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ABBREVIATIONS

DDD	Defined daily dose
FTI	Fatal toxicity index
SSRI	Selective serotonin reuptake inhibitor
TCA	Tricyclic antidepressant
ATC	Anatomic chemical therapeutic
ICD	International classification of diseases

1. LIST OF ORIGINAL PAPERS

This thesis is based on the following original papers, which are referred to in the text by roman numerals I-VI.

- I Annakatri Ohberg, Jouko Lonqvist, Seppo Sarna, Erkki Vuori and Antti Penttila. Trends and availability of suicide methods in Finland: proposals for restrictive measures. *British Journal of Psychiatry* 1995; 166: 35-43.
- II Annakatri Ohberg, Jouko Lonqvist, Seppo Sarna and Erkki Vuori. Violent methods associated with high suicide mortality among the young. *Journal of the American Academy of Child and Adolescent Psychiatry* 1996; 35: 144-153.
- III Annakatri Ohberg, Erkki Vuori, Timo Klaukka and Jouko Lonqvist. Antidepressants and suicide mortality (submitted to *Journal of Affective Disorders*).
- IV Annakatri Ohberg, Erkki Vuori, Ilkka Ojanperä and Jouko Lonqvist. Alcohol and drugs in suicides. *British Journal of Psychiatry* 1996; 69: 75-80
- V Annakatri Ohberg and Jouko Lonqvist. Suicides hidden among undetermined deaths. *Acta Psychiatrica Scandinavica* (in press).
- VI Annakatri Ohberg, Antti Penttila and Jouko Lonqvist. Driver suicides. *British Journal of Psychiatry* 1997; 171: 468-472.

2. INTRODUCTION

2.1. Definition of suicide

Deliberate self-harm can be determined as self-injurious behaviour either with or without suicide intent (Herpetz 1995). Moreover, the concept of suicidal behaviour involves a wide range from suicidal ideation and suicide attempt to completed suicide. In studying suicidal behaviour, it is therefore essential to define what kind of suicidal acts are being analysed. In the present study, because only acts with a fatal outcome have been examined, the reliability of the determination of the cause and the manner of death is thus essential. In the official classification, suicide is defined as death resulting from an intentional self-inflicted injury (in the 10th revision, the "injury" is replaced by a slight wider concept "self-harm"). According to this definition, death must be caused by an injury (or poisoning) effected by the deceased him- or herself, which usually can be reliably settled in the death scene investigation. However, suicide intent may be difficult to prove if it is not obvious from the circumstances. In Finland, the assessment of suicide intent is based on the balance of probability; thus, the number of misclassified suicides probably remains smaller than if a high standard of proof were required.

2.2. Suicide as a public health problem

Suicide constitutes a significant public health problem in Finland. Previous studies have shown an upward trend in suicide mortality over the present century (Järventie and Perä-Rouhu 1986, Palonen et al. 1990, Lester 1997a). According to the latest statistics by WHO (1996), suicide mortality of men in Finland is the seventh highest in Europe after Lithuania, the Russian Federation, Latvia, Estonia, Hungary and Slovenia, while the figure for Finnish women is only slightly higher than the average in Europe. Upward

suicide trends have been observed in several European countries and the United States (Low et al. 1981, Diekstra 1993, LaVecchia et al. 1994). The suicide rate of young men, in particular, has increased markedly since the 1960s (Barraclough 1988, Diekstra 1989, Lowy et al. 1990, McClure 1994, Charlton 1995). At present, in Finland, suicide is the commonest manner of death in men 20 to 34 years of age (Central Statistical Office of Finland 1996).

2.3. Suicide research

In his classic study, Durkheim (1897) developed a sociological theory of suicide and considered suicide primarily as a social event which is affected by various forms of integration and regulation in society. In several later reports, an association between suicide and mental health (Barraclough et al. 1974, Miles 1977, Rich et al. 1986, 1988, Monk 1987, Henriksson et al. 1993, King 1994, Moscicki 1995, Conwell et al. 1996), abuse of drugs or alcohol (Rich et al. 1989, Murphy and Wetzel 1990, Murphy et al. 1992, Ashworth and Gerada 1997, Rivara et al. 1997), stressful life-events (Murphy and Robins 1967, Murphy et al. 1992, Heikkinen et al. 1994, 1995), familiar and biological factors (Brent et al. 1996, Shaffer 1988) and availability and lethality of suicide methods (Kreitman 1976, Farmer and Rohde 1980, Kellermann et al. 1992, Marzuk et al. 1992) have been emphasised. On the whole, suicide is currently considered as a fatal outcome resulting from a process which varies in length and is affected by several interacting personal and external factors.

A significant part of suicide research involves retrospective epidemiological analyses of suicides. In the early 1960s, a multidisciplinary approach called psychological autopsy was originally developed to promote classification of suicide (Litman et al. 1963, Curphey 1968). Since then, several studies (including the National Suicide Prevention Project in Finland) have applied

the psychological autopsy method to widen knowledge of risks and background factors of suicide (Shneidman 1981, Beskow et al. 1990, Clark and Horton-Deutch 1992). The most significant problem for a prospective study on suicide is the relative rarity of suicide in the general population. Prospective follow-up studies on risks for suicide require large samples and extensive human and material resources. Because of these facts, follow-up studies usually focus on selected samples, which inevitably limits the conclusions for other populations.

The main target of suicide research is to discover means for suicide prevention. Suicide represents the extremity of mental and social unwellbeing, and it is generally accepted that efforts to prevent these events are both reasonable and justified. This point of view is supported, for instance, by the fact that on average only 10%-15% of those who have attempted suicide eventually kill themselves (Gunnell and Frankel 1994, Maris 1992). In a 5-year follow-up study from Finland, the risk of suicide among suicide attempters was less than 4% (Suokas and Lönnqvist 1995). The World Health Organization, in fact, has specified suicide as an increasingly important area of public health, and has issued guidelines to member states to develop comprehensive strategies to arrest the growing suicide trend by the year 2000 (WHO 1990a). Also in Finland, the National Suicide Prevention Project began in 1986 with its main target to reduce suicide mortality by 20% by the year 1995 (Lönnqvist 1988).

In the past, in many European countries, punitive measures were applied to reduce suicides. Suicide used to be illegal, and up to the early 19th century, a person could be jailed or even executed for attempting suicide (Farmer 1992). Currently, various strategies for suicide prevention both in primary and in secondary care settings have been initiated, for instance, population-based measures including telephone crisis services, school-based programs, restrictions on availability of lethal methods and education of primary health-care professionals to identify high-risk groups (Miller et al. 1984, Gunnell and

Frankel 1994, Taylor et al. 1997). Efforts to improve family environment and social support for people at risk have also been emphasised (Lester 1997b). By assessing the theoretical effect of various preventive measures, Lewis et al. (1997) concluded that changes in suicide rates are most likely to be achieved by population strategies and by interventions for those who have attempted suicide. However, the influence of different strategies on suicide mortality has remained inconclusive (Gunnell and Frankel 1994, Lewis et al. 1997).

3. SUICIDE METHODS

Suicide methods may be divided, for instance, by their lethality, speed, degree of mutilation, or by the level of activity needed to commit suicide. Relating number of deaths to all incidents: firearms, carbon monoxide and hanging are considered the most lethal suicide methods, whereas drug poisoning and use of cutting or piercing instruments represent methods of lower lethality (McIntosh 1992). The highly lethal methods are also fairly quick and require deeds to be performed by the person to commit suicide, whereas poisoning by solids or liquids, cutting the vessels of the wrists or drowning leave time for someone else to intervene. Jumping from a high place or leaping in front of a moving vehicle, on the other hand, represents a highly lethal and disfiguring act, but on the other hand, these are fairly passive suicide methods; the suicidal act must be initiated by a person him- or herself, but the fatal injury itself is left to others or to surrounding circumstances.

3.1. Factors affecting choice of a suicide method

Trends in the methods used for suicide, and especially factors affecting the choice of a suicide method have been intensively examined. Suicide methods of males differ from those used by females, and variation exists also between

different age groups, nations, geographic and sociocultural areas, and over time (Farmer and Rohde 1980, McLoone and Crombie 1987, Rosenberg et al. 1987, Crombie 1990, Lester 1990a, Bille-Brahe and Jessen 1994, McClure 1984). Poisoning, for instance, being in several nations the most common suicide method among females, has been explained by the passiveness, painlessness and non-disfiguring nature of that method (Lester 1988). On the other hand, this opinion is contradicted by the fact that jumping from a height or in front of a moving vehicle are relatively common suicide methods among young females (Cooper and Milroy 1995).

Lethality of a suicide method naturally affects the probability of fatal outcome, and therefore, lethality of the method chosen for suicide may reflect the strength of suicide intent. Furthermore, method-specific imitation of suicidal behaviour has been observed among psychiatric inpatients (Taiminen et al. 1998). Published suicides have also been found to have an effect on the choice of a suicide method, especially among the young (Berman 1988). Consistent with this, Marzuk et al. (1994) examined the effect of the publication *Final Exit* (published in the United States in 1991 by the Hemlock society, advocating voluntary euthanasia) to the choice of a suicide method, and found a substantial increase in suicides by suffocation by use of a plastic bag and a moderate increase in self-poisonings by certain substances, the suicide methods recommended in *Final Exit*. It is noteworthy that although the book was intended for people suffering from terminal illness, most suicide victims who apparently had consulted the book before committing suicide did not have any terminal illness (Marzuk et al. 1993).

One of the most important determinants in the choice of a suicide method is, however, its availability. Hanging, for instance, being universally available, is the most common suicide method in many countries world-wide (Lester 1990a). In the United States, on the other hand, where guns are relatively easily available, firearms are the most frequently used suicide method irrespective of gender or age (Lester 1980, Boyd 1983, McIntosh 1992).

Relatively frequent suicides by jumping from a height among in-patients has also been explained by lack of access to other methods (Gunnell and Nowers 1997). Moreover, Heim and Lester (1991) analysed various sociodemographic and situational factors among suicide victims and concluded that availability is the major factor affecting choice of a suicide method.

3.2. Effect of availability of suicide methods on suicide mortality

Various examples of the association between availability of lethal suicide methods and suicide mortality have been presented. Marzuk et al. (1992), for instance, explored suicide rates in different counties of New York, and concluded that virtually all of the differences in overall suicide risks were explained by differences in rates involving methods that were differentially available. An association between availability of firearms and suicide rate by guns, and even total suicide rate has been observed in the United States and in several European countries (Lester 1990b, Killians 1993). Moreover, suicide rate by car-exhaust fumes has been found to correlate positively both with carbon monoxide content of car-exhaust (Lester 1989) and with car ownership rate (Curran and Lester 1991). Also Wiedenmann and Weyerer (1993), reported a close relationship between the peaks in the total suicide rate in Germany and the high proportional use of firearms and poisoning by solid, liquid or gaseous substances, which the authors explained by the availability, lethality and relative painlessness of these methods.

3.3. Restrictions on availability of methods in suicide prevention

In suicide prevention, one of the main issues is the effect of restrictions on availability of suicide methods not only on suicides by that particular method, but on total suicide mortality. One point of view proposes that restrictions

actually do not prevent suicides, rather people switch from a restricted method to another. On the other hand, a readily available suicide method may lower the threshold to commit suicide which otherwise would not occur. Successful restrictions have been carried out locally, for example, barriers in commonly used high jumping sites (O'Carroll et al. 1994), or in metro stations to prevent falling or jumping on the rails (O'Donnell and Farmer 1992). Restrictive measures focused on widely used suicide methods have been found even to influence the total suicide mortality, at least for the short-term. In the 1950s, suicides by coal gas accounted for nearly half of all suicides in England and Wales, and by the the early 1970s, detoxification of domestic gas resulted in a significant decrease in both method-related and total suicide rate in all age groups and for both sexes (Kreitman 1976). In the late 1970s, however, the suicide mortality of men began to increase again (Farmer 1992). On the other hand, detoxification of domestic gas in Japan, accounting for 8% of all suicides, reduced suicides by that method but failed to affect the total suicide rate (Lester and Abe 1989a).

3.3.1. Restrictions on availability of firearms

The effect of restrictions on availability of firearms has been eagerly examined in the United States, where the gun-control legislation varies from one state to another. Firearms injuries, mainly involving handguns, are a major cause of morbidity and mortality in United States urban areas (Kellermann et al. 1996). Loftin et al. (1991) analysed suicides and homicides in the District of Columbia before and after a law that banned possession of handguns by civilians was adopted in 1976. They found that restrictive licensing was accompanied by a significant decline in both suicides and homicides by use of firearms, which was not seen in adjacent areas where the restrictions did not apply. Furthermore, in a case-control analysis by Kellermann et al. (1992), after controlling for several characteristics, including living alone, abuse of drugs or alcohol, use of psychotropic medication, and low level of education,

ready availability of firearms was most associated with increased risk of suicide. This is consistent with findings by Brent et al. (1991, 1993a), who have analysed suicides among adolescents. Studying same-age suicide attempters, never-suicidal psychiatric patients and community controls, they found a highly significant association between adolescent suicide and guns in the home, independent of the method of storage of the guns.

Despite abundant research, the effect of restrictive measures on total suicide rate is far from clear. In the United States, for instance, despite the fact that firearms are the most frequently used suicide method, conclusive evidence has not been forthcoming. The effect of gun-control in reducing firearm suicides has been found to be compensated for by the use of other suicide methods (Rich et al. 1990). In the study from the District of Columbia mentioned above (Loftin et al. 1991), even though restrictions on handguns were followed by a decline in suicides by use of firearms, no significant change was noticed in the total suicide rate. Consistent with this, the gun control law in Canada was followed by a decrease both in level and trend of firearm and total suicide rates locally in Ontario (Carrington and Moyer 1994), but not in the whole country (Leenars and Lester 1998). In a study by Sloan et al. (1990), the authors came to the conclusion that restricting access to handguns might be expected to reduce the suicide rate in the young aged 15 to 24, but not the overall suicide mortality.

3.3.2. Restrictions on availability of drugs

Suicides by solid or liquid substances showed a steep increase throughout Europe and North-America in the 1950s, and this rise was almost entirely accounted for by an increase in the number of poisonings by medicines (Farmer 1994). Since the 1980s, overdosing has remained second or third in the rank order of suicide methods, mainly after hanging and firearms. Overdosing is favoured especially by women (McLoone and Crombie 1987,

Crombie 1990, Lester 1990a, Kelleher et al. 1992, Wiedenmann and Weyerer 1993, Bille-Brahe and Jessen 1994). Over the past decades, various hypnotics, analgesics and antidepressants have been the drugs most commonly used for suicide (Retterstol 1993, Farmer 1994, Carlsten et al. 1996); moreover, they are often prescribed by the victims' own doctors (Starkey and Lawson 1980). From the viewpoint of suicide prevention, both availability and lethality of various drugs used for suicide have therefore been an area of special interest.

Previously, much attention has been paid to the toxicity and frequent use of barbiturates in suicides. This resulted in restrictive measures, and consequently, self-poisonings by barbiturates have obviously declined (Barraclough 1974a, Ekeberg et al. 1987, Farmer 1994). In Australia and Japan, legislative restriction on the availability of barbiturates was associated with a temporary decline in the method-specific and even total suicide rate (Oliver and Hetzel 1973, Lester and Abe 1989b). Since the 1970s, a significant trend toward an increase has been noticed in the number of overdoses by two analgesics, paracetamol and dextropropoxyphene, a situation which applies especially to England and Wales (Farmer 1994, Hawton and Fagg 1992, Crome 1993). Moreover, suicide by antidepressants has been intensively followed (Starkey and Lawson 1980, Leonard 1986, Cassidy and Henry 1987), particularly since the late 1980s, when several new drugs, selective serotonin reuptake inhibitors (SSRI), were introduced. In suicide prevention, however, the role of antidepressants has remained contradictory. On the one hand, the toxicity of various antidepressants used for suicide, and on the other hand, failure in the recognition and treatment of depressive patients has been emphasised (Kapur et al. 1992, Isacson et al. 1994, Henry et al. 1995, Jick et al. 1995). Because both availability of antidepressants and the number of different antidepressive agents have markedly increased also in Finland, the special stress in the present analysis of suicides by drug poisoning is placed on suicides by use of various antidepressants.

4. ANTIDEPRESSANTS AND SUICIDE

It has been concluded that antidepressants do have an effect on depression, and these drugs have been recommended for the treatment of moderate or severe depression (Paykel and Priest 1992). On the other hand, several studies have confirmed that depression constitutes a significant risk for suicide; approximately 60% to 80% of suicide victims have been found to have suffered from depressive disorders (Rich et al. 1986, Henriksson et al. 1993, Harris and Barraclough 1997, Hirschfeld and Russel 1997). Therefore, in suicide prevention, the role of antidepressants has been emphasised (Isacsson et al. 1994, Isometsä et al. 1994). As early as in the 1970s, biochemical studies suggested an association between a low level of a metabolite of serotonin (5-HIAA, 5-hydroxyindoleacetic acid) in the cerebrospinal fluid and violent suicidal behaviour (Åsberg et al. 1976, Träskman-Benz et al. 1992), and since the late 1980s, several selective serotonin reuptake inhibitors have been introduced. In completed suicides, however, low prevalences of antidepressant prescriptions or antidepressants in the blood samples of suicide victims at the time of death have been observed. These findings have been interpreted as indicators of failure of identification or of undertreatment of depression in suicide victims (Isacsson et al. 1992 and 1994, Mendelsson and Rich 1993, Isometsä et al. 1994, Marzuk et al. 1995).

4.1. Antidepressants in the treatment of depression

Antidepressants have been compared in terms of efficacy in the treatment of depression or acceptability based on their reported side-effects, their discontinuation rates, their price, or their connection with suicidal acts. Many of these reports are meta-analyses, which are useful in compiling results and overcoming problems of multiple small studies. Song et al. (1993) found no difference in efficacy in the treatment of depression or in discontinuation rates

between selective serotonin reuptake inhibitors (SSRI) and tricyclic antidepressants (TCA). This was later questioned by Montgomery et al. (1994) and Montgomery and Kasper (1995) who reported an increased risk of drop-out due to side-effects for TCAs. In their meta-analysis, also Anderson and Tomenson (1994) concluded that both SSRIs with TCAs are in general equally effective in the treatment of depression, but in a later study by the same authors, risk for treatment discontinuation due to side-effects was higher for TCAs (Anderson and Tomenson 1995). Hotopf et al. (1997) explained the discrepancy in compliance by the different TCAs used in comparison with SSRIs; they suggested no differences in drop-out rates when SSRIs were compared with, for instance, clomipramine and nortriptyline or with heterocyclics (e.g. maprotiline, mianserin and trazodone). Severity of depressive illness, however, is found to be a significant factor in comparing efficacy of different antidepressants, showing the advantage of TCAs in relatively severe depression (Danish University Antidepressant Group 1986, 1990 and 1993, Anderson and Tomenson 1994).

4.2. Antidepressants in suicide prevention

Regarding antidepressants in suicide prevention, Freemantle et al. (1994) made an effort to evaluate the cost-effectiveness of various compounds. They used observational data on costs, volume of prescriptions, toxicity of various antidepressants, and deaths, and concluded that heterocyclics may be more cost-effective than SSRIs, due to similar toxicity but lower price. On the other hand, in a systematic review of randomised controlled trials, meta-analyses and cost-effectiveness studies comparing SSRIs and TCAs, Hotopf et al. (1996) considered the economic aspects of suicide impossible to evaluate because of suicide's rarity. Based on a case report (Teicher et al. 1990), it was once suggested that fluoxetine, one of the SSRIs, may even promote suicidal ideation, which however, has been contradicted later by a

meta-analysis by Beasley et al. (1991) and a study of 1,017 depressive outpatients receiving antidepressants (Fava and Rosenbaum 1991).

In a case-control analysis by Jick et al. (1995), suicide risk was examined in people who had received at least one antidepressant prescription. They found several factors to be associated with increased suicide rate, but after controlling for these, no differences were observed in the risk of suicide between various antidepressants including old TCAs, new TCAs or SSRIs. On the other hand, identification of depression and its adequate treatment have also been underlined (Isacsson et al. 1992 and 1994, Isometsä et al. 1994), especially for physicians in primary health care, who have a great responsibility for recognition of suicide risk (Beaumont 1989, Beaumont and Hetzel 1992).

4.3. Suicide risk of antidepressants

Risks of various drugs may be estimated by relating number of fatal poisonings by a drug to its availability. In the 1970s, Barraclough (1974a) compared barbiturates with other hypnotics by assessing deaths per million prescriptions. Similarly, several reports from the National Poisons Unit in the United Kingdom have compared various antidepressants by calculating fatal toxicity indices (FTI). The authors divided antidepressants into four main groups: old (or pre-1970) TCAs, monoamine oxidase (MAO) inhibitors, atypical (or post-1973) compounds, and SSRIs. According to their results, the highest FTIs have been repeatedly associated with old TCAs, with amitriptyline and dothiepin as the most common drugs responsible for fatal antidepressant poisonings. The earlier reports covering the years from 1975 to 1989 showed an intermediate toxicity for MAO inhibitors, but the latest figures including SSRIs presented evidently smaller FTIs and smaller differences between groups other than TCAs. The pattern was found to be similar irrespective of whether number of prescriptions or defined daily doses

(DDD units) were used as the measure of availability (Cassidy and Henry 1987, Henry and Antao 1992, Henry 1994, Henry et al. 1995).

From the viewpoint of suicide prevention, these authors have emphasised that the safety of antidepressant should be considered in the treatment of depressive patients. On the other hand, Isacson et al. (1997) have evaluated risks for various antidepressants by relating number of detections of an antidepressant at any level to the number of person-years exposed to the same drug obtained from sales in DDD units and a sample of prescription data. Contrary to the findings from the United Kingdom, their results suggested the highest risk values for mianserin, trimipramine, moclobemide, citalopram, fluvoxamine and nortriptyline. Thus, evidence of estimated suicide risks of various antidepressants has remained inconclusive; moreover, associations between these risks and suicide mortality are complex and influenced by several interacting factors.

5. IMITATION OF SUICIDE

Probably the most famous historical example of learning by a process of modelling was the effect of von Goethe's first novel, *The Sorrows of Young Werther* (published in 1774), in which the hero committed suicide. The book was widely read throughout Europe, and the hero's behaviour was obviously imitated. Authorities in Italy, Denmark and Germany responded to the subsequent increase in suicides by banning the novel (Phillips 1974, Phillips and Carstensen 1988). The term "Werther effect" was introduced by Phillips (1974), who detected an increase in the national suicide figures in the United States and in Britain after suicide stories had appeared in newspapers. The effect also seemed to be dose-related; in other words, the more publicity the greater the increase in suicide figures. The death of Marilyn Monroe, for instance, was followed by a 10% to 12% increase in suicides. The effect has

been supposed to last around ten days, teen-agers seeming more predisposed to suggestion than adults (Phillips and Carstensen 1986). This is consistent with a later report by Gould et al. (1990), who analysed age-specific effects in suicide clusters, and found significant clustering among the teen-aged and young adults. The imitative effect has been found to associate with suicide news presented on television as well (Bollen and Phillips 1982), and with fictional television films (Phillips 1980, Gould and Shaffer 1986, Schmidtke and Häfner 1988), although Wasserman (1984) has suggested that imitation applies only to the suicides of famous and admired persons.

Several explanations have been presented for the Werther effect. Other preceding conditions may have produced an epidemic of suicides, of which the published one is only an example. This is opposed by the fact that the effect is almost always preceded by the published story. It is also suggested that the effect reflects only an acceleration in suicides which would have occurred very soon. However, no compensatory decline in suicides within a period after the effect had not been observed. Moreover, a shift from other manners of injury (unintentional or undetermined), suggesting misclassification of suicide, had not been noticed. In their studies, Phillips (1974) and Phillips and Carstensen (1988) came to the conclusion that "additional" imitative suicides do exist, especially among the teen-aged population, but the effect is small in comparison with many other factors affecting suicide mortality.

Despite suggestions of media influence on suicidal behaviour, contradictory findings have also been presented. Phillips and Paigt (1987), for instance, found no media effect on suicides in California and Pennsylvania after the showing of the same fictional television films which were earlier reported to be followed by significant increases both in completed suicides and in suicide attempts among teenagers in New York (Gould and Shaffer 1986). Moreover, Simkin et al. (1995) analysed the effect of a television drama showing a teenage girl's overdosing with paracetamol. They found an increase

in suicide attempts by use of paracetamol three weeks after the broadcast, but after controlling for several factors including gender, age, time period, season, year and drug, the change did not reach statistical significance. The results were consistent with a previous report of Platt (1987), who also found no evidence of media influence after an overdose presented in a popular television series. Probably the most recent example contradicting the Werther effect is the suicide of Kurt Cobain, a famous American rock star. His suicide in 1994 received great publicity in the Seattle area, and was followed by an evident increase in suicide crisis calls but not in the number of suicides (Jobes et al. 1996).

Despite inconclusive findings, analyses supporting a suggestive effect for published suicide stories have apparently been considered convincing enough to lead to recommendations for reporting of suicide. The Centers for Disease Control (1994) in the United States, for instance, has encouraged avoidance of repetitive and excessive reports, especially descriptions of technical details. In addition, providing simplified explanations for suicide, presenting suicide as means of coping with personal problems, or glorifying suicide victims have been considered undesirable. These principles have been emphasised especially for adolescent suicide prevention (Garland and Zigler 1993). Experiences from Austria, for instance, strongly support the theory of media effect and the recommendations for cool and well-considered policy in reporting of suicide. The number of subway suicides in Vienna increased steeply between 1984 and the first half of 1987. In the second half of 1987, the Austrian Association for Suicide Prevention created media guidelines. This was followed by a marked change in the style of reporting of suicide in local newspapers, and perhaps as a result, by a decrease of 75% in subway suicides in Vienna. This effect was sustained over the five-year follow-up (Sonneck et al. 1994).

Imitation of suicidal behaviour has also been reported from Finland, mainly in limited situations such as psychiatric hospitals, when the contagion of suicide

has often been direct from patient to another (Taiminen et al. 1992, Taiminen 1993, Taiminen et al. 1998). Moreover, in Oulu, in northern Finland, a micro-level epidemic of firearm suicides has been observed among adolescents who were exposed to suicide both directly and through the media (Väisänen and Hägglund 1981). Any quantitative effect of the epidemic of inpatient suicides observed in Finland, however, has remained unproved (Taiminen and Helenius 1994).

6. UNDER-RECORDING OF SUICIDES

Suicide research is mainly based on figures for officially classified suicides. The different methods of registering unnatural deaths in various countries, however, it is suggested, reduces the validity of suicide mortality data for scientific research (Atkinson et al. 1975, Sainsbury and Jenkins 1982, Phillips and Ruth 1993). Barraclough, for instance, analysed suicide rates (1972) and classification of poisoning deaths (1974b) in England and Scotland, and explained obvious variation in suicide figures between those counties by different ascertainment procedures for suicide.

6.1. Undetermined deaths

The 8th revision of the International Classification of Diseases (ICD-8) introduced the undetermined manner of death as "injury undetermined whether accidentally or purposely inflicted" (WHO 1967). A significant part of this classification presumably comprises self-inflicted injuries, which cannot be specified as either accidental or intentional. In the United States, for instance, the introduction of the ICD-8 resulted in a decrease of 5% to 6% in the reported number of suicides (O'Carroll 1989). The corresponding figure reported in Finland was 6% (Lönqvist 1977). Kleck (1988) analysed

mortality data in the United States including undetermined deaths, accidents, natural deaths and even possible overcounting of suicides, and concluded that the reported suicide rate may be an underestimate of up to 10%.

It has been suggested that misclassification of female suicides, in particular, is one reason for the notably lower suicide rates among women than in men (Cooper and Milroy 1995). In a report from the United States, unnatural deaths of women were less likely to be investigated by medical examiners than those of men (Dijkhuis et al. 1994). On the other hand, the existence of a medical examiner's report in suicides or in transport injuries was relatively high. Certain types of fatal traffic accidents, especially single-vehicle fatalities, however, are suspected to include misclassified suicides (Phillips 1977 and 1979, Jenkins and Sainbury 1980).

Despite problems in the recording of suicide, reports on suicide rates among different cultures or peoples suggest a true variation in suicide mortality. Sainsbury and Jenkins (1982), for instance, evaluated suicide mortality among immigrants in the United States and Australia. They found that suicide rates followed the level of rates in the immigrants' original countries, and concluded that sources of error in reporting of suicide are random; they do not invalidate comparisons between countries and over time. Moreover, inclusion of undetermined deaths, or undetermined deaths plus a portion of accidental deaths, has found not to have any significant effect on the relative rankings of the national suicide rates (Barraclough 1973, Lester 1992). In order to improve the reliability of suicide statistics, also criteria for the determination of suicide have been developed (Rosenberg et al. 1988, Jobes et al. 1991).

The ICD-8 was adopted in Finland in the year 1969, and currently, annually the manner of around 200 unnatural deaths remains undetermined, comprising 0.4% of total mortality (range from 0.2% to 0.6% depending on the province). In the first five-year period (1969-73) in Finland, undetermined

deaths accounted for 10% of all suicides in both sexes annually, but the figure has gradually increased, being in the present decade (1990-1995) 13% in males and 18% in females. (Central Statistical Office of Finland, 1970-1996). Miscounting of suicide inevitably involves also deaths that are readily classified as unintentional rather than undetermined, for instance, fatal traffic accidents. Noyes (1985) reviewed studies on motor vehicle accidents related to psychiatric impairment and concluded that less than 5% of traffic fatalities represent suicides. Even though the total extent of under-recording of suicide has been evaluated from the viewpoint of recording of suicide, studies examining features and circumstantial factors associated with "missing suicides" have, however, remained few.

7. AIMS OF THE STUDY

The aim of the present study was to analyse suicides by various methods of suicide in Finland, with a focus upon:

- trends in the methods used for suicide by various age groups and by both genders, availability of suicide methods, and associations between these and the total suicide mortality over the period from 1947 to 1995 (I, II, III).
- trends in the availability and suicides committed by use of various drugs and drug groups with an emphasis on various antidepressants over the period from 1982 to 1995 (I, III, IV).
- the role of alcohol and various drugs in all suicides during the research phase of the National Suicide Prevention Project (IV).
- features associated with concealed suicides among undetermined deaths and motor vehicle driver fatalities, and the effect of these on the officially reported suicide rate (V, VI).

8. MATERIAL AND METHODS

8.1. Suicides from 1947 to 1995

For suicide trends, the data were obtained from the Finnish official statistics on mortality from 1947 to 1995 (Central Statistical Office of Finland 1948-1996a). Data were analysed by gender, age and suicide method, by using the 9th (III) or 10th (I, II) revisions of the International Classification of Diseases codes for suicide (WHO 1977 and 1992). Since 1969, suicides by gaseous substances have been distinguished from those by solid or liquid substances, these methods being examined separately between 1969 and 1995. The age groups were 15-19, 20-24, 25-34, 35-64, and over 64 years. The whole period from 1947 to 1995 in Finland involved 42,104 suicides committed by males and 11,485 suicides by females (I, II, III).

8.2. Suicides by drug poisoning

Suicides committed by use of different drugs or drug groups were analysed over two periods: from 1982 to 1992 (I), and from 1990 to 1995 (III). During the first period, altogether 2,621 suicides were committed by intake of solid or liquid substances (Central Statistical Office of Finland 1985-1994), and in the present study, suicides by antidepressants, neuroleptics and barbiturates were analysed. Over the second period, from 1990 to 1995, a total number of 3,394 fatal drug poisonings took place in Finland, 2,044 (60%) of these being suicides (Central Statistical Office of Finland 1991-1996a). Over that period, fatal poisonings and suicides by various antidepressants were examined. Toxicological data on drug poisonings for both periods were obtained from the Division of Toxicology of the Department of Forensic Medicine at the University of Helsinki.

8.2.1. Fatality risks of drugs used for suicide

The data on drug poisonings were analysed based on the principal drugs responsible for death detected in the forensic toxicological examination. The principal drug was defined as the drug with the highest ratio of detected concentration to therapeutic concentration. Various drugs used for suicide were compared by fatality risks. Fatality risks were assessed by calculating fatal toxicity indices (FTI) by relating number of fatal poisonings by a drug or a drug group to its availability. Availability of drugs was estimated by their sales in Finland, described as the annual number of defined daily doses (DDD) per 1,000 inhabitants per one day, i.e., DDD units. Defined daily dose is the assumed average dose per day for a drug used for its main indication in adults (Nordic Council on Medicines 1985, 1988, 1990, 1993 and 1996; Appendix I).

Over the period from 1982 to 1992, the FTIs were calculated for suicides by neuroleptics, antidepressants and barbiturates, while from 1990 to 1995, all fatal poisonings by various antidepressants were used for the calculation of the FTIs. The latter period comprised the introduction of several new antidepressants in Finland, including SSRIs and moclobemide. Fluoxetine and fluvoxamine were introduced in 1989, citalopram in 1990, moclobemide in 1992, paroxetine in 1993 and sertraline in 1994. The other antidepressants studied had been available in Finland over the whole study period. Drugs were specified by using the Anatomical Therapeutic Chemical (ATC) codes (WHO 1990b, Appendix I).

8.3. Toxicological data on suicides during the research phase of the National Suicide Prevention Project

A cross-sectional analysis of toxicological data on suicides committed during the research phase of the National Suicide Prevention Project in Finland was carried out (IV). The research phase of the project took place between April

1, 1987 and March 31, 1988, and included all suspected suicides in the whole country. In addition to police investigation and medicolegal autopsy, the study design involved a psychological autopsy (Lönnqvist et al. 1993) in all cases. During the research phase, 1,397 suicides were committed in Finland, and samples for screening for drugs and other substances were obtained from 1,348 (96.5%) victims. The analysis comprised not only substances used for suicides by poisoning, but also alcohol and drugs in suicides by all other methods.

8.4. Toxicological analyses

All post-mortem toxicological samples in Finland are investigated in the Division of Toxicology of the Department of Forensic Medicine at the University of Helsinki. Alcohol determinations were performed by two head-space gas chromatographic methods for at least two samples, usually blood and urine (Jones and Schubert 1989). A broad-scale thin-layer chromatographic method was applied in screening for drugs in the liver. Moreover, drugs were detected and quantified in blood samples by dual-column gas chromatography (Rasanen et al. 1996).

8.5. Undetermined deaths

During the research phase of the National Suicide Prevention Project (from April 1, 1987 to March 31, 1988), all deaths suspected to be suicides were initially taken into the project, but eventually, cases that were officially classified undetermined deaths were excluded from the analysis of suicides. During the study period of the project, official statistics comprised a total of 190 undetermined deaths. Of these, 51 were excluded from the present analysis because of no evidence of suicide. The exclusion was based on history and/or sequence of events indicating uncertainty between accidental

or homicidal death rather than that between suicide or unintentional death. The remaining 139 undetermined deaths included 61 cases that were initially suspected suicides, and these had been taken into the research phase of the National Suicide Prevention Project including a psychological autopsy. The present study analysed all 139 undetermined deaths, comprising the 61 initially suspected suicides and the remaining 78 cases in which suicide could not be excluded (V). The undetermined deaths were analysed by age, gender and cause of death. From the case reports of the psychological autopsies in the 61 initially suspected suicides, direct or indirect evidence of suicide intent following the criteria for the determination of suicide (Rosenberg et al. 1988, Jobes et al. 1991) was recorded (Appendix II).

8.6. Driver suicides from 1987 to 1991

8.6.1. Accident-investigation teams

Finnish traffic safety authorities and insurance companies have been maintaining accident-investigation teams since 1968. The team consists of a police officer, a vehicle engineer, a road specialist, a physician, and other specialists, e.g. a psychologist or a railway specialist, if needed. The teams are centrally co-ordinated by the Traffic Safety Committee of Insurance Companies (VALT), and altogether fourteen teams cover the whole country. By using a standard format, the teams investigate all motor vehicle accidents involving death of a driver or a passenger. The team collects detailed information on all participants, vehicles, roads and circumstances to analyse their involvement in the accident. The police member interviews the vehicle occupants and witnesses, collects information from police records and interviews relatives about the victim, and his or her health and life events. The physician collects information from medical records. The condition and geometric features of the road, sight distances and current circumstances are also recorded. The vehicle engineer inspects the vehicles' technical condition,

examines marks left by the vehicles and carries out reconstruction calculations. Finally, based on the collected data, the teams produce a report including a description of the course of events, the key occurrence defined as the last essential event(s) occurring before an accident, its consequences, and risk factors, and then make safety proposals (Hantula 1992).

8.6.2. Present data on driver suicides

Over the study period from 1987 to 1991, 1,419 motor vehicle driver fatalities took place in Finland. Data for the present analysis (VI) were obtained from files of the accident-investigation teams and comprised all traffic fatalities in which the team considered the driver's intention to be the probable or possible key occurrence in the accident (n=99).

By use of a format designed for the present study (Appendix III), information on vehicles, driving conditions, sequence of events, the victim's recent life events, presence of any mental disorder for which the victim had received treatment from a psychiatrist (detailed diagnoses were not available), physical diseases, history of problems with the use of alcohol and probable state of mind at the time of the accident were recorded. Previous suicide attempt(s), expression of suicidal thoughts, suicide notes, hopelessness or other clearly suicidal behaviour, e.g. making preparations for death, demonstrating or rehearsing suicidal acts, were considered as indicating intention to die (data obtained from relatives, witnesses, police or medical records originally collected by accident-investigation teams). The official classification and cause of death and forensic toxicological findings of alcohol were recorded from the death certificate and autopsy report. A medicolegal autopsy was performed in all cases.

8.6.2.1. *Driver suicides*

Based on information collected in the 99 cases considered by the teams to be possible or probable suicides, the manner of death (suicide, unintentional, undetermined) was assessed by two forensic pathologists according to the 9th revision of the International Classification of Diseases (WHO 1977). In cases of disagreement, classification was agreed by common consent, and those cases finally classified as suicides were included in the study. This assessment resulted in 84 suicide cases ($\kappa=0.809$; CI 95% from 0.646 to 0.972). The fifteen excluded cases involved ten deaths that were considered here undetermined and five considered to be unintentional deaths.

8.6.2.2. *Control drivers*

A control driver for each case driver was randomly selected from all traffic fatalities in which the accident investigation team did not suspect the driver's intention to be involved with the cause (key occurrence) of the accident. Using the same format as for the cases, data were collected also for the controls; drivers of motor vehicle fatalities that were considered certainly unintentional by one forensic pathologist (AÖ) served as the control group. Controls were matched with the cases by age (± 2.5 years), sex, marital status, occupation (5 classes) and time of year (± 1.5 months) when the accident took place.

8.7. Statistical methods

8.7.1. Tests for suicide trends

Suicide trends were analysed by examining suicide rates by different methods, age groups and both genders over the study period. Suicide rates were calculated by relating the annual number of suicides to the corresponding

mean same-age population per 100,000 inhabitants (I, II, III). To smooth out random variation, moving averages of three years were used, and 95% confidence intervals (CI 95%) based on the Poisson distribution were calculated (Gardner and Altman 1992).

Suicide trends were also described by the proportion of each suicide method of the total number of suicides in four-year groups over the period from 1947 to 1991, with the chi-square (χ^2) test for trend (Medstat 1991) used for each method (I). In the analysis of suicide trends among the young (II), a Poisson regression model was applied. In that test the rate ratio (RR) per year presents the proportion of the annual change in the rate of suicides by each method out of the total change in the use of that method over the study period; 95% confidence intervals for the rate ratios were calculated (EGRET 1990).

8.7.2. Univariate tests

Proportions of alcohol or various drugs detected in suicides of men and women were analysed by Fisher's exact fourfold chi-square test (Medstat 1991; IV). This test was used also to compare driver suicides that had not been officially classified suicides with official driver suicides (VI). McNemar's test for matched pair analysis (Campbell and Machin 1992) was applied to the case-control analysis of driver suicides (VI). Causes of undetermined deaths were compared with those of suicides by use of the Nx2-table chi-square test (Medstat 1991; V).

9. RESULTS

9.1. Trends in suicides and suicide methods in men (I)

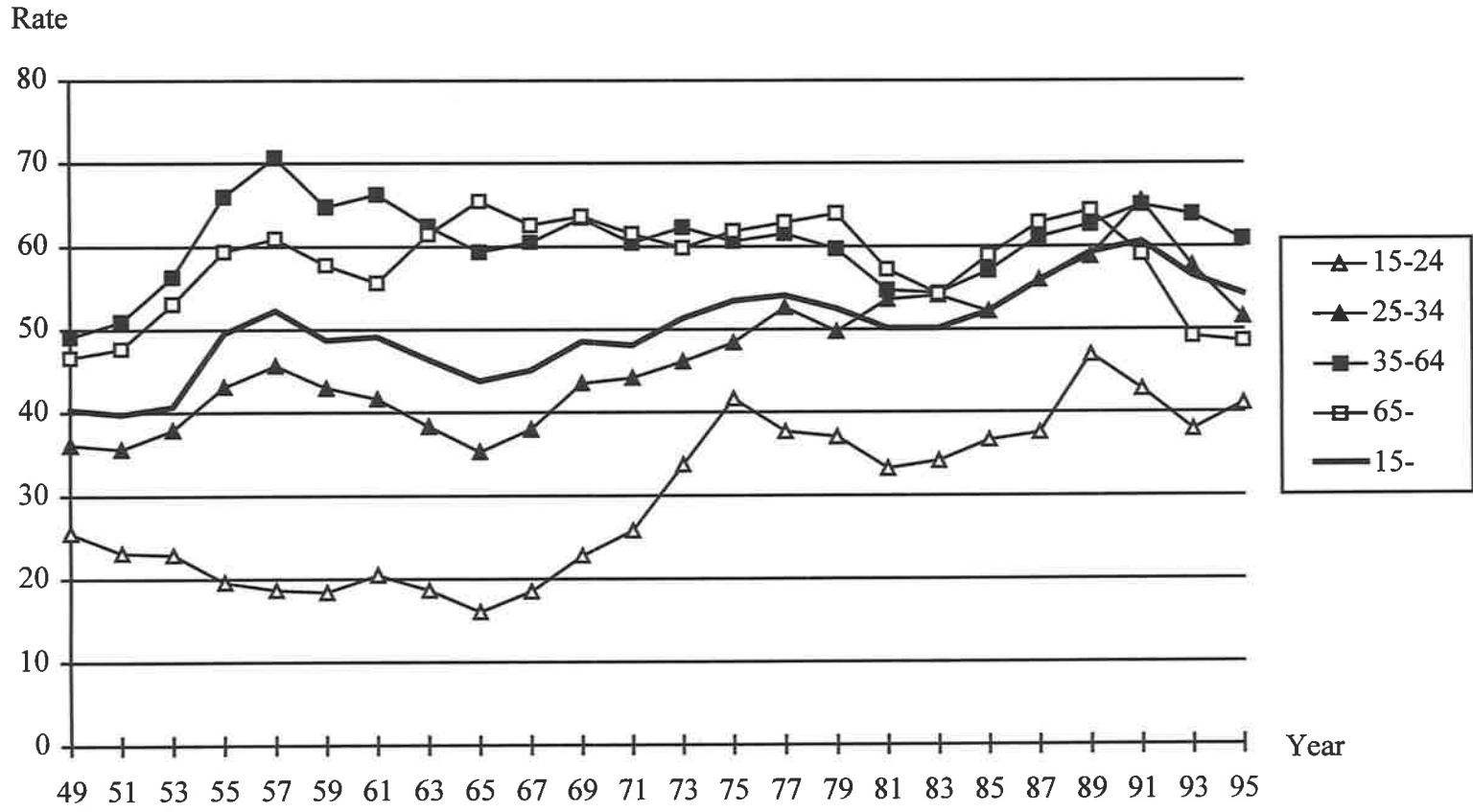
Over the period from 1947 to 1990, the suicide rate by Finnish men (age over 14 years) increased significantly from 39.7 to 61.7 per 100,000 population (Table 1). This change was observed in all age-groups, being largest among 15- to 24-year-olds. After the year 1990, total suicide mortality of men of all age groups turned toward a decline (Figure 1). From 1947 to 1990, in males of all age-groups, the proportion of suicides by poisoning (including solid, liquid and gaseous substances) among all suicide methods showed the largest increase, from 6.8% to 23.3% (trend test $\chi^2=394$, $df=10$, $p<0.0001$). Solid and liquid substances remained more common as the means for self-poisoning than gases, but since the 1970s, especially the use of automobile-exhaust fumes began a significant increase. Between 1969 and 1990, among all suicide methods, the proportion of suicides by gaseous substances, mainly car-exhaust fumes, increased significantly from 3.1% to 9.3% (trend test $\chi^2=193$, $df=10$, $p<0.0001$), while the figure for solids and liquids remained unchanged (14.1% in 1969 and 14.3% in 1990).

In the 1990s, the suicide rate by hanging or by car-exhaust fumes declined significantly, while the suicide rate by poisoning by solids or liquids was the only method which continued increasing (III). In 1990, the rate by car-exhaust fumes reached 5.9 (CI 95% 4.8-7.0) per 100,000 population, but in 1995, the figure fell to 3.3 (CI 95% 2.5-4.1). The rates for suicides by solids or liquids rose from 9.4 (CI 95% 8.1-10.8) in 1990 to 12.1 (10.5-13.6) per 100,000 population in 1995. On the whole, hanging and firearms remained men's most commonly used methods. At the end of the study period, these methods accounted for 30.2% and 25.6% of male suicides, respectively (Table 1).

Table 1. Suicide mortality per 100,000 population (age > 14) by method and gender in Finland; 95% confidence intervals shown below the rates (M=males, F= females).

Suicide method	Sex	1947	1955	1960	1965	1970	1975	1980	1985	1990	1995
Poisoning (solids, liquids and gases)	M	2.9 1.9-3.8	7.2 5.8-8.6	6.9 5.6-8.3	8.7 7.2-10.1	7.0 5.7-8.3	8.0 6.7-9.3	8.9 7.5-10.2	10.9 9.4-12.4	15.3 13.6-17.1	15.3 13.6-17.0
	F	2.8 1.9-3.6	4.9 3.8-6.0	5.2 4.1-6.3	4.5 3.5-5.4	5.4 4.4-6.5	3.8 3.0-4.7	4.3 3.4-5.2	3.6 2.8-4.4	7.2 6.1-8.4	7.0 5.9-8.2
Hanging	M	17.7 15.4-20.0	23.3 20.8-25.9	23.0 20.5-25.4	20.0 17.8-22.2	19.7 17.5-21.8	21.3 19.2-23.5	20.4 18.3-22.5	20.3 18.3-22.4	21.1 19.0-23.1	16.3 14.6-18.1
	F	1.4 0.8-2.0	3.5 2.6-4.4	3.9 2.0-4.9	2.8 2.0-3.6	3.2 2.4-4.0	4.0 3.1-4.9	3.5 2.7-4.3	3.4 2.6-4.2	2.8 2.1-3.5	2.9 2.2-3.7
Drowning	M	1.9 1.2-2.7	2.6 1.8-3.5	2.4 1.6-3.1	3.3 2.4-4.2	2.5 1.7-3.3	3.0 2.2-3.8	1.9 1.2-2.5	2.1 1.4-2.7	2.8 2.1-3.5	1.9 1.3-2.5
	F	1.2 0.7-1.8	1.7 1.1-2.4	2.1 1.4-2.8	1.9 1.2-2.5	2.0 1.3-2.6	2.5 1.8-3.3	2.4 1.7-3.1	2.0 1.4-2.6	1.5 1.0-2.1	2.1 1.5-2.7
Firearms	M	12.8 10.8-14.7	12.0 10.2-13.8	11.6 9.9-13.4	10.0 8.5-11.6	13.2 11.4-14.9	15.4 13.6-17.3	16.9 15.0-18.8	11.8 10.3-13.4	16.0 14.2-17.8	13.8 12.2-15.5
	F	0.5 0.2-0.9	0.3 0.04-0.6	0.3 0.04-0.6	0.2 0-0.4	0.2 0-0.4	0.6 0.2-0.9	0.7 0.3-1.0	0.6 0.3-0.9	0.6 0.2-0.9	0.7 0.3-1.0
Other methods	M	4.4 3.3-5.6	2.7 1.8-3.6	4.5 3.4-5.6	3.5 2.6-4.4	3.7 2.8-4.6	4.8 3.8-5.8	4.9 3.8-5.9	5.6 4.6-6.7	6.5 5.4-7.6	6.7 5.6-7.9
	F	1.1 0.6-1.7	1.5 0.9-2.1	1.2 0.6-1.7	1.6 1.0-2.2	1.2 0.7-1.7	2.2 1.6-2.9	2.3 1.6-3.0	2.3 1.6-2.9	3.1 2.4-3.9	2.1 1.5-2.7
Total	M	39.7 36.2-43.1	47.8 44.1-51.5	48.3 44.7-51.9	45.5 42.2-48.9	46.0 42.8-49.3	52.6 49.2-56.0	52.9 49.6-56.2	50.8 47.6-54.0	61.7 58.2-65.2	54.1 50.8-57.3
	F	7.1 5.7-8.4	11.9 10.2-13.6	12.6 10.9-14.4	10.9 9.4-12.5	12.0 10.2-13.6	13.2 11.6-14.8	13.2 11.6-14.8	11.8 10.3-13.3	15.2 13.5-16.9	14.4 12.8-16.0

Figure 1. Suicide rate by age per 100,000 population in males in Finland from 1947 to 1995



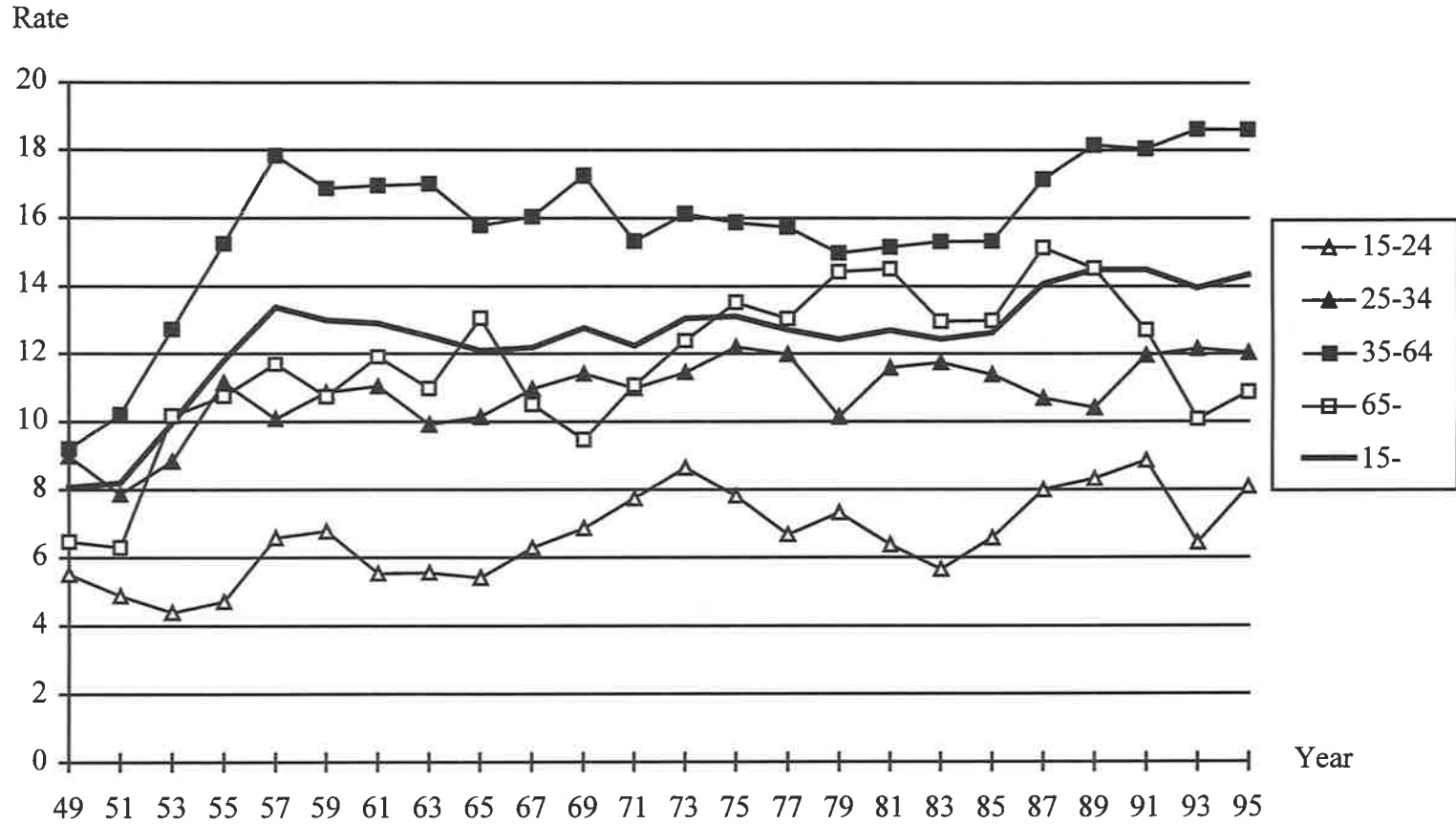
9.2. Trends in suicides and suicide methods in women (I)

Suicide mortality among Finnish women (age over 14 years) increased significantly from 7.1 to 14.4 per 100,000 inhabitants between 1947 and 1995 (Table 1). This upward trend was noticed in all age-groups, but due to small numbers, the change was statistically significant only in the middle-aged (34-64 years) women, whose suicide rate was the highest throughout the study period. In the 1990s, the suicide mortality of women did not reveal any decline similar to that noticed among men (Figure 2). From 1947 to 1990, the proportion of suicides by poisoning expanded significantly from 29.6% to 42.8% (trend test $\chi^2=91.4$, $df=10$, $p<0.0001$) and showed two separate periods of increase: in the 1950s and in the 1980s. In both of these periods, suicides by poisoning increased in all age-groups, but in the 1950s, the change was most obvious among young women (15-24 years) from 32.8% to 58.7% (trend test $\chi^2=17.4$, $df=2$, $p=0.00016$), and in the 1980s, among 25- to 64-year-olds from 33.3% to 47.6% (trend test $\chi^2=41.8$, $df=2$, $p<0.0001$). Suicides by automobile-exhaust fumes remained infrequent among women, at the end of the study period accounting for less than 2.5% of all suicides. On the whole, the most commonly used suicide methods were poisoning, hanging and drowning. At the end of the study period, these methods accounted for 46.6%, 20.3% and 14.4% of all female suicides, respectively (Table 1).

9.3. Trends in suicides and suicide methods in the young (II)

Over the period from 1947 to 1991, suicide rates by 15- to 19-year-old males increased from 16.4 (CI 95% 10.2-22.5) to 35.2 (CI 95% 26.0-44.7) per 100,000 same-age population, while the figures for males 20 to 24 were from 36.3 (CI 95% 26.8-45.3) to 59.0 (CI 95% 47.9-70.5). In both male age-groups, suicide rates showed a significant trend toward an increase for all methods except drowning. The strongest trend in 15- to 19-year-old males was noticed for suicides by firearms, and in 20-to 24-year-olds, for those by

Figure 2. Suicide rate by age per 100,000 population in females in Finland from 1947 to 1995



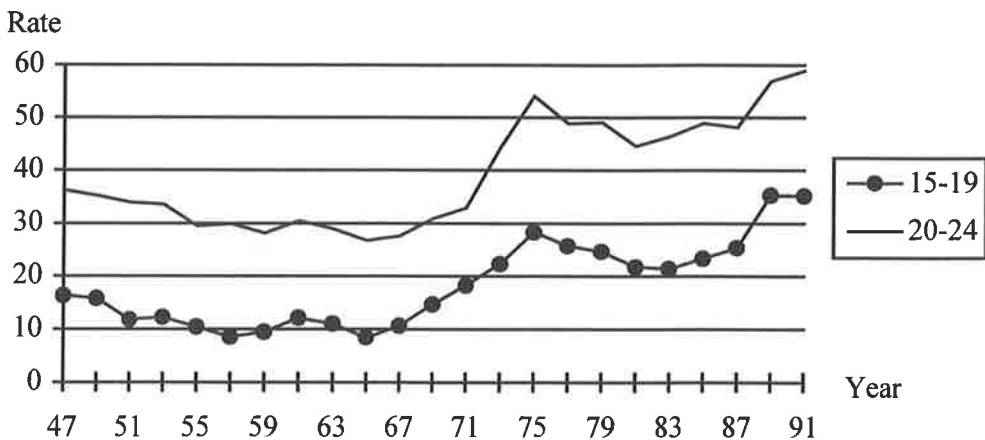
poisoning (including solid, liquid and gaseous substances, Table 2). The most obvious change in suicide mortality among young males was the increase between the mid-1960s and the middle of the 1970s (Figure 3).

Table 2. Suicide trends by various methods in males 15 to 19 and 20 to 24 in Finland from 1947 to 1991

Suicide method	Age 15-19		Age 20-24	
	RR(%) / year	p value	RR(%) / year	p value
Poisoning	2.6 1.3-3.9	< 0.001	3.3 2.6-4.0	< 0.001
Hanging	2.3 1.5-3.1	< 0.001	1.7 1.2-2.2	< 0.001
Drowning	0.99 0.97-1.4	= 0.507	1.0 0.99-1.0	= 0.775
Firearms	3.4 2.7-4.1	< 0.001	0.7 0.3-1.2	= 0.001
Other	4.1 2.8-5.5	< 0.001	3.4 2.5-4.4	< 0.001
Total	2.9 2.4-3.3	< 0.001	1.6 1.4-1.9	< 0.001

RR, rate ratio/year = proportion (%) of the annual change in suicide rate per 100,000 population by each method out of the total change by that method over the study period; 95% confidence intervals shown below the rate ratios (Poisson regression analysis).

Figure 3. Suicide rate in males aged 15 to 19 and 20 to 24 per 100,000 population in Finland from 1947 to 1991



Among 15- to 19-year-olds, firearms and hanging accounted for 41% and 40% of the increase in the total suicide rate, and the corresponding figures in 20- to 24-year-olds were 41% and 36%, respectively (Table 3). In the 1990s, the suicide rate of young men aged 15 to 24 years showed a similar decline as noticed among all other groups.

Table 3. Suicide rates per 100,000 population by method in males aged 15 to 19 and 20 to 24 in the mid-1960s and the mid-1970s; 95% confidence intervals shown below the rates

Suicide method	Age 15-19		Age 20-24	
	1965	1975	1965	1975
Poisoning	1.4 0-2.6	2.3 0.3-4.6	6.5 2.6-10.0	6.5 3.1-9.9
Hanging	2.5 0.5-4.4	10.5 5.9-14.7	7.1 3.0-10.7	17.0 11.6-22.7
Drowning	0.3 0-1.2	1.1 0-2.3	1.5 0-3.6	2.9 0.6-5.0
Firearms	3.7 1.3-6.1	11.8 7.1-16.5	10.6 6.0-15.7	21.8 15.6-28.0
Other	0.6 0-1.2	2.6 0.3-4.6	1.0 0-2.7	5.9 2.7-9.3
Total	8.4 4.6-11.8	28.3 21.1-35.9	26.7 19.1-34.4	54.1 44.4-64.0

Among males of the young age-groups studied, the first suicide by automobile-exhaust fumes was reported in 1965. After that time, an increasing trend in suicide rates by this method was observed in both young male age-groups: 7.3% (CI 95% 3.4%-11.4%) per year for 15- to 19-year-olds, and 6.2% (CI 95% 4.2%-8.2%) per year for 20- to 24-year-old males. Among young adults, the suicide rate by car-exhaust fumes increased particularly in the 1980s. Between 1982 and 1991, in 20- to 24-year-old males, use of car-exhaust fumes accounted for 26% of the increase in the

total suicide rate, equal to the use of firearms, 27%, while the figure for hanging was 13%. Among 15- to 19-year-olds, on the other hand, use of car-exhaust fumes was responsible for only 12% of the increase in the total suicide rate, whereas firearms and hanging accounted for 40% and 26% of that increase, respectively.

In 20- to 24-year-old females, total suicide rates showed a weak upward trend of 0.9% (CI 95% 0.3%-1.5%) per year. No significant trend was discovered for any single suicide method in females of either age-group.

9.4. Suicides by poisoning

9.4.1. Parathion (I)

During the first decade of the present study period, parathion, a pesticide, became an important means for suicide by poisoning. From 1952 to 1958, the total suicide rate increased significantly from 17.6 (CI 95% 16.4-18.9) to 21.0 (CI 95% 19.6-22.3) per 100,000 population. Over that seven-year period, suicides by use of parathion increased rapidly from one single case in 1952 to 102 cases in 1958, and parathion accounted for 48% of the increase in the total suicide mortality, with the figure for all other suicide methods together being 52%. In the 1960s, after restrictions on availability, the use of parathion for suicide gradually decreased. This decline coincided with a downward trend in total suicide rate, which however, did not reach statistical significance. By the early 1970s, the significance of pesticides or other non-medical substances as suicide methods fell, as they were replaced by medicines, especially by psychotropic drugs.

9.4.2. Drugs used for suicide from 1982 to 1992 (I)

Over the period from 1982 to 1992, of all suicides, the proportion by use of antidepressants increased significantly from 1.5% to 5.5% ($\chi^2=71.9$, $df=10$,

$p < 0.0001$). Figures for neuroleptics showed a slight increase from 3.0% to 5.0% ($\chi^2=19.6$, $df=10$, $p=0.033$), whereas the proportion of barbiturates declined from 2.2% to 0.8% ($\chi^2=40.5$, $df=10$, $p < 0.0001$). Over the study period, these three drug groups accounted for the major part (54%) of suicides by overdosing. Fatal toxicity indices (FTI) revealed a consistently high risk for barbiturates, and an upward trend in the figures for antidepressants, while the risk for neuroleptics remained unchanged. In suicides committed by the use of antidepressants, TCAs were the major compounds. The annual number of suicides as well as the FTIs for these drugs increased, while the figures for other antidepressants hardly changed (Table 4). In the cross-sectional analysis of suicides during the research phase of the National Suicide Prevention Project (IV), a high risk, 9.6, was observed also for dextropropoxyphene. In contrast, wide use of benzodiazepines was accompanied by only a few suicides committed with these drugs, the FTI for benzodiazepines being as low as 0.3.

9.4.3. Suicides by antidepressants from 1990 to 1995 (III)

Among all suicides during the period from 1990 to 1995, on average 6.3% were committed by use of antidepressants, with an upward trend from 5.6% to 8.4% ($\chi^2=16.0$, $df=5$, $p=0.0068$). TCAs accounted for 59% and SSRIs or moclobemide for 28% of that increase. TCAs were the principal drugs in the majority (82%) of suicides by antidepressants. On the whole, 76% of all fatal antidepressant poisonings were suicides (Table 5). A single drug was detected in only 14% of all antidepressant poisonings, the proportion being 15% for TCAs, 14% for heterocyclic drugs (maprotiline, trazodone and mianserin) and 9.7% for SSRIs or moclobemide ($\chi^2=1.44$, $df=2$, $p=0.487$, NS). The most common coexisting drug was a benzodiazepine, found in 54% of all antidepressant poisonings. Alcohol (blood alcohol concentration $\geq 0.05\%$, w/w) was detected in 44% of these deaths.

Table 4. Suicides by poisoning and fatal toxicity indices (FTI) for antidepressants, neuroleptics, and barbiturates in Finland from 1982 to 1992

Year	Suicides by poisoning			Suicides by any antidepressants			Suicides by TCAs			Suicide by other antidepressants			Suicides by neuroleptics			Suicides by barbiturates		
	n	DDD	FTI	n	DDD	FTI	n	DDD	FTI	n	DDD	FTI	n	DDD	FTI	n	DDD	FTI
1982	139	17	5.5	3.1	-	-	-	-	-	-	35	10.8	3.2	26	2.9	9.0		
1983	183	28	5.9	4.7	23	4.3	5.3	5	1.5	3.3	40	10.8	3.7	25	2.6	9.6		
1984	186	29	6.2	4.7	24	4.5	5.3	5	1.6	3.1	46	-	-	34	2.3	15.0		
1985	174	34	6.3	5.4	28	5.2	5.4	6	1.1	5.5	44	16.7	2.6	18	2.2	8.2		
1986	220	38	7.4	5.1	32	5.7	5.6	6	1.7	3.5	50	16.4	3.0	24	1.9	13.0		
1987	260	60	7.8	7.7	54	6.2	8.7	6	1.6	3.8	69	17.0	4.1	24	1.6	15.0		
1988	254	52	8.1	6.4	48	6.5	7.4	4	1.6	2.5	62	16.7	3.7	15	1.4	11.0		
1989	256	52	8.5	6.1	45	6.6	6.8	7	1.9	3.7	76	15.6	4.8	11	1.5	7.3		
1990	324	84	9.3	9.0	75	6.8	11.0	9	2.5	3.6	72	15.7	4.5	29	1.3	22.0		
1991	322	78	11.0	7.1	69	7.0	9.9	9	3.8	2.4	73	15.7	4.7	11	1.2	9.2		
1992	303	79	13.0	6.1	67	6.9	9.7	12	5.9	2.0	73	15.5	4.6	11	1.1	10.0		

DDD = number of defined daily doses / 1000 inh. / day

FTI = fatal toxicity index = suicides by a drug related to its number of DDD units

TCA = tricyclic antidepressants

Table 5. Suicides and all fatal poisonings by use of various antidepressants in Finland from 1990 to 1995

Antidepressant	Suicides		Total		Single-drug	
	n	%	n	%	n	%
Amitriptyline	202	37.0	272	38.0	37	35.9
Doxepin	193	35.3	229	32.0	32	31.1
Citalopram	23	4.2	34	4.7	6	5.8
Clomipramine	19	3.5	35	4.9	11	10.7
Trimipramine	23	4.2	32	4.5	2	1.9
Moclobemide	17	3.1	24	3.4	1	1.0
Mianserin	15	2.7	23	3.2	2	1.9
Maprotiline	16	2.9	20	2.8	4	3.9
Trazodone	12	2.2	13	1.8	2	1.9
Nortriptyline	9	1.6	11	1.5	3	2.9
Fluoxetine	7	1.3	11	1.5	0	0
Imipramine	6	1.1	6	0.8	2	1.9
Dibenzepine	2	0.4	2	0.3	1	1.0
Sertraline	0	0	2	0.3	0	0
Nialamid	1	0.2	1	0.1	0	0
Sulpiride	1	0.2	1	0.1	0	0
Fluvoxamine	0	0	1	0.1	0	0
Any antidepressant	546	100.0	716	100.0	103	100.0

In the 1990s, total use of antidepressants in Finland increased markedly from 9.3 DDD units in 1990 to 21.8 in 1995. The strongest increase was noticed for the use of citalopram, fluoxetine and moclobemide, while the use of amitriptyline and doxepin remained stable (Figure 4). In examining FTIs for the six most commonly used antidepressants year by year, amitriptyline and doxepin showed high risks throughout the study period (Figure 5). Overall, in rank order of mean annual FTIs, tricyclics, trazodone and maprotiline presented substantially higher risks than SSRIs, moclobemide or mianserin (Table 6).

Figure 4. Number of defined daily doses (DDD units) of the six most commonly used antidepressants in Finland, 1990 to 1995

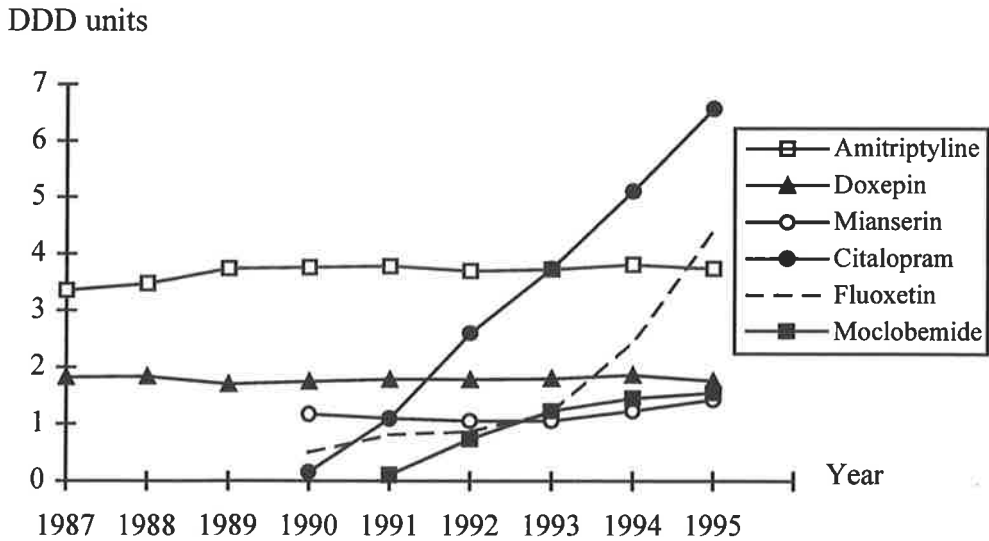


Figure 5. Fatal toxicity indices (FTI) for the six most commonly used antidepressants in Finland, 1990 to 1995

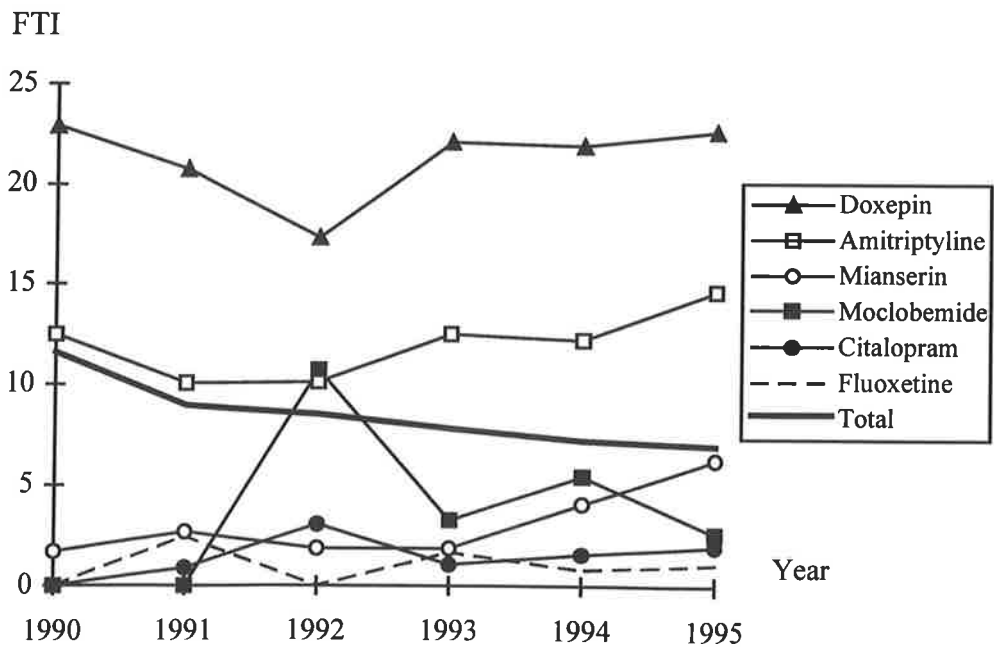


Table 6. Mean annual fatal toxicity indices (FTI) of the ten most commonly used antidepressants in Finland from 1990 to 1995; 95 % confidence intervals shown below the indices

Antidepressant	DDD units mean / year	Drug poisonings n 1990-1995	FTI mean / year
Doxepin	1.79	229	21.3 19.5-23.6
Trimipramine	0.31	32	17.2 11.8-24.2
Trazodone	0.14	13	15.4 8.3-26.2
Amitriptyline	3.75	272	12.1 10.9-13.2
Maprotiline	0.30	20	11.1 6.7-17.2
Clomipramine	0.70	35	8.3 5.7-11.4
Moclobemide	1.24	24	4.8 3.2-7.3
Mianserin	1.18	23	3.2 2.0-4.8
Citalopram	3.21	34	1.8 1.2-2.4
Fluoxetin	1.70	11	1.1 0.6-1.9

DDD units = number of defined daily doses / 1000 inh. / day

FTI = fatal toxicity index = deaths caused by a drug related to its number of DDD units

9.5. Role of alcohol and drugs in suicides (IV)

Throughout the research phase of the National Suicide Prevention Project (from 1 April, 1987 to 31 March, 1988), determination of alcohol and screening for drugs were performed for 96% of all suicides. On the whole, 36% of suicide victims had been under the influence of alcohol at the time of suicide, and 42% had taken some type of drug. Alcohol was significantly more prevalent among men, 41%, than among women, 20% ($\chi^2=47.6$, $p<0.0001$). In fact, any type of drug was observed significantly more often in

women, 67%, than in men, 34% ($\chi^2=107.4$, $p<0.0001$). This difference was most obvious for antidepressants: found in 19% of females but in only 4.8% of male suicide victims ($\chi^2=64.6$, $p<0.0001$). The most frequently detected drugs were benzodiazepines, found in 23% of suicide victims. The next most common were neuroleptics, antidepressants and barbiturates, found in 13%, 8.2% and 7.0% of suicide victims, respectively.

9.6. Suicide hidden among undetermined deaths (V)

During the period from 1 April, 1987 to 31 March, 1988, undetermined deaths that were initially suspected to be suicides accounted for 44% of all officially classified undetermined deaths ($n=139$). Males accounted for the majority (74%) of all undetermined deaths, and half (49%) of the victims were 30 to 49 years old. No significant differences were observed in age-group ($\chi^2=16.4$, $df=12$, $p=0.185$) and gender ($\chi^2=1.68$, $df=2$, $p=0.432$) between suicides ($n=1397$), undetermined deaths initially suspected to be suicides ($n=61$) and the undetermined deaths in which suicide could not be excluded ($n=78$).

9.6.1. Causes of undetermined deaths

Poisoning by solid or liquid substances or by drowning were the most common causes of undetermined deaths, accounting for 46% of undetermined deaths initially suspected to be suicides ($n=61$) and 74% of the cases where suicide could not be excluded ($n=78$). On the other hand, all undetermined deaths in traffic and most of those from "other causes" were initially suspected to be suicides. The "other causes" included deaths from hypothermia, natural causes in which neglect of necessary treatment was suspected, and deaths from some cause unknown due to the advanced decomposition of the corpse. Overall, causes of undetermined deaths differed significantly from those of suicides (Table 7). Deaths by hanging or firearms, in particular, were almost always classified as suicides. Moreover, 93% of

suicides by carbomoxide poisoning were committed by use of car-exhaust fumes, whereas all undetermined deaths by carbomoxide poisoning involved victims of fire.

Table 7. Suicides and officially classified undetermined deaths comprising those initially suspected suicides and cases where suicide could not be excluded, proportions (%) by various causes.

Cause of death	Suicides		Undetermined deaths			
	n	%	suicide suspected n	suicide suspected %	suicide not excluded n	suicide not excluded %
Solids & liquids	268	19.2	22	36.1	41	52.6
Carbomoxide	119	8.5	2	3.3	5	6.4
Hanging	467	33.4	2	3.3	2	2.6
Drowning	96	6.9	6	9.8	17	21.8
Firearms	292	20.9	1	1.6	4	5.1
Cutting	32	2.3	0	0	2	2.6
Fall from a high place	43	3.1	4	6.6	4	5.1
Being run over by a vehicle	49	3.5	6	9.8	0	0
Driving a vehicle	7	0.5	5	8.2	0	0
Fall from a vehicle	1	0.1	1	1.6	0	0
Burning	10	0.7	3	4.9	2	2.6
Other	13	0.9	9	14.8	1	1.3
Total	1397	100.0	61	100.0	78	100.0

Suicides vs all undetermined deaths: $\chi^2=204.4$, $df=11$, $p<0.0001$

Suspected suicides vs cases of suicide not excluded: $\chi^2=33.1$, $df=11$, $p=0.00051$

9.6.2. Evidence of suicide intent in undetermined deaths

Some indirect evidence of suicide intent was observed in 87% of undetermined deaths initially suspected to be suicides. Previous suicide attempt(s) or suicide threats were noted in 31% and 34% of these cases, respectively. Alcohol dependence or abuse was reported in 31% of the victims. Moreover, depression or other mental disorders mainly involving schizophrenia, unspecified psychoses or personality disorders were reported

in one-quarter of the victims. Half of the victims had received treatment in a mental hospital or a mental health center (51%). Psychotropic medication was prescribed for 54% of the victims. In only three victims (4.9%) was no evidence of suicide intent present; in five cases (8.2%), suicide intent could not be assessed because of insufficient information.

9.7. Suicides among driver fatalities (VI)

The present analysis of motor vehicle driver fatalities between 1987 and 1991 in Finland found 84 driver suicides. These cases accounted for 5.9% of all driver fatalities over the study period, the proportion being highest for 25- to 34-year-olds. Of all victims, 74 (88%) were male. The overall mean annual suicide rate by vehicular crash was 0.42 per 100,000 population, a rate which declined with age. On the whole, driver suicides accounted for only 1.2% of all suicides (n=7166) over the study period (Table 8).

Table 8. Suicide rate per 100,000 population by vehicular crash, the proportion of driver suicides in all driver fatalities and in all suicides by age in Finland from 1987 to 1991; 95% confidence intervals shown below the rates and proportions

Age group	Driver suicide rate per 100,000 inh.	Driver suicides of all driver fatalities (%)	Driver suicides of all suicides (%)
15-24	0.90 0.18-1.62	6.3 4.3-8.9	3.3 2.2-4.7
25-34	0.52 0.01-1.03	8.2 5.2-12.3	1.5 0.9-2.3
35-64	0.37 0.09-0.64	6.6 4.6-9.1	0.9 0.6-1.2
65-	0.15 0-0.45	0.5 0.02-2.8	0.1 0.01-0.5
Total	0.42 0.22-0.63	5.9 4.8-7.3	1.2 0.9-1.4

The official classification of death for the 84 cases covered 37 (44%) suicides, 27 (32%) unintentional and 20 (24%) undetermined deaths. All driver fatalities during this study period that were officially classified as suicides were also considered suicides in the present analysis. Among the present study cases that were not officially classified as suicides, the proportion of 15- to 24-year-olds was significantly smaller, 23%, than in the official driver suicides, 49% ($\chi^2=5.84$, $p=0.029$). Furthermore, acute use of alcohol was less frequently detected in the study cases, 19%, compared to the official driver suicides, 46% ($\chi^2=6.63$, $p=0.019$). Otherwise no significant differences were observed between the two groups.

9.7.1. Features and background factors in driver suicides

The majority of the suicide victims (92%) were driving a passenger car (registered for a maximum of eight passengers). Head-on collisions between two vehicles with a large weight disparity (a passenger car / van weighing less than 3500 kg and a truck over 3500 kg) were clearly more common than single-car fatalities. Those drivers committing suicide were seldom accompanied by passengers. Moreover, these cases usually did not result in death of the driver or a passenger in the participant vehicle. History of life-event stress or treatment of mental disorders were associated with 76% and 43% of the driver suicides, respectively, the difference from control drivers being highly significant (Table 9). Moreover, 13% of the suicide victims but none of the controls had previously attempted suicide. No significant differences between the driver suicides and the control fatalities were observed in regard to any history of problems with the use of alcohol, acute use of alcohol, or confused or angry state of mind at the time of the accident, or in physical illness (Table 9).

Table 9. Driver suicides compared with control fatalities in Finland from 1987 to 1991

	Suicides n=84 %	Controls n=84 %	χ^2	p
Passenger car	92	80	4.17	0.041
Single-car crash	16	29	3.27	0.071
Head-on collision	82	36	22.0	<0.0001
Large weight-disparity*	80	18	33.0	<0.0001
Passengers involved	2.4	44	31.4	<0.0001
Other victims involved	3.6	61	42.7	<0.0001
Life-event stress	76	25	35.3	<0.0001
Mental disorders	43	1.2	31.2	<0.0001
Previous suicide attempt	13	0	9.10	0.003
Problems with alcohol	16	8.3	1.80	0.180
BAC \geq 0.05% (w/w)	35	24	1.65	0.199
Confused state of mind	26	17	1.78	0.182
Physical illness	8.3	7.1	0.08	0.782

* Collision between a passenger car or a van (less than 3500 kg) and a truck (over 3500 kg)
BAC = blood alcohol concentration

10. DISCUSSION

10.1. Methodological considerations

10.1.1. Determination of the cause and the manner of death in Finland

According to Finnish law, a medicolegal investigation of the cause and the manner of death should be carried out when death has been unnatural, or is suspected to be unnatural, or when death has been sudden or unexpected. The present legislation has been in force from the year 1974, but the main principles of examining the cause of death, especially in unnatural deaths, have been similar throughout this century. Moreover, the proportion of medicolegal investigations in suicides has not undergone any large variation which may invalidate analyses on suicide trends (Näyhä 1980). Furthermore, since the year 1936, death certificates have been obligatory, and they have been systematically reviewed by a medical officer and collected by the Central Statistical Office of Finland. At first, the National Board of Medical Affairs confirmed a list of diseases and causes of death to be used in death certificates. The 6th revision of the International Classification of Diseases (ICD) was adopted in Finland in 1952, the 7th revision in 1956, the 8th revision in 1969, the 9th revision in 1987, and the 10th revision was adopted in 1996.

Availability of medicolegal autopsies improved in 1973, when offices for forensic pathologists were established in each province of Finland. At that time, the medicolegal autopsy rate reached 18% of all deaths in Finland, and the figure has remained stable over the last two decades. Over the same period, the autopsy rate in unnatural deaths has been on average 90%, and the figure for suicides has been as high as 99%. The number of clinical autopsies, on the other hand, has constantly decreased since the late 1970s and is currently at the same level as in the mid-1960s (Central Statistical Office of Finland 1965-1996a). The overall autopsy rate in Finland is relatively high:

31% in 1995 (Central Statistical Office of Finland 1996a). The corresponding figures for Denmark, Sweden and Norway in the mid-1980s were similar: 36%, 30% and 20%, respectively (Hesso 1987). In the United States in the mid-1980s, on the hand, autopsy (either clinical or medicolegal) was performed in only 15% of all deaths (Council Report 1987). According to these facts, determination of the cause and the manner of death in Finland can be considered reliable, and especially in unnatural deaths with suicide included, also sufficiently consistent to allow for conclusions on suicide trends over time.

10.1.2. Fatal toxicity index in assessing risk of drugs

In the present study, the main focus regarding suicides by drug poisoning has been on fatality risks of various drugs (I, III, IV). Risk was defined by relating the number of fatal outcomes from each drug or drug group to its availability. The same principle of assessing risk has been applied in several reports from the United Kingdom (Cassidy and Henry 1987, Farmer and Pinder 1989, Henry and Antao 1992, Henry et al. 1995), the United States (Kapur et al. 1992), and also in previous studies from Finland (Vuori et al. 1989, Vuori 1992). Availability may be estimated by number of prescriptions (as in most of the reports), number of patients receiving a drug, or by number of DDD units. The limitation of the number of DDD units is that it ignores the actual number of patients receiving a drug, their indications, and doses prescribed for them. In Finland, on the other hand, according to the national prescription register of the Social Insurance Institution, DDD units of various antidepressants reflected well the number of patients receiving these drugs in 1994 (IV). Henry et al. (1995) analysed risk of various antidepressants by using both prescriptions and DDD units as a measure of availability of drugs, and found a strong correlation in the ranking between these two indices. Another method for assessing risk would be to relate the number of completed suicides by use of a drug to the number of prevented suicides for patients using that same drug. The latter figure, however, will always remain

unknown. Finally, the standard pharmacological method of estimating risk by toxicity, defined as LD50 (lethal dose 50), the amount of drug required to kill 50% of the given population, is naturally inappropriate for human beings. On the whole, the method used in the present study probably ignores many related factors among suicide victims, but it provides the means for comparing different drugs and drug groups, and also helps to put the national findings into an international context.

10.2. Suicide trends from 1947 to 1995

The present study analysed trends in the methods used for suicide in Finland over the post-war period covering the last five decades. In this analysis, five trends of interest were distinguished: 1) a steep increase in total suicide mortality in the 1950s, 2) an increased suicide rate among young men between the middle of the 1960s and the mid-1970s, 3) an upward trend in suicides by car-exhaust fumes, especially among young men in the 1980s, 4) trends in suicides by drug poisoning, and finally, 5) a decline in suicide mortality for men in the 1990s. These trends have been examined with a focus on availability and lethality of various suicide methods.

10.2.1. Parathion in the 1950s

Parathion is a pesticide with cholinesterase-inhibiting activity, and it became available in Finland after the Second World War. At that time, in the 1950s, suicide mortality in Finland showed an obvious increase which was observed in all age-groups except for adolescents (15- to 19-year-olds). Suicides by one single method, ingesting parathion (sold under the trademarks Bladan or E650), accounted for a major part of that increase (I). In the 1950s, over 80% of all deaths caused by parathion were considered intentional (Alha 1959, Alha and Isotalo 1964). Subsequently, the availability of parathion was restricted, which resulted in a gradual but obvious decline in its use for

suicide during the 1960s. Access to parathion was presumably first denied to persons who knew its lethal effect and would buy it for the particular purpose of suicide. Later, parathion was obviously available only to those who had stored it for its normal use. The reduction in suicides by parathion coincided with a slight downward trend in total suicide mortality; however, an increase was observed in the use of other methods. Closer analysis of suicide methods suggests that suicides by violent methods, especially by hanging, drowning or firearms, outnumbered the benefit obtained by restricting the availability of parathion. Those are the methods one would expect to be available instead of parathion, especially in the countryside. Currently, parathion suicides are very rare and are usually committed by farmers or gardeners who may acquire a licence to buy parathion.

Despite the significant contribution of parathion to the rise in total suicide rate in the 1950s, the majority of all suicides were still committed by hanging or firearms. Even at its peak, parathion contributed to only 11% of all suicides (I). Therefore, restrictions apparently reduced suicide rate by that particular method but the effect was too weak to significantly reduce total suicide mortality. However, a slight downward suicide trend noticed in the first half of the 1960s followed by an increase towards the 1970s, presented a pattern similar to that observed in the United Kingdom and Australia. Experience from these countries suggest that even though restrictive measures on a widely used suicide method may be effective in reducing total suicide mortality, in the course of time, the restricted methods tend to be replaced by other methods (Kreitman 1976, Oliver and Hetzel 1973).

10.2.2. Violent suicide methods

In the present study, suicide rates of adolescent and young adult males rose steeply between the middle of the 1960s and the mid-1970s, and subsequently, after a short downward trend, continued increasing in the 1980s. These rates followed the general suicide trend, but the changes were

the most obvious particularly among young men. The present analysis indicated that the most significant rise in the total suicide mortality of young men was associated with increased rates by violent methods, mainly hanging, firearms and car-exhaust fumes. Methods chosen by young women aged 20 to 24 years, as well, became more lethal and more likely to succeed, while an upward trend was clear in the rate of suicides in the category "other methods", mainly including jumping from a height or in front of a moving vehicle (II). The majority of all suicides were committed by lethal methods, either by hanging or firearms. This was mainly due to a high frequency of these suicide methods among men, and the fact that male suicide mortality is four times that of females (I).

Availability of firearms in Finland has been relatively highly restricted. A licence from the police is required to buy a gun, and the purpose for the licence must be acceptable. Most of these licences (80%) have been issued for hunting or sports shooting. According to the number of new gun licences in 1963, 1972, 1984 and 1990, the availability of firearms did not undergo any considerable change over the period when firearm suicides of the young men, for instance, showed the largest increase (II, Ministry of the Interior 1994, Ministry of Social Affairs and Health 1974). Therefore, the significant increase in the suicide rate of young men cannot be explained solely by availability. A similar conclusion may be drawn in respect to car-exhaust fumes. The rate of private car ownership in Finland tripled between 1969 and 1991, coinciding with an upward trend in the use of this method for suicide in general (I, Central Statistical Office of Finland 1992). On the other hand, in terms of the annual increase in the number of registered private cars, the greatest increase in the availability of this method did not coincide with the most obvious rise in suicide figures by car-exhaust fumes among young adult males in the 1980s (II). Furthermore, hanging can be considered an almost always readily available method. Hanging was the most commonly used method in all suicides over the whole study period, and it was one of the three violent methods which markedly contributed to the significant increase in the

suicide mortality of young men. Access to this method can be restricted only in specific situations, such as in custody or in hospital isolation rooms. Based on such findings, factors other than availability and lethality must have also been involved in the steeply increased suicide rate for young men in the 1960s and 1970s, and with relatively high suicide mortality in men of all ages.

10.2.3. Suicides by various drugs

In the early 1980s in Finland, the drugs most commonly used for suicide were neuroleptics, followed by barbiturates and antidepressants. Over the period from 1982 to 1992, suicides by neuroleptics and antidepressants showed an upward trend, while those committed by intake of barbiturates decreased (I). The present findings are consistent with those reported from Norway (Retterstol 1993) and Sweden (Carlsten et al. 1996). On the other hand, the rise in the figures for fatal self-poisonings by paracetamol that has been noticed in England and Wales (Farmer 1994, Hawton et al. 1995, 1996), was not observed in Finland.

10.2.3.1. *Antidepressants*

Until 1990, the fatality risk for antidepressants showed an upward trend accompanied by an increase in the number of suicides committed by use of these drugs (I). In the 1990s, these trends diverged (III). Despite a continuous increase in the annual number of suicides by use of antidepressants, the risk associated with these drugs declined significantly. This coincided with the introduction of several new antidepressants in Finland including SSRIs and moclobemide. This reduction in total risk was predominantly explained by the markedly increased consumption of SSRIs, which was not accompanied by any corresponding increase in either suicidal, undetermined or unintentional poisonings by these new drugs. Over the same period, consumption of tricyclics, mainly amitriptyline and doxepin, remained unchanged. These drugs were responsible for the majority of all fatal

antidepressant poisonings, and their fatality risks remained high. Equally high risks were observed for two heterocyclic compounds, trazodone and maprotiline, while the lowest FTIs were associated with fluoxetine, citalopram, mianserin and moclobemide.

The present findings, particularly concerning tricyclics, are consistent with previous studies using similar method for assessing risk. Conclusions on heterocyclic compounds (except for mianserin) in the other studies have, however, suggested an intermediate toxicity for these drugs (Cassidy and Henry 1987, Farmer and Pinder 1989, Henry and Antao 1992, Kapur et al. 1992, Henry et al. 1995). Relatively small figures both for use and for fatal poisonings by use of maprotiline or trazodone in the present study probably contribute to the present discrepancy. The method used for analysing risk seems to have a greater effect. Michel et al. (1994), for instance, compared patterns of drug use in fatal and non-fatal overdoses. They found that barbiturates were the only drugs that were recorded significantly more often in fatal than non-fatal overdoses, whereas no significant differences were observed for tricyclics or other types of drugs. However, the main concern with that study was the lack of toxicological analyses in almost all of the cases, even in completed suicides. In other words, drugs used for the poisoning cases in that study were defined on the basis of medical records. This may be justified by the fact that people often use their own drugs for committing or attempting suicide, but for the same reason, it is no surprise that benzodiazepines, for instance, were the most commonly recorded drugs in both groups.

Isacsson et al. (1997) assessed risk for various antidepressants by relating number of suicides (by any method) in which a particular drug was detected to the number of person-years at risk (obtained from DDD units and prescription data) for that same drug. They found relatively high risks for SSRIs, moclobemide and mianserin. The essential difference in this method of calculating risk is the use of antidepressant detections instead of fatal

antidepressant poisonings as the numerator, which analyses risk in a broader sense than do the fatal toxicity indices examined in the present study. According to their results, on the other hand, tricyclics accounted for 78% of antidepressant detections at toxic level, while the figure for SSRIs was substantially lower, 18%.

Fatal overdoses by use of SSRIs have been reported (Henry et al. 1995, Öström et al. 1996), and such deaths were not rarities in the present study, either. Thirty suicides were committed by use of SSRIs, 6 these being single drug poisonings (III). In our results, citalopram accounted for the majority of suicides committed by use of SSRIs. However, in relation to its wide use and the total number of suicides, citalopram did not represent an essentially higher risk than did other SSRIs. The risk for moclobemide showed greater variation from one year to another than for SSRIs. Closer analysis of this variation revealed a notable proportion of unintentional deaths by moclobemide poisoning in the first two years after its introduction. Moreover, a significant proportion of moclobemide fatalities occurred in combination with clomipramine, and some of the victims were proven to have developed a fatal serotonin syndrome-like illness (Neuvonen et al. 1993). Excluding these combinations, the risk of moclobemide was similar to that of SSRIs or mianserin.

On the whole, the majority (86%) of fatal antidepressants poisonings from 1990 to 1995 involved multiple drugs, the most frequent coexisting drugs being benzodiazepines. Moreover, in a considerable proportion (44%) alcohol was also involved. One may argue that a large proportion of multiple-drug fatalities or the frequent involvement of alcohol gives a misleading or at least too unfavourable picture of risks of individual drugs or drug groups. In spite of several substances being detected, the principal drug causing death has often been obvious, for instance, a high toxic level of doxepin accompanied by traces of diazepam and moderate level of alcohol. In individual cases, however, it may have been extremely difficult and sometimes even impossible

to decide what has been the contribution to death of each substance. On the other hand, if only single drug fatalities were examined, the majority of cases would have been excluded. Therefore, the present method of listing the drug with the highest ratio of detected concentration to therapeutic concentration as the principal drug responsible for death gives useful data for analysing fatal overdoses and comparing different substances. This is supported, for instance, by the fact that estimated risk for an individual drug has not shown large variation from one year to another. Moreover, in the present study, the relative rankings of various antidepressants in multiple-drug fatalities were consistent with those observed in single-drug poisonings.

10.2.3.2. *Other drugs*

The estimated risk for neuroleptics was lower than that for antidepressants and showed a moderately increasing trend. Barbiturates and dextropropoxyphene, on the other hand, showed risks equally as high as for TCAs. These substances differed from TCAs in respect to consumption. Despite limited availability, barbiturates or dextropropoxyphene were used as means for suicide relatively more often than drugs of wider use (I, III). This may be partly explained by substance abuse, which, in several studies, has been found to be associated with increased suicide risk, especially among a young population (Brent et al. 1993b, Bukstein et al. 1993, Hawton et al. 1993, Rich et al. 1986). Availability of a misused drug may therefore persist among risk groups, although its use by the general population declines. Both barbiturates and dextropropoxyphene are known to be misused (Karch 1996, Tacke and Mattila 1996), and most deaths associated with dextropropoxyphene have been classified as suicides (Finkle 1984, Segest 1993, Obafunwa et al. 1994). In suicides in Finland, the problem of dependence or abuse has usually been attributable to alcohol rather than drugs (Marttunen et al. 1991, Henriksson et al. 1993); however, in the current study, suicides committed by intake of dextropropoxyphene or barbiturates seldom involved the victim's own prescribed drugs. Instead,

drugs for these suicides were usually obtained from relatives, acquaintances, or in some cases, even by theft (III).

10.2.3.3. *Restrictive measures on drugs in suicide prevention*

Currently, suicides by drug poisoning account for 28% of all suicides in Finland, 22% of men's suicides and 46% of women's (Central Statistical Office of Finland 1996a). Thus, overdosing is an important means of suicide with its proportions large enough so that method-specific preventive measures may even influence total suicide mortality. In England and Wales, the most commonly used individual drug for both completed and attempted suicide is paracetamol, which is available without prescription (Farmer 1994). Hawton et al. (1995) examined suicide attempters, and found that easy availability and awareness of its potential lethality were the most important reasons for choosing paracetamol for a suicide attempt. However, contradictory views about the significance of the availability of paracetamol in British suicides have been presented by Spooner et al. (1993), who considered chiefly unintentional deaths by paracetamol as preventable.

In Finland, the facts that psychotropic drugs accounted for a major proportion of suicides by overdosing (IV), and that most suicide victims suffered from mental disorders (Henriksson et al. 1993) constitute a contradictory situation in suicide prevention. A continuously increasing number of suicides by antidepressants strongly supports a move toward drugs with low risk whenever appropriate for a patient's clinical condition. It must be emphasised, however, that although antidepressants currently make up the most significant drug group in suicides by poisoning, the majority of all fatal overdoses still resulted from other drugs. Fatality risk seemed to be a less dominant aspect of suicide by neuroleptics. On the other hand, the number of suicides by use of dextropropoxyphene or barbiturates were evidently disproportionate to their availability, which further highlights the necessity of careful prescribing of these drugs.

10.2.4. Recent suicide trends in the 1990s

Total suicide mortality in Finland peaked in 1990, after which the total rate has declined significantly. This declining trend was noticed in all age-groups of men, but the female suicide rate has remained unchanged. Rates by hanging and car-exhaust fumes decreased significantly, whereas the only upward trend was for suicides by solid or liquid substances (III). The expanded use of antidepressants coincided with an increased number of deaths and an upward trend in suicides by use of these drugs. By the end of the study period, hanging remained the most frequently used suicide method, but self-poisoning had become almost equally common. This rise in the number of suicides by antidepressants involved mainly TCAs rather than SSRIs or moclobemide, which showed the largest increase in availability. It seems that the possible benefit of the widened use of new and safer antidepressants did not result in a reduced number of suicides by TCAs, nor by antidepressants on the whole.

A similar trend toward widened consumption of new antidepressants coinciding with a significant decline in the total suicide rate has been observed also in Sweden (Isacsson and Bergman 1996). By comparing suicides among depressive patients who were treated with antidepressants with those who were not so treated, Isacsson et al. (1996) concluded that antidepressants reduce suicide risk among depressives. On the basis of the present results, it is, however, impossible to draw any conclusions on causality between the reduced suicide rate and the considerable increase in use of SSRIs. The decrease in the suicide rate in the 1990s coincided also with the implementation of various preventive measures following the National Suicide Prevention Project in Finland. The findings of the project, for instance, had emphasised identification and treatment of comorbid depressive disorders (Lönnqvist et al. 1995). Experience from Gotland had showed a decline in suicide rates following an educational program for general practitioners (Rutz et al. 1989), although in a five-year follow-up the effect seemed to be temporary, which the authors explained, for instance, by moving

out of the doctors who had participated in the program (Rutz et al. 1992). In fact, in a recent study on psychiatric outpatient care in Finland, improvement was observed in recognition and pharmacological treatment of major depression, as well as an increase in the use of new antidepressants among these patients (Sorvaniemi 1998).

In the first years of the 1990s, an economic depression arrived in Finland, which had been preceded by a strong economic boom in the late years of the 1980s. This economic recession appeared as a steeply increasing unemployment rate, which rose from 3.5% in 1989 to 17% in 1995. At the same time, the central government debt expanded eightfold (Central Statistical Office of Finland 1996b). In a Finnish study from the early 1990s, mental well-being decreased in persons with a low income and uncertainty about the future (Viinamäki et al. 1993). In another study, Martikainen and Valkonen (1996) have reported excess mortality in association with the rapidly increasing unemployment rate in Finland between 1987 and 1992. It would have been expected that suicide mortality would follow this trend and continue increasing in the 1990s. The fact that the opposite occurred implies complex interrelationships between economic factors and suicide mortality. Instead, the suicide rate seems to have peaked in association with the economic upswing rather than with recession.

10.3. Role of alcohol and drugs in suicides

Several studies have concluded that alcohol is often associated with violent behaviour including suicide (Berglund 1984, Murphy and Wetzel 1990, Suokas and Lönnqvist 1995, Ashworth and Gerada 1997, Rivara et al. 1997). The prevalence of acute use of alcohol observed in the present study (IV), 36%, is similar to that reported from Australia (Hayward et al. 1992) and from Hamburg (Kubo et al. 1991). In the San Diego study, alcohol was detected in 28% of suicide victims (Mendelsson and Rich 1993). In Finland,

consumption of alcohol (defined by the use of 100% alcohol per person per year) has increased constantly over the last three decades. In 1960, for instance, 1.4 litres of alcohol was consumed per person, while the figure in 1995 was 6.7. The greatest and the most rapid change occurred in the period from 1965 to 1974, when the annual use of alcohol increased 2.7-fold. The peak, 7.7 litres per person, was observed in 1990, after which alcohol consumption according to the officially reported figures has slightly decreased (Central Statistical Office of Finland 1986 and 1996b). An increased consumption of alcohol has therefore at least coincided with, but possibly also contributed to the increased suicide mortality of men since the 1960s. According to a recent analysis from Finland, this association prevailed especially among men under 50 years of age (Makela 1996). In the present study, the association seems to hold for the opposite trend, as well. The decline observed in the consumption of alcohol between 1990 and 1995 was accompanied by the significantly reduced suicide rate of men over that same period. This is, however, opposed by the fact that some of the alcohol consumption remains excluded from the statistics. In 1995, the estimated amount of consumption of alcohol outside of the official statistics was 2.1 litres per person (Simpura et al. 1997).

Alcohol may not be the sole reason for suicide, but it is found to be a frequent contributor to comorbid depressive disorders among suicide victims (Henriksson et al. 1993). Moreover, suicide intent is an often ambivalent and not even persistent state; therefore, because alcohol is known to weaken impulse-control, it may lower the threshold to a suicide attempt. Accompanied by lethal methods, these impulses are likely to result in a fatal outcome. Therefore, availability and lethality of suicide methods in association with the impairing and triggering effect of alcohol provide one reasonable explanation for the evidently increased suicide rate of men, especially among the young. Our finding is consistent with a report from Brent et al. (1987), who examined suicides among the young over the period from 1960 to 1983. They noticed that the suicide rate by firearms increased

much faster than that by other methods, and the proportion of victims under the influence of alcohol at the time of suicide expanded markedly. Furthermore, suicide victims who had used firearms were more likely to have been drinking than those who had used other methods. The authors concluded that access to firearms in combination with use of alcohol made a significant contribution to the increase in suicide rate among the young.

Comprehensive data on drugs in all suicides in Finland were available only cross-sectionally over the one-year research phase of the National Suicide Prevention Project in 1987. Therefore, it is impossible to draw conclusions on trends. Whereas alcohol was found twice as often in men as in women, the relationship was the reverse concerning drugs (IV). Benzodiazepines, in particular, were observed in women equally often as alcohol among men, which suggests different methods of dealing with anxiety. Moreover, the prevalence for neuroleptics was twice as high in women as among men, whereas the difference in respect of antidepressants was even fourfold. Comparison of these findings with prevalences of mental disorders in a random sample of the same project suggests an obvious undertreatment both of depressive disorders and of psychoses, which were diagnosed in 59% and 25% of the victims, respectively (Henriksson et al. 1993). A discrepancy between the prevalence of these diseases and evidence of appropriate psychotropic treatment in the forensic toxicological examination was most obvious among male victims. This is consistent with the earlier finding by Isometsä et al. (1994), who analysed the frequency of antidepressant prescriptions in the same sample, and found that only 3% of victims suffering from major depression had received antidepressant treatment at adequate doses. This low frequency of antidepressants in suicide victims therefore indicates therapeutic failure, a point of view supported by reports from Sweden (Isacsson et al. 1992, 1994) and the United States (Marzuk et al. 1995).

10.4. Role of imitation

In the present analysis of trends in suicides and suicides methods among the young in the 1980s, the possible effect of imitation of suicidal behaviour came up for discussion (II). A Finnish film, *Ajolähtö* or *Force Play*, directed by Mikko Niskanen, featuring car-exhaust fumes for committing suicide, was released in 1982, when 4.5% of the population (age over 15 years) saw it in the cinema. The movie was later presented three times (1984, 1989 and 1989) on national television. According to the Finnish Film Archives, it reached roughly 1.5 million people, a significant proportion of the population of 5 million (II). These facts imply that awareness of the lethality of car-exhaust fumes presumably increased during the 1980s, especially among the young movie-going population. *Force Play* presents clearly, even though from a distance, the suicide of a young man by the method of using a vacuum cleaner hose to conduct car-exhaust fumes from the exhaust pipe to the inside of the car. Currently, suicides by car-exhaust fumes are mainly committed by that particular method.

Previous analyses of the possible suggestive effect of suicide stories have implied that the effect is the most obvious in persons whose age and sex were similar to the those of the model; and that teenagers, in particular, are prone to imitate suicidal behaviour (Gould and Shaffer 1986, Phillips and Carstensen 1986). Schmidtke and Häfner (1988) have also demonstrated an increase in suicides by the same method as was featured in a model. In the present study, adolescents and young adults were presumably equally often exposed to the suicide story of the movie *Force Play*. Among young adults, in the 1980s, the increase in suicide mortality was mainly associated with increased rates by firearms and by car-exhaust fumes, the latter being the method depicted in the movie. Among teenagers, however, use of car-exhaust fumes did not significantly account for the increased suicide figures over the same period (II). This difference may be partly explained by availability. Considering the age-limit of 18 years for a driver's licence in Finland, young

adults presumably had easier access to this method than did adolescents. Thus, the present study demonstrated a temporal association between exposure to a suicide story and increased suicide rate among people of the same age and sex, and also by the same suicide method as had been featured in the story. In the investigation reports of these young Finnish male suicides, however, no connection with the movie could be ascertained, although a connection may have existed despite its not being determined in the regular investigation of death. It must be emphasised, however, that the present analysis does not allow conclusions on causality between exposure to the suicide story in the film and the increased suicide rate among young men.

10.5. The problem of "missing" suicides

It is generally accepted that suicides are under-reported (Sainsbury and Jenkins 1982). The category of "undetermined deaths", in particular, has been assumed to include mainly concealed suicides (Holding and Barraclough 1975). The use of this classification in different nations is evidently dependent on the procedure of investigating unnatural deaths and standard of proof required (Barraclough 1972, O'Carroll 1989). Moreover, religion, tradition and cultural characteristics affect the acceptability of suicide (Farmer and Rohde 1980). Suicides may be misclassified as unintentional, too, or even as natural deaths. Traffic accidents represent typical occurrences where circumstances usually support the assumption of unintentional injury. Furthermore, some poisoning cases may remain totally unrecognised if a natural cause is available, and no features indicating a poisoning at the death scene or in the history of the deceased were noticed. From the viewpoint of suicide research, the essential concern is the effect of under-recording on suicide mortality, and possible differences in that effect by gender or age.

10.5.1. Suicides among undetermined deaths

Undetermined deaths often involve cases which could be considered intentional from a psychological point of view, but which do not meet the legal criteria for suicide applied in countries of coronial practice. O'Donnell and Farmer (1995) and Kelleher et al. (1996) have therefore recommended applying a clinical definition of suicide as an indicator of the suicide rate. Some researchers have decided to include undetermined deaths in their studies on suicide (McClure 1984, Charlton 1995), and even the confusing term "undetermined suicide" has been adopted (Ferrada-Noli et al. 1997). The present study analysed features of and background factors among undetermined deaths by utilising data both from medicolegal and psychological autopsies (V). The analysis included officially classified undetermined deaths consisting of two distinct groups: undetermined deaths that were initially suspected suicides, and cases where suicide could not be excluded. Psychological autopsy was available only for the first group.

10.5.1.1. *Causes and circumstances*

Causes and circumstances of undetermined deaths differed significantly from those typically observed in suicides, with poisoning or drowning being the most common causes of undetermined deaths. The cases also included falls from a height and deaths by fire. The proportions of fatal poisonings and drownings were larger in the cases where suicide could not be excluded than among suspected suicides. In these deaths (poisoning and drownings), the motive is not self-evident from the circumstances, and lack of eye-witnesses or otherwise sufficient information about the victim's last moments before death obviously contributed to the undetermined classification. In contrast, undetermined deaths in traffic, either by driving or being run over, were usually observed by some other person, and therefore seemed to present features suggesting suicide. However, despite fairly extensive data available in these cases, it has been hard to find convincing evidence of suicide. Perhaps

the requirements for evidence of suicide are higher in traffic deaths, especially if the driving conditions have been poor or if alcohol was involved.

Cooper and Milroy (1995), examining suicides and undetermined deaths, found a significantly smaller proportion of suicides among women than among men. The figure was lowest among females over 45 years of age. They also reported high prevalences for fatal poisonings and drownings among undetermined deaths, and suggested under-recording of female suicides because these methods were favoured by women. The present analysis does not allow a similar conclusion. On the contrary, regarding all deaths by poisoning, drowning or falling from a height in 1987, nearly three-quarters (72%) were classified as suicides among women, while the figure for men was 40% (Central Statistical Office of Finland 1989). Moreover, undetermined deaths were similar to suicides in respect both to age and to gender. According to these findings, the fourfold higher suicide mortality in men compared to that in women can hardly be explained by misclassification of female suicides. Over the present study period, the total rate of undetermined deaths in Finland reached 10% of that of suicides. Even if all of these deaths were truly intentional, which probably is not the case, the increase in total suicide mortality would not have reached statistical significance.

10.5.1.2. *Background factors*

Psychological autopsies were available in 44% of all undetermined deaths. These cases differed from the rest of the undetermined deaths by comprising more traffic deaths and fewer poisoning or drowning cases. The two groups of undetermined deaths were, however, similar in regard to age and gender. Cautious conclusions may therefore be drawn to cover all undetermined deaths. Previous suicidal behaviour in terms of suicide threats or suicide attempts were frequently evident. Similar findings apply to depression and alcohol dependence or abuse. Moreover, half of the victims had been treated

in a mental hospital or mental health clinic or had been prescribed psychotropic medication. According to these findings, undetermined deaths obviously resembled suicides. The higher prevalences for depression and alcohol dependence or abuse in suicides over the same period is partly explained by different diagnostic approaches (Henriksson et al. 1993). These disorders may also be under-reported in medical records. This finding is consistent with previous results by Holding and Barraclough (1975), who reported a high prevalence of psychiatric disorders among undetermined deaths. However, in a later analysis, they compared the same undetermined deaths both to suicides and to unintentional deaths and obtained contradictory results. The authors concluded that research on mortality in association with mental disorders should be widened to all manners of unnatural death (Holding and Barraclough 1978).

10.5.2. Suicides among driver deaths

The present results suggest that 6% of driver fatalities in Finland from 1987 to 1991 were suicides, whereas the figure given in the official statistics was noticeably lower, 2.6%. The obvious explanation for this discrepancy is the much wider data gathered by the accident investigation teams than by officers in regular investigation of death. An earlier study from Finland, which was also based on data collected by the accident investigation teams, revealed an upward trend in driver suicides from 1.1% in the middle of the 1970s to 6.8% in the mid-1980s (Keskinen and Pasanen 1990). The proportional increase is presumably also affected by the decreased rate of motor vehicle fatalities over that same period (Central Statistical Office of Finland 1992). The proportion of suicides among driver fatalities in reports from other countries varies from 1.7% to 2.7% (Schmidt et al. 1977, Jenkins and Sainsbury 1980, Morild 1994). The higher prevalences in Finland may be associated with higher total suicide mortality. Similarly, non-fatal traffic accidents have been claimed to include unrecognised suicide attempts (Grossman et al. 1993).

Phillips (1977, 1979) and Bollen and Phillips (1981), who examined the media effect on suicide figures, also observed increases in the number of motor-vehicle fatalities after published suicide stories. Because this change was most obvious in single-car accidents, the authors concluded that these deaths probably included concealed suicides. The present analysis, however, did not support the picture of single-vehicle fatalities as typical driver suicides. The most common type of accident in driver suicides in Finland was a head-on collision between a passenger car and a heavy vehicle, usually a truck. Most of the victims were young men driving alone, and significant prevalences were observed for life-event stress and evidence of mental disorders. These results thus suggested similar background factors in driver suicides and in Finnish suicides in general (Henriksson et al. 1993, Heikkinen et al. 1994). A history of mental disorders and suicide attempts among controls, however, seem to present lower prevalences than have been estimated among the general population, which is probably due to insufficient information obtained by the accident-investigation teams (Cross-National Collaborative Group 1992, Meehan et al. 1992). In the present analysis, on the other hand, long-term problems with the use of alcohol and acute influence of alcohol were common both in driver suicides and in controls. In several studies, psychiatric impairment, low tension-tolerance, subjective stress, and foremost, alcohol abuse have been found associated with traffic accidents of any kind (Selzer and Vinokur 1974, Noyes 1985, Tsuang et al. 1985). Cushman et al. (1990) observed suicide attempts and suicidal ideation more frequently among those causing motor vehicle accidents than in the general population, and consistent with the present study, drivers with psychiatric diagnoses or depression did not have more single-vehicle accidents than did controls.

Investigation of all motor vehicle fatalities in Finland by use of a standard format furnished useful data for examining driver suicides covering the whole country. Some suicides, however, may have been excluded from the present study if the accident investigation team did not suspect intention to cause the

accident. In the final report, the team presented several possibilities for the key occurrence of the accident, with driver's intention included in the list even if it was not the most probable alternative. On the other hand, in choosing controls among fatalities in which intention was not listed, some cases had to be abandoned because of insufficient information to consider them certainly unintentional. However, none of these cases met the criteria for suicide according to ICD-9. It is therefore unlikely that the number of missing driver suicides is large enough to invalidate the conclusions of the present study. The present results suggest that less than half of the driver suicides are identified. However, due to the low number of these cases in relation to all suicides, under-recording does not affect the reported suicide rate. On the whole, the major concern in these cases is about traffic safety rather than classification of death. The present results imply that young men at risk can be recognised, and that preventive measures focused on them may be beneficial.

11. SUMMARY

11.1. Trends in suicide methods and suicide mortality

This thesis examined suicide trends in Finland over the period from 1947 to 1995. The analysis focused on various suicide methods and the relationship between availability and lethality of the methods and suicide mortality. The suicide rate showed a steep increase in the 1950s, which applied to both sexes and all age groups, except for young men. A significant proportion of this increase was contributed by suicides caused by use of parathion, a highly lethal pesticide. In the 1960s, suicides by parathion decreased following the restrictions on its availability. This coincided with a slight downward trend in total suicide rate, but by the 1970s, the effect was compensated for by an increase in the number of suicides by other lethal accessible methods, mainly hanging, drowning and firearms.

Another significant trend was that observed among young men between the middle of the 1960s and the mid-1970s, when their suicide mortality increased markedly. This increase was predominantly accomplished by two lethal methods, hanging and firearms. This trend was not found to be associated with any changes in availability of firearms.

Suicide by young men presented another upward trend in the 1980s, and was among adolescents once again mainly accomplished by the use of firearms or hanging. Among young adults, on the other hand, suicides by car-exhaust fumes together with firearms were the principal methods contributing to the increased suicide rate. This trend coincided with the release of a popular Finnish film featuring the suicide of a young man by the method of conducting car-exhaust fumes inside a car. The temporal association concurrent with access to the lethal method suggests that imitation may have contributed to the upward suicide trend among young adult men.

Suicides by poisoning showed an increasing trend over the whole study period. Fatality risks of various drugs and drug groups were estimated by relating number of suicides committed by use of a drug to its availability. Risks were examined for various drug groups over the period from 1982 to 1992, and were assessed also for various antidepressants between 1990 and 1995, the period when several new antidepressants were introduced in Finland. From 1982 to 1992, neuroleptics presented an intermediate risk with a moderate upward trend. The risk for barbiturates was constantly high despite the downward trend in the use of these drugs. Between 1982 and 1990, risk for antidepressants increased concurrently with the number of suicides by use of these drugs, after which these trends diverged. In the 1990s, risk for antidepressants turned into a decline in spite of the fact that suicides committed by these drugs continued increasing. Substantial differences in the risk between various antidepressants were observed. The highest risks as well the largest number of deaths were associated with tricyclics, predominantly amitriptyline and doxepin. The lowest risks were observed for SSRIs, moclobemide and mianserin.

The overall suicide rate decreased in the 1990s. This holds for suicides of men in all age-groups, whereas the corresponding trend did not occur for female suicides. Self-poisoning was the only method showing an upward trend, which, however, was balanced by significantly reduced rates by hanging and car-exhaust fumes. At the end of the study period, hanging remained the most frequently used suicide method, but poisoning had become almost equally common.

11.2. Under-recording of suicide

The present study analysed possible under-recording of suicide by examining undetermined deaths and motor-vehicle driver fatalities. Undetermined deaths were similar to suicides in respect to age and gender, but causes of undetermined deaths differed from those of suicides. Fatal poisonings and

drownings accounted for the majority of undetermined deaths, in addition to falls from a height, traffic fatalities and being a victim of fire. According to psychological autopsy reports which were available in some part of the cases, victims of undetermined deaths closely resembled suicides. Driver fatalities were analysed by means of files from the accident-investigation teams. Less than half of the driver suicides were identified. The crashes were usually head-on collisions between two vehicles with a large weight disparity, and the victims were mostly young men with background factors similar to those among suicides in general. On the whole, the present findings imply that both undetermined deaths and driver fatalities included concealed suicides. However, the figure of "missing suicides" is relatively low. The official suicide rate may be underestimated by 10%, which does not significantly influence the reported suicide mortality.

12. CONCLUSIONS

12.1. Implications for suicide prevention

The present study confirmed the view of a connection between a rise in the use of lethal methods and increased suicide mortality. Moreover, the results do not support the view of immediate substitution of a restricted method by other means of suicide, although the benefit achieved by restrictions seem to recede in the long-term. Availability of lethal methods obviously affects the probability of suicide for persons who are predisposed to it. Easy access to a lethal method, particularly in association with alcohol and possibly with a conspicuous model of suicide, may result in a suicide which otherwise would not occur. Restrictions on the availability of lethal methods are therefore useful in suicide prevention both for the general population and for people at risk.

Restricting access to lethal methods naturally does not solve the basic problems and end the causes leading to suicide, but may be essential for winning time for other preventive actions. The fact that suicide mortality in Finland decreased in the 1990s, mainly due to the obviously reduced suicide rate by hanging, promotes the significance of preventive measures other than restrictions. On the other hand, according to present findings, suicides by poisoning showed a continuous increase and have become the second most common method of suicide. In suicide prevention, concern about availability should therefore focus on substances used for self-poisoning, with careful prescribing of potentially lethal drugs emphasised.

12.2. Implications for recording of suicide

The present results imply that poisoning by solids or liquids is the most important cause of death that may involve concealed suicides. Currently, the annual figure for fatal drug poisonings in Finland exceeds 500 cases, one-third

of these being classified as undetermined or unintentional deaths. Therefore, accurate determination of the manner of poisoning deaths is significant for producing reliable suicide mortality data, and hence, for promoting suicide research and prevention. Much attention has been successfully paid to improving traffic safety by extensive investigation of traffic deaths, which, however, account for less than half of the annual number of suicides. A multi-disciplinary approach in equivocal deaths, at least in fatal poisonings, would therefore both improve quality of suicide statistics and continuously produce data for developing suicide prevention.

12.3. Implications for future study

The decreasing overall suicide rate in the 1990s deserves a longer follow-up. From the point of method availability, suicides by poisoning, in particular, establish an area of interest. Regarding the upward trend in fatal overdoses, the role of individual substances other than psychotropic drugs needs to be evaluated. Furthermore, the present findings of under-recording of suicide are inconclusive because the analysis did not include unintentional deaths other than driver fatalities. According to the present findings, fatal poisonings comprise the most important category of deaths with concealed suicides. In the future, the question of under-recording of suicide and its possible effect on suicide statistics should therefore be extended to unintentional deaths with a focus upon fatal poisonings. Moreover, the present study presented descriptive data on possible suicide contagion; the quantitative effect of mass-media on imitation of suicidal behaviour at the population level deserves also to be evaluated.

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15. APPENDIX

APPENDIX I

Anatomical therapeutic chemical codes of drug groups and defined daily doses of various antidepressants studied.

Drug group	ATC-code
Antidepressants	N06A
Barbiturates	N05CA/B
Benzodiazepines	N05BA/CD
Neuroleptics	N05A
Dextropropoxyphene	N02AC04

Antidepressant	ATC-code	DDD (1995)
Amitriptyline	N06AA09	75 mg
in combinations	N06CA01	75 mg
Citalopram	N06AB04	20 mg
Clomipramine	N06AA04	100 mg
Dibenzepine	N06AA08	*300 mg
Doxepin	N06AA12	100 mg
Fluoxetine	N06AB03	20 mg
Flovoxamine	N06AE02	100 mg
Imipramine	N06AA02	100 mg
Maprotiline	N06AC01	100 mg
Mianserin	N06AC02	60 mg
Moclobemide	N06AG02	300 mg
Nialamid	N06AZ02	#100 mg
Nortriptyline	N06AA10	75 mg
Trazodone	N06AD02	300 mg
Trimipramine	N06AA06	150 mg
Paroxetine	N06AB05	20 mg
Sertraline	N06AB06	50 mg
Sulpiride	N05AL01	800 mg

ATC = anatomical therapeutic chemical, DDD = defined daily dose

* 1992, # 1990

APPENDIX II - Undetermined deaths during the National Suicide Prevention Project
Data collection format

1. Case number	_____
2. Toxicological number	_____
3. Age	_____
4. Gender	01 male 02 female
5. Marital status	01 single 02 married 03 divorced 04 widowed 99 unknown
5. Immediate suicide threat	01 yes 02 no 99 unknown
6. Suicide note	01 yes 02 no 99 unknown
7. Indirect evidence of suicidal intent	00 none 01 preparations for death 02 unusual farewell 03 desire for death 04 hopelessness 05 difficult life situation 06 rehearsing means of death 07 avoiding rescue 08 previous suicide attempt(s) 09 previous suicide threat(s) 10 significant losses (actual or threatening) 11 depression (received treatment by a specialist) 12 alcohol dependence or abuse 13 other mental disorder (received treatment by a specialist) 99 unknown
8. Psychiatric treatment in hospital / mental health clinic	01 yes 02 no 99 unknown
9. Psychotropic medication	01 yes 02 no 99 unknown
10. ICD-code for cause of death	970-978 9791 under vehicle 9792 driver 9793 fall from a vehicle 9794 burning / fire death 9795 freezing 999 unknown 000 natural death

APPENDIX III

Driver suicides- data-collection format

1. Case number _____
2. Accident-investigation team number _____
3. Date of accident _____
4. Date of death _____
5. Vehicle
 - 1 passenger car
 - 2 van
 - 3 motorcycle
 - 4 other motor vehicle
 - 5 bicycle
 - 6 pedestrian
 - 7 other
 - 9 unknown
6. Passengers
 - 1 no
 - 2 yes
7. Participant vehicle
 - 1 lorry / truck
 - 2 bus
 - 3 van
 - 4 passenger car
 - 5 motorcycle
 - 6 train
 - 7 other
8. Injuries to participant
 - 1 no injuries
 - 2 minor injuries
 - 3 severe injuries
 - 4 death
 - 9 unknown
9. Type of accident
 - 01 head-on collision
 - 02 driving off the road
 - 03 collision with a stationary object
 - 04 rear-end collision
 - 05 collision with a train
 - 06 driving over a pedestrian
 - 07 other
 - 99 unknown
10. Road conditions
 - 1 dry
 - 2 wet
 - 3 icy
 - 9 unknown
11. Road type
 - 1 straight lane
 - 2 hill
 - 3 curve
 - 4 cross-roads
 - 5 other
 - 9 unknown
12. Environment
 - 1 daylight
 - 2 street lights
 - 3 dark
 - 4 fair
 - 5 rain, fog
 - 6 other
 - 9 unknown
13. Province
 - 01 Uusimaa
 - 02 Turku and Pori
 - 04 Häme
 - 05 Kymi
 - 06 Mikkeli
 - 07 North Karelia
 - 08 Kuopio
 - 09 Central-Finland
 - 10 Vaasa
 - 11 Oulu
 - 12 Lapland
14. Age
15. Gender
 - 1 male
 - 2 female
16. Marital status
 - 1 single
 - 2 married / cohabiting
 - 3 divorced
 - 4 widowed
 - 5 unknown
17. Occupation
 - 01 entrepreneur
 - 02 farmer
 - 03 managerial personnel
 - 04 white-collar personnel
 - 05 blue-collar personnel
 - 06 service-sector worker
 - 07 student
 - 08 housewife
 - 09 retired
 - 10 no occupation
 - 11 other
 - 99 unknown

18. Prior driving style
 1 high speed
 2 normal speed
 3 slow
 4 stopped
 5 unstable
 6 other
 9 unknown
19. Prior driving event
 1 sharp turn
 2 gentle slope
 3 overtaking
 4 other
 9 unknown
20. Efforts to avoid
 1 not observed
 2 tried to control
 3 braking
 4 other
 9 unknown
21. Purpose of the trip
 1 work
 2 other business
 3 pleasure drive
 4 other
 9 unknown
22. Driver's licence
 1 yes
 2 cancelled
 3 no
 9 unknown
23. Sight
 1 good
 2 glasses, in use
 3 glasses, not in use
 9 unknown
24. Chronic illness
 01 eye disease
 02 impaired hearing
 03 neurological disorder
 04 psychiatric disorder
 05 other mental disorder
 06 alcohol dependence or abuse
 07 cardiac disease
 08 diabetes
 09 renal disease
 10 musculoskeletal disorder
 11 other
 99 unknown
25. Acute illness
 1 no
 2 fever, common cold
 3 headache
 4 probable stroke
 5 other
 9 unknown
26. Substance misuse
 1 none
 2 alcohol
 3 drugs and/or alcohol mixed
 4 illicit drugs
 5 other
 9 unknown
27. Medication
 1 no
 2 regular psychotropic medication
 3 regular other medication
 4 occasional
 9 unknown
28. Life events
 01 death or loss of next of kin
 02 divorce
 03 termination of a relationship
 04 problems in other personal relationships
 05 job problems
 06 unemployment
 07 change of job
 08 start of studies
 09 loss of money
 10 health problems
 11 guilt, humiliation
 12 suicide of next of kin
 13 confusing / difficult life situation
 14 other
 15 nothing special
 99 unknown
29. Future plans
 1 pressing / exciting changes ahead
 2 hopelessness
 3 normal situation
 4 other
 9 unknown

30. State of mind
 1 excited
 2 confused
 3 depressed
 4 irritated, angry
 5 other
 6 normal
 9 unknown
31. Traffic penalties
 1 none
 2 drunken driving
 3 speeding
 4 other
 9 unknown
32. Traffic accidents
 1 none
 2 single-car accidents
 3 multiple-car accidents
 4 other
 9 unknown
33. Education
 1 primary school
 2 high school
 3 college
 4 trade school or institute
 5 university
 6 other
 9 unknown
34. Autopsy number _____
35. Underlying cause of death _____
36. Official classification of death _____
37. Contributing causes _____

38. Blood alcohol concentration _____
39. Urine alcohol concentration _____
40. Toxicological analyses
 01 analysed, no findings
 02 antidepressant drug
 03 neuroleptic
 04 benzodiazepines
 05 other drug acting on CNS
 06 illicit drug
 07 analgesic
 08 cardiac therapy
 09 other
 99 unknown, not analysed
41. Own assessment
 1 suicide highly probable
 2 suicide fairly probable
 3 suicide possible
 4 suicide fairly improbable
 5 suicide highly improbable
42. Death self-inflicted
 1 yes
 2 no
 9 unknown
43. Suicide intent
 01 previous suicide attempt(s)
 02 suicide threats
 03 hopelessness
 04 suicide note
 05 preparations for death
 06 learning about means of death
 07 rehearsing suicidal acts
 08 other obviously suicidal behaviour
 09 no evidence on suicide intent
 99 unknown
44. Risk factors
 01 severe physical illness
 02 mental disorder
 03 alcohol dependence or abuse
 04 state of mind
 05 acute use of alcohol or drugs
 06 careless attitude
 07 knowledge
 08 skill
 09 speed
 10 vehicle's condition
 11 environmental /circumstantial factors
 12 other
 13 no risk factors observed
 99 unknown
45. Key occurrence(s) _____
46. Risk factors _____
47. Source of information
 1 driver of the participant vehicle
 2 other participants
 3 witnesses
 4 police records
 5 relatives
 6 other records
 9 unknown
48. Injury Severity Score _____

