical illness among females

Of all cohort females, 57.6 % (n= 3 099) had been treated for at least one physical illness or complaint in a hospital ward (from 16 to 28 years of age). Females with single-parent family background were more commonly treated for any physical condition (normal deliveries and induced abortions excluded) than females from two-parent families of origin 61.3 % vs. 56.7 % (adj. OR 1.2, CI 1.0-1.3) (I: Table 1). They had also been more commonly treated for ICD-categories “pregnancy, childbirth and puerperium“ and “injury and poisoning“. In addition, in the subcategories of “vertebral column disorders“ (adj. OR 1.7, 95% CI 1.0-2.9), “gastrointestinal symptoms“ (adj. OR 1.3, 95% CI 1.0-1.8) and “other infections“ (adj. OR 1.2, 95% CI 1.0-1.5) females with single-parent family background were over-represented.

5.1.2.1 . The risk of injuries and poisonings

The risk of hospital-treated intracranial injuries was 2.0-fold (95% CI 1.0-3.8) among females with a single-parent family background compared to females with two-parent family background (I: Table 1). Other hospital-treated injuries (adj. OR 1.4, 95% CI 1.1-1.9) were also more common in females with a single-parent family background. Any statistically significant associations between single-parent family background and poisonings among females were not found.

5.1.2.2 Hospital admissions due to pregnancy, abortion or childbirth

During the follow-up time, 21.6 % of the females with single-parent family backgrounds had an induced abortion whereas 13.7 % of the females with two-parent family backgrounds had experienced an induced abortion in the same period of time (Table 7). Complications of pregnancy, childbirth and the puerperium as well as spontaneous abortions and normal deliveries were more common in females with single-parent family background compared with other females.

Table 7. Frequencies of pregnancy related hospital admissions among females with single- and two-parent family backgrounds (I: Table 1).

	Single-parent family (n=1040)		Two-parent family (n=4341)		Adjusted* OR (95% CI)
	n ^a	%	n ^a	%	
Pregnancy, childbirth, and puerperium					
Normal delivery	475	45.7	1837	42.3	1.1 (1.0-1.3)
Malposition and malpresentation of foetus	37	3.6	131	3.0	1.1 (0.8-1.7)
Spontaneous abortion	49	4.7	143	3.3	1.4 (1.0-2.0)
Complications of pregnancy, childbirth and the puerperium	310	29.8	1137	26.2	1.1 (1.0-1.3)
Induced abortion	225	21.6	593	13.7	1.6 (1.4-1.9)

^a Number of cohort members appearing in FHDR.

* Adjusted for psychiatric hospital diagnosis, maternal age and parental social class.

5.2. Association between childhood single-parent family and later mortality (II)

During the follow-up time (between 16 to 28 years of age), 117 cohort members (90 males, 27 females) had died (Table 8). The overall mortality rate for males was 3-fold compared to that of females ($\chi^2=31.4$, $df=1$, $p<0.0001$).

Table 8. Distribution of causes of deaths in the Northern Finland 1966 Birth Cohort (1982-1994) by gender.

Cause of death	Number of cases		n (%)	
	Total	Males	Females	
Natural	25	15 (16.7)	10 (37.0)	
Accident	60	50 (55.6)	10 (37.0)	
Suicide	30	25 (27.8)	5 (18.5)	
Homicide	2	0 (-)	2 (7.4)	
All causes	117	90 (100)	27 (100)	

5.2.1. Mortality among males

The mortality risk of males with single-parent family background was almost twice as high as was the risk of males from two-parent families (adj. OR 1.8, 95% CI 1.1-2.9). The risk of suicide was the highest among males with single-parent family background (adj. OR 2.5, 95% CI 1.1-5.8). The risk of accidental deaths (adj. OR 1.4, 95% CI 0.7-2.6) and natural deaths (adj. OR 2.4, 95% CI 0.9-7.1) was also increased, although the results did not reach statistical significance after adjusting for confounders (i.e. psychiatric hospital diagnosis, parental social class). Of all the deceased males, 32 % had a single-parent family background, while correspondingly of those males who were alive, 18 % came from single-parent families. This difference was statistically significant ($\chi^2=11.3$, $df=1$, $p=0.001$). Furthermore, of those males who committed suicide, 40 % had a single-parent family background. (II: Table 1).

Due to the small number of deaths that occurred in the cohort, we were not able to carry out statistical analyses by different types of single-parent families. Table 9 shows the frequency distributions of deaths in single-parent family subgroups.

Table 9. Number of the males by cause of death in single-parent family subgroups.

Cause of death	All time	At birth	Parental death	Parental divorce
Natural	1	1	2	2
Accident or trauma	-	2	2	9
Suicide	1	1	2	6
Homicide	-	-	-	-

5.2.2 Mortality among females

Among females, statistically significant differences of mortality risks were not found in comparisons between subjects with two- and single-parent family backgrounds. Only four (14.8 %) of the 27 deceased females had a single-parent family background, while correspondingly of those females who were alive, 18.9 % came from single-parent families (II: Table 2). Of the deceased females with a single-parent family background, three died due to natural causes and one due to accident.

5.3. Childhood single-parent family in relation to criminality in adulthood (III, IV)

Out of the 607 cohort male offenders (at least one registered criminal offence), 212 (34.9 %) were violent and 395 (65.1 %) non-violent criminals. Nearly half of the violent male offenders (n= 98, 46.2 %) had repeated violent acts. Among females, there were 72 offenders, of whom 63 (87.5 %) were non-violent criminals. Of the violent female offenders, four were recidivists. The frequency and percentage distributions of sociodemographic and clinical variables among non-violent, violent and non-criminals are shown in Table 10 for males and in Table 11 for females.

Table 10. Frequency and percentage distributions of some sociodemographic and clinical variables among male cohort members according to criminality.*

Variable	Non-violent offenders n (%)	Violent offenders		Non-criminals n (%)
		All cases n (%)	Recidivists n (%)	
Family type				
Single-parent				
All time	9 (2.3)	13 (6.1)	9 (9.2)	58 (1.2)
At birth	11 (2.8)	15 (7.1)	10 (10.2)	88 (1.8)
Parental death	35 (8.9)	22 (10.4)	7 (7.1)	296 (5.9)
Parental divorce	64 (16.2)	36 (17.0)	15 (15.3)	391 (7.8)
Two-parent	276 (69.9)	126 (59.4)	57 (58.2)	4149 (83.3)
Maternal age				
<20	39 (9.9)	32 (15.1)	17 (17.3)	310 (6.2)
≥20	353 (90.1)	180 (84.9)	81 (82.7)	4653 (93.8)
Maternal smoking				
Yes	86 (21.9)	61 (29.8)	31 (32.6)	682 (14)
No	303 (78.1)	144 (70.2)	64 (67.4)	4196 (86)
Psychiatric hospital diagnosis				
Yes	62 (15.7)	54 (25.5)	33 (33.7)	148 (3.0)
No	333 (84.3)	158 (74.5)	65 (66.3)	4834 (97.0)
Parental social class				
I, II	99 (25.1)	40 (19.0)	15 (15.5)	1565 (31.4)
III, IV	276 (69.9)	153 (72.5)	75 (77.3)	2795 (56.1)
Farmers	20 (5.1)	18 (8.5)	7 (7.2)	619 (12.4)
Perinatal complications				
Yes	24 (6.1)	18 (8.5)	12 (12.2)	353 (7.1)
No	371 (93.9)	194 (91.5)	86 (87.8)	4629 (92.9)

* Total n on which percentages are based varies due to missing data for some subjects.

*Table 11. Frequency and percentage distributions of some sociodemographic and clinical variables among female cohort members according to criminality**

Variable	Non-violent offenders n (%)	Violent offenders		Non-criminals n (%)
		All cases n (%)	Recidivists n (%)	
Family type				
Single-parent				
All time	2 (3.2)	-	-	79 (1.5)
At birth	6 (9.5)	1 (11.1)	1 (25.0)	103 (2.0)
Parental death	5 (7.9)	3 (33.3)	2 (50.0)	342 (6.5)
Parental divorce	15 (23.8)	1 (11.1)	-	475 (9.0)
Two-parent	35 (55.6)	4 (44.4)	1 (25.0)	4274 (81.1)
Maternal age				
<20	9 (14.3)	-	-	344 (6.6)
≥20	54 (85.7)	9 (100.0)	4 (100.0)	4901 (93.4)
Maternal smoking				
Yes	15 (24.6)	3 (33.3)	1 (25.0)	725 (14.1)
No	46 (75.4)	6 (66.7)	3 (75.0)	4428 (85.9)
Psychiatric hospital diagnosis				
Yes	11 (17.5)	2 (22.2)	2 (50.0)	109 (2.1)
No	52 (82.5)	7 (77.8)	2 (50.0)	5164 (97.9)
Parental social class				
I, II	11 (17.5)	2 (22.2)	-	1584 (30.1)
III, IV	49 (77.8)	7 (77.8)	4 (100.0)	3037 (57.6)
Farmers	3 (4.8)	-	-	648 (12.3)
Perinatal complications				
Yes	7 (11.1)	-	-	411 (7.8)
No	56 (88.9)	9 (100.0)	4 (100.0)	4862 (92.2)

* Total n on which percentages are based varies due to missing data for some subjects.

5.3.1. Criminality among males

5.3.1.1. Family background and non-violent offences

A single-parent family of type “all time“ (adj. OR 1.6, 95% CI 0.7-3.5) or “at birth“ (adj. OR 1.5, 95% CI 0.7-2.9) was not associated with non-violent offending (III: Table 1). If the parents were divorced during the offspring’s childhood, the male offspring’s risk of committing non-violent crimes was two-fold (adj. OR 2.0, 95% CI 1.5-2.7) compared to males with two-parent family background. Parental death also increased the risk of committing a non-violent crime during early adulthood among males (OR 1.5, 95% CI 1.0-2.3, adjusted for maternal age, maternal smoking during pregnancy, psychiatric hospital diagnosis, parental social class, and perinatal complications).

5.3.1.2. Family background and violent offences

Male subjects who were born and raised in a single-mother family (“all time“) had the highest risk of committing a violent crime during the follow-up time (from 15 to 32 years of age) (III: Table 1). The risk was 5-fold compared to males with a two-parent family background even after controlling for maternal age, maternal smoking during pregnancy, psychiatric hospital diagnosis, parental social class, and perinatal complications (adj. OR 5.2, 95% CI 2.5-10.6). Correspondingly, the probability of violent crimes was 3.6-fold (95% CI 1.8-7.0) if the male subject was born to a single-mother family (“at birth“) and 2.5-fold (95% CI 1.6-3.7) if parents got separated during the follow-up time. If a parent had died during the offspring’s childhood, the risk of violent offending doubled (adj. OR 2.2, 95% CI 1.3-3.6) compared to males with intact, two-parent family backgrounds.

5.3.1.3. Family background and recidivism

The risk of recidivism was highest among males who were born and raised in a single-mother family “all time“, adjusted odds ratio being 7.8 (95% CI 3.1-19.4) (IV: Table 1). Correspondingly, the risk of violent recidivism was 5.0-fold (95% CI 2.1-11.9) if the male subject was born to a single-mother who married later during the offspring’s childhood (“at birth“) and 2.0-fold (95% CI 1.1-3.8) if the parents had a divorce during the offspring’s childhood. Furthermore, parental death was not significantly associated with the risk of violent recidivistic offending among males.

5.3.2. Criminality among females

Females with a single-parent family in childhood had a 2.7-fold risk (95% CI 1.5-4.5) (adjusted for maternal age, maternal smoking during pregnancy, psychiatric diagnosis, parental social class, and perinatal complications) of becoming non-violent criminals over females with two-parent family backgrounds. The risk of violent offending in females with a single-parent family background was 4.4-fold (95% CI 1.1-17.0) compared with that of other females. Due to the small number of cases no subgroup analyses of different family types were made.

5.4. Childhood family background in relation to drunk driving in adulthood (V)

In the total sample 401 (7.2 %) males and 31 (0.6 %) females had at least one registered drunk driving offence in the follow-up time between 15 to 32 years of age.

5.4.1. Drunk driving among males

The proportion of males with early-onset drunk driving offences (first offence before 21 years of age) was over two-fold in single-parent family subgroups: “at birth”, “all time” and “divorce” compared with males of two-parent family backgrounds (V: Table 1). An over two-fold percentage in these subgroups, but also in the “parental death” subgroup, was seen in late-onset drunk driving offences (first offence 21 years of age or older). Among those cohort male members who had been born into or been raised in a single-mother family (“all time”, “at birth”), the proportion of recidivist drunk drivers (three or more registered drunk driving offences) was statistically significantly higher than in males raised in two-parent families ($\chi^2=7.80$, $df=1$, $p<0.01$).

In logistic regression analyses the adjusted odds ratios (adjusted for psychiatric hospital diagnosis, maternal age, and parental social class) for committing any drunk driving offence were significantly increased in all types of single-parent families except for parental death (V: Table 1). The risk of drunk driving was 2.4-fold (95% CI 1.4-4.2) in “at birth” and 1.9-fold (95% CI 1.0-4.0) in “all time” subgroups. Single-parent family background due to parental divorce increased the risk of drunk driving 1.9-fold (95% CI 1.4-2.6).

5.4.2. Drunk driving among females

Of the female drunk drivers, 48.4 % had grown up in a single-parent family. The corresponding percentage of females among non-drunk drivers with single-parent family background was 19.1 %. The difference was statistically significant ($\chi^2=16.9$, $df=1$,

$p < 0.001$). The risk of any drunk driving offence was 3.6-fold (95% CI 1.7-7.7) among females with single-parent family background (adjusted for psychiatric hospital diagnosis, maternal age, and parental social class). Due to the low number of female drunk drivers it was not possible to analyse separately the different single-parent family subgroups.

6. Discussion

6.1. Discussion of the results

6.1.1. Physical illness of adults with single-parent family background (I)

According to the present population based study, the offspring of single-parent families are mostly in as good a somatic health as others when hospital-treated physical illnesses are considered. However, a weak positive association between overall hospital-treated physical illnesses and single-parent family background among females was found. This association was explained due to the excess of females with single-parent family background in the ICD-categories of “pregnancy, childbirth and puerperium“ and “injury and poisoning“. Among males no difference with regard to overall hospital-treated physical illnesses was found. In the ICD subcategories there were, however, some remarkable differences. The risk of poisonings by psychotropic drugs, fractures and other injuries was elevated also among males with single-parent family background compared with other males.

The increased risk of hospitalisation due to poisonings, accidents and injuries had previously been detected among males (Romelsjö *et al.* 1992). The present study suggests an elevated risk of hospital-treated intracranial and other injuries also for females. Contrary to the finding of this study, Lundberg (1993) suggested that both males and females with single-parent family background were generally in considerably worse a state of health as compared to persons with a two-parent family background. In that study, health variables were gathered by questionnaires, which may have caused some bias to the study and may in part explain the differences regarding the results of this thesis. One may assume that false positive cases accumulate in studies based on questionnaires compared to register studies. On the other hand, the results of this thesis may be biased due to the fact that the data concerning physical illness were gathered from the hospital discharge register (FHDR), which includes only the most severe (hospital-treated) somatic conditions of a person.

In previous studies it was shown that females with single-parent family background had experienced induced abortions more commonly (Aro & Palosaari 1992) and tended to

have children at earlier ages (Aro & Palosaari 1992, Kiernan 1992, Tulisalo 1999) than females with two-parent family backgrounds. These findings parallel findings of the present study. The amount of induced abortions was rather high in the present study (15.2 %), and females from single-parent families had an almost two-fold risk of induced abortions compared with other females. Based on these findings it can be hypothesised that the young adult females with a single-parent family background might experience an earlier transition to adulthood. One speculative explanation for the present finding might be that the females from single-parent families have adapted the parental role model of an early intimate relationship and child bearing as a part of it. In addition to environmental reasons, genetic factors such as inherited impulsive behavioural characteristics might, in part, explain these findings.

In conclusion, these results suggest that childhood family background has some effect on physical illness in early adulthood. Personal relationship and life style related problems like induced abortions and accidents emerged; this is an important issue from both psychological and public health points of view. Persons with single-parent family background tend to be less able to protect themselves from accidental injuries and poisonings. This may be an aftermath of the childhood family situation, a manifestation of problematic adaptation (Aro & Palosaari 1992), since it has recently been shown in epidemiological studies that long-term effects of childhood adversities may emerge after a delay (Chase-Lansdale *et al.* 1995, Kessler *et al.* 1997). Assessing the causal relations of these findings may, however be premature due to limited data in this study design.

6.1.2. Mortality of adult offspring of single-parent families (II)

The results have shown that the general mortality risk from 16 years of age up to the age of 28 for males with a single-parent family background was significantly increased compared with males with a two-parent family background. The highest risk increase was seen in relation to suicides. Thus, earlier reports of a higher mortality risk among offspring of single-parent families (Romelsjö *et al.* 1992, Judge & Benzevel 1993, Schwartz *et al.* 1995), and particularly the higher risk of committing suicides (Gould *et al.* 1996), were now confirmed by using a large unselected, general population birth cohort. However, no difference in mortality rates were observed when females with single-parent and two-parent family backgrounds were compared. This may be due to the small number of deaths in general among females in this database, and the question needs further investigations.

Our finding revealed an excess of mortality similar to that earlier reported on the basis of epidemiological studies (Romelsjö *et al.* 1992, Lundberg 1993, Schwartz *et al.* 1995, Mansfield *et al.* 1999). However, we have now established that the high mortality is particularly focused on suicides. As it is shown, for example in the National Suicide Prevention Project in Finland, major depression may be one contributing factor to suicides (Lönqvist *et al.* 1993). One possible explanation for the major finding in this thesis, might be the higher incidence of major depression, among people who have experienced a single-parent family in childhood. The finding in this thesis of an increased suicide risk is also in line with the reported finding of the high number of injuries and

poisonings. In some cases accidental injuries and poisonings may in fact be attempted suicides. In the light of earlier studies it seems that suicidal behaviour is more frequent among persons with single-parent family background (Kienhorst *et al.* 1990, Rubenstein *et al.* 1998) as is also depressive disorder (Mäkikyrö *et al.* 1998a, Agid *et al.* 1999, Tulisalo 1999).

In a study of childhood origins of self-destructive behaviour it was suggested that due to the immaturity of the central nervous system of children, they are vulnerable to lasting biological changes caused by trauma and neglect, and that impulsive behaviour may also be a hormonally mediated response which is triggered by reminders of earlier trauma and abandonment (van Der Kolk *et al.* 1991). Furthermore, Agid *et al.* (1999) observed that vulnerability to major depression increased particularly when the parental loss was due to parental separation rather than death. It may be speculated that childhood psychological trauma caused by a lack of a parent may affect the neurobiology of the individual to such an extent that the adverse effect lasts the entire life and causes the vulnerability to later life-stress, even suicide in adulthood (Coplan *et al.* 1996, Agid *et al.* 1999).

6.1.3. Childhood single-parent family in relation to impulsive behaviour in adulthood (III-V)

The risk of violent offences and recidivism was significantly increased among males who had been born into a single-mother family (single-parent family all time, at birth). Such association did not reach statistical significance with non-violent crimes. Further, the highest percentages of drunk drivers was found among males who were born to a single-mother, independently of the later marriage status of the mother. Also among females with single-parent family background a tendency towards increased criminality as well as drunk driving was seen.

The results of this thesis are in accordance with some important previous studies of an increased probability of criminality among persons with single-parent family background (Wadsworth 1979, Raine *et al.* 1994, 1997, Farrington 1995). At the same time, the findings give support to an earlier notion by Kolvin *et al.* (1988), who suggested that some types of deprived families appear to be more harmful than others. In addition to marital instability, economic deprivation, overcrowding and poor mothering were seen as the most important risk factors for later criminality (Kolvin *et al.* 1988). Also Wells and Rankin (1991) concluded that the association with delinquency is slightly stronger for families broken by divorce than by a parent's death. Further, the present findings are in line with some previous studies on the positive association between childhood single-parent family and later alcohol related problems of the offspring (Hope *et al.* 1998, Kendler *et al.* 1996, Kuh & Maclean 1990, Tennant & Bernardi 1988, Wolfinger 1998). Now, for the first time, it was shown at an epidemiological level that single-parent family background increased also the risk of drunk driving later in life.

In the present study, the single-mother family, lacking the father during the entire childhood (from birth to 14 years of age), was the family type with the most adverse effect on criminality and drunk-driving in adulthood. Due to the fact that the mother rears the child alone, there might be a failure in the childhood environment to provide sufficient

facilities for the psychological and social development of the child. Further, children from disharmonious broken families may be more likely to offend because they do not build up internal inhibitions against socially disapproved behaviour (Farrington 1995). Family structure that includes two adults is more likely to contribute to positive child outcome since emotional and practical stresses involved with child rearing can be shared (Silverstein & Auerbach 1999).

Parental control is often reduced in single-parent households (Amato & Keith 1991a, Wolfinger 1998). This may afford children more opportunity to experiment with alcohol and other substances (Wolfinger 1998), as it was already shown in this cohort earlier among adolescents from single-parent families (Isohanni *et al.* 1993, 1994). Altogether, this may lead to an increased likelihood of substance abuse also later in life. The results of the increased drunk driving risk among offspring of single-parent families lend support to this finding and, in addition, it seems that a long-lasting link between childhood family environment and alcohol-related problems exists.

Another possible explanation for these results is that it may not be the lack of the father per se that affects the child, but rather the lack of a father might be a marker of genetic vulnerability. In genetic studies of type 2 alcoholism, often related to antisocial personality traits, it is shown to be inheritable (Cloninger *et al.* 1981) as is antisocial personality disorder (Cadoret 1978, Lappalainen *et al.* 1998). It is well known that people suffering from an antisocial personality disorder may not be able to sustain a constant monogamous relationship (Lahey *et al.* 1988). The proportion of antisocial fathers is probably high in the subgroups where the mother was single "all time" and "at birth". The absent fathers may have passed the antisocial and violent tendencies on to the child. Farrington (1995), too, concluded that later criminal offending of male offspring was associated to having a convicted father, which may be connected to a genetic transmission of antisocial traits but also to a father serving as a role model for criminal behaviour.

Raine and Mednick (1989), suggested that perinatal complications in combination with other risk factors, such as adverse rearing conditions, may cause neurobiological dysfunction which in turn causes impulsivity and predisposes persons to criminality. Recent findings from a prospective follow-up study of children with perinatal complications and psychosocial risk factors, however, suggest that psychosocial risk factors outweigh the influence of perinatal risks in determining the children's adjustment at school age (Laucht *et al.* 2000). Furthermore, no interaction between these risk factors was found. On the other hand, van Der Kolk *et al.* (1991) suggested that impulsive behaviour might be a hormonally mediated response which is triggered by reminders of childhood traumatic events. These issues need to be disentangled in further studies which will also have to take into account interactions between family background, later criminality and perinatal risks in order to explain the effect of childhood environment on impulsive behaviour.

6.2. General discussion

Most of the offspring of single-parent families did well during the follow-up time, for example 98 % of them stayed alive and 89 % had not committed any registered crimes.

They have coped successfully with the possible adverse effects of growing up in a single-parent family. It has been suggested that some children of divorced families emerge as exceptionally resilient individuals, who are enhanced by confronting the increased challenges and responsibilities followed by divorce (Hetherington *et al.* 1989, Wallerstein & Blakeslee 1989). However, due to the limited database, it was not possible to explore the resilience perspective and possible protecting factors (Rutter 1987) in the present study.

Living in a single-parent family may be considered as a potential risk factor, but the present findings may not be explained only by means of a lack of the father, or the mother rearing the child alone. The single-parent family may be an indicator of other adverse events and/or of genetic loading associated with increased risk but which was not recorded in this study, e.g. parental immaturity or mental disorders. Therefore, other factors such as quality of parental care, possible parental psychopathology, socioeconomic situation of the family, and social support systems as well as possible genetic vulnerability are also of importance (Weissman *et al.* 1997, Mäkikyrö *et al.* 1998a, Sadowski *et al.* 1999, O'Connor *et al.* 1999). It is possible that some of the above mentioned psychosocial aspects may be stronger explanatory factors for the finding of this thesis.

In the case of parental loss, many problems attributed to single-parent family may have been present before the actual parental divorce or death. Temperamentally difficult children might contribute to the risk of parental divorce and might also manifest psychological problems independently of the family background (Block *et al.* 1986, Hetherington *et al.* 1989, 1998). Children whose parents later got divorced have been found to exhibit adjustment problems even before the parental break-up (Block *et al.* 1986). These different risks, personal characteristics and social circumstances interact with each other, and are mediated and moderated in complex ways. It is possible that the balance between risks and resources is what determines the impact of family background on children (Hetherington *et al.* 1998). One of the greatest difficulties in assessing the long-term effects of childhood family background on child development is the multitude of factors that may mediate this process.

The importance of other close adults and a safe childhood environment should not be underestimated in promoting healthy child and adolescent development. A wide variety of family structures can support positive child outcomes. A child needs at least one responsible, care-taking adult, woman or man, who has positive emotional connections to them and with whom the child has a consistent relationship (Silverstein & Auerbach 1999). The sex or the biological relationship of the adult to the child has not emerged as a significant factor in the preceding positive development of the child (Silverstein & Auerbach 1999). Such an adult may also be found outside the family context. In the present study it was, however, not possible to clarify if such relationships existed in the social network of children in single-parent families. Later in adolescence and in adulthood the ability to establish and maintain an intimate relationship functions as a buffer and protective factor against adverse outcomes, such as depression and criminality for example (Farrington 1995, Palosaari & Aro 1995, Tulisalo 1999).

These results should, however, be interpreted with caution since the society has changed markedly and the families today are versatile. Changes in divorce rates have probably the most profound implications, no other single changes having so significantly

altered family life (Bumpass 1990, Jallinoja 2000). On the other hand, different forms of families (single-parent, step-parent, families with illegitimate, out of wedlock children) are not themselves a problem, it is the meaning society gives to family background status of a person (Lambert & Streather 1980). People differ from each other, they have different likes, aspirations and talents, and they live in various circumstances. Therefore, families cannot be alike, but inevitably become variable, so that all forms of families should be accepted (Jallinoja 1994).

6.2.1. Strengths of the study

The sample of the present study was based on the unselected general population birth cohort of more than 12 000 subjects at the baseline, which comprised 96 % of all births during 1966 in the study area (Rantakallio 1988). The representative study population sharing same culture and language, and the use of register information, minimised selection, information, and recall biases. The results can be generalised to represent the entire Finnish population of young adults under 32 years of age.

The participation throughout the study was good. Information on physical illness as well as mortality and criminality was gathered from official national registers, which are considered to be reliable tools for epidemiological research (Poikolainen 1983, Keskimäki & Aro 1991). The use of registers in obtaining data for cohort-study offers several advantages. It is possible to obtain much larger data sets with moderate costs and efforts than by any other method. Registers are also an excellent method for choosing representative samples for studies (Barker *et al.* 1998).

Physical illness was measured precisely during hospital treatment by ICD-diagnoses which can be considered to be valid (Keskimäki & Aro 1991). A birth cohort study is well suited for examining mortality because it excludes the selection bias. Determination of the causes of death is considered to be reliable since the high overall autopsy and medicolegal autopsy rates in Finland (Näyhä 1980, Öhberg 1998). Furthermore, mortality and criminal records in Finland are accurate, and persons are easily identified by their unique social security numbers (Statistics Finland 1999b).

6.2.2. Limitations of the study

The singlemost major limitation of this study is the fact that family background of a person alone is too robust a measurement in explaining the lifecourse of children in single-parent families. As in any large population sample, only part of the potential exposure or confounding variables could be assessed in this study. Epidemiological and population based studies with broad measures for investigating complex associations between psychological, environmental and social processes in human development have many limitations. The single-parent family is not a specific risk factor of adverse adult outcome of an offspring, due to the great variation in life situations of the different types of families.

Family atmosphere or possible friction was not measured in any way, although difficulties and discordance in family life may have a stronger effect on children and their health than do parental lack or loss itself (Rutter 1981, Emery 1982, Breier *et al.* 1988, Portes 1992). Information on the mental state, alcoholism or criminality of the parents was not available. Moreover, it is well-known that parental psychiatric illnesses as well as alcoholism and antisocial personality may in part endanger a healthy child's development regardless of the family structure (Cohen & Brook 1987, Lahey *et al.* 1988, Farrington 1995, Trad 1995, Kessler *et al.* 1997, Weissman *et al.* 1997, Laucht *et al.* 2000). Further studies should be conducted to analyse how these risk factors operate in various family types. Furthermore, we did not have any information on the amount and quality of contacts with the non-custodial parent and the child.

These results may be biased due to the fact that the data concerning physical illness were gathered from the hospital discharge register (FHDR), which includes only severe hospital-treated cases of physical illnesses, poisonings, and injuries. The information of possible treatment in out-patient clinics or private hospitals was not available. Furthermore, only registered criminal acts are considered in this thesis which may cause some bias since crimes committed before the 15th birthday are not included. This is, however, a minor limitation since those who commit crimes only under 15 years of age but not after that are a marginal minority. It has earlier been shown that even 30 % of criminals commit their first offence under 15 years of age and that those offenders seem to be at higher risk of recidivistic offending (Stattin *et al.* 1989). The results of this thesis should be interpreted with these limitations in mind.

It was not possible to explore the putative influence of genetic loading in the present study. A wide array of evidence on the importance of genetic factors in antisocial disorder, alcoholism and depression has been presented (Cloninger *et al.* 1981, Kendler *et al.* 1996, Lappalainen *et al.* 1998). A hypothesis of gene-environment interaction has earlier been presented, for example in the case of schizophrenia (Wahlberg *et al.* 1997). Persons with genetic vulnerability appear to have been protected by a healthy family environment and furthermore are more often mentally disturbed when reared in dysfunctional family conditions. This could be one possible explanatory model for the results of this thesis. Those cohort members who had, for example antisocial parents, and thus possible genetic vulnerability, may have been more negatively affected by the single-parent family environment. Furthermore, in those families parental care is putatively poorer than in families with no antisocial parents.

7. Conclusions

7.1. Main findings

The offspring of single-parent families are mostly in as good a somatic health as the offspring of two-parent families. The risk of accidental injuries and poisoning was, however, significantly increased among both female and male offspring of single-parent families. Females from single-parent families also had abortions, pregnancies and pregnancy related complications more frequently than other females.

Mortality among males (from 16 to 28 years of age) with single-parent family background was significantly increased compared to other males. The risk of committing suicide was particularly high. Among females any significant differences in mortality was not found, partly due to the small number of deaths during the follow-up time among females.

The risk of criminal offending, violent offences and recidivism in particular, was significantly increased among males who were born to single-mother families. Non-violent crimes were associated only with parental divorce or death among males. The trend of an increased risk of criminality was also seen among females from single-parent families.

The results of this thesis suggest that growing up in a single-parent family is a potentially powerful predictor of adult alcohol-related problems, i.e. early-onset, late-onset and recidive drunk driving among males. Among females with single-parent family background the increased risk of drunk driving was also present.

Single-parent family environments (and factors related to them) experienced in childhood appear to have some negative effects to the well-being of the offspring. However, a single-parent family background may be a stressor that, in the larger scheme of things, has only minor effects on most of the offspring of such families.

7.2. Practical implications

This thesis showed, at epidemiological level, an association between single-parent family background and increased risk of injuries, mortality and criminal behaviour of the offspring during adulthood. However, the family variables used in this thesis were rather limited. It is possible that the present findings could be explained by other intermediating psychosocial factors such as parental psychiatric disorders. Human development is a complex phenomenon in which causality is difficult to prove to exist. For these reasons only some general implications are stated here.

The finding of this thesis calls for health care professionals to provide more preventive mental health support for children and adolescents living in single-parent families, especially if they express suicidal behaviour patterns. Effective interventions to alleviate the effect of childhood adversities and to prevent mental health problems do exist (Black 1996). Approximately half of the suicides among adolescents are associated with depression (Marttunen *et al.* 1991). Early detection and treatment of depression and other problems among all adolescents and young adults need the co-operation of schools, social services, primary health care, and psychiatric services. The society should provide more facilities and financial resources to enable forming and maintaining effective treatment organisations.

Furthermore, the findings of this thesis call for greater attention to primary health care resources and focused psychosocial evaluations for young single-mothers who attend maternity clinics alone. A preventive program for unmarried mothers during prenatal period and their child's first years has already been shown to be effective in reducing serious antisocial behaviour of a child (Olds *et al.* 1998). In Northern Finland there has been a project in which public health nurses have been trained in effective parent counselling in order to identify the children at risk and to support their parents (Kurki *et al.* 2000). Trained workers are able to enhance the well-being of families and thus prevent some possible adjustment problems of the children. Such programs should be further encouraged and financially supported by the society and through legislation.

Any supportive systems, therapeutic interventions or community programs to promote family well-being as well as the psychosocial development of children and adolescents are of great importance in the attempt to prevent social and psychological problems of the offspring of single-parent families. Marital counselling and family therapy should be available for all families in difficult life situations to alleviate the problems and to avoid hasty divorce decisions. A challenge to all health care professionals is to find the families and children at risk.

7.3. Implications for further study

This thesis deals with problematic outcomes of offspring of single-parent families. The majority of the young adults with single-parent family background, however, did well during the follow-up. In the present data it was not possible to study factors which promote well-being of offspring of single-parent families, although it would be of prime

interest for preventive mental health work. Those cohort members who managed to adjust well in spite of childhood adversities could give us valuable information on the nature of coping mechanisms and buffering factors. Further research on adult offspring of single-parent families, in particular longitudinal studies, would be of great value in the attempt to understand this phenomenon.

Further detailed studies are also needed concerning the social, psychological and biological risk-increasing factors which are specific for a single-parent family and which may explain the elevated mortality and criminality rates of the offspring. In the future, it would be interesting to study whether these increased mortality and criminality risks are associated with the timing of the parental separation. Also, it would be interesting to study the putative parental psychiatric morbidity in order to explain the association between violence and childhood family structure. The possible inheritance of antisocial traits of cohort members should be investigated using methods of epidemiological genetics.

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