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Main Characteristics of Train-Pedestrian Fatalities on Finnish Railroads

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Abstract

The aim of this study was to describe the frequency of fatalities, timing of collisions and characteristics of persons killed in train-pedestrian collisions on Finnish railways during 2005–2009. In addition, the Finnish results were compared with those collected in Sweden. The Finnish data were combined from five different sources. The results showed that 311 pedestrians were killed in train-pedestrian collisions, including 264 suicides, 35 accidents and 12 unclassified events. For each event type, most of the victims were male. Most suicide victims were in the 20–29 year age group and on average younger than people who chose some other form of suicide. About half of all victims were intoxicated by alcohol, medicines and/or drugs. Both suicides and accidents occurred most often at the end of the week but no specific peak for time of year was found. Suicides occurred most frequently from afternoon to night and accidents during the rush hours. Most train-pedestrian fatalities happened in densely populated areas. In conclusion, the effective prevention of railway suicides and accidents calls for a systems approach involving effective measures introduced by authorities responsible for urban planning, railways, education and public health.

1. Introduction

Among all fatal railway accidents in Finland, train-pedestrian fatalities are the most frequent accident type (European Railway Agency, 2010). During 2006–2008 a total of 211 people were killed in railway accidents in Finland; if road users, railway passengers and railway personnel involved in railway accidents are excluded, 185 fatalities remain. Thus 87.7% of all the fatalities on Finnish railroads are train-pedestrian fatalities, sustained by trespassers (i.e. pedestrians walking on the track or crossing the track outside level crossings) and people who commit suicide.

The statistics of the European Railway Agency (2010) show that 80% of train-pedestrian fatalities on Finnish railways were suicides during 2006–2008. However, it is frequently challenging to determine whether or not a given death is an (unintentional) accident or a (intentional) suicide, since in many cases there is insufficient information to make a definitive classification (Mishara, 2007). This concerns both railway fatalities (Mishara, 2007) and road traffic fatalities (Hernetkoski and Keskinen, 1998). In addition to practical issues (such as insufficient information), the accurate identification of railway

suicides can be complicated due to the social, legal, financial or ethical implications of assigning suicide as a cause of death (Lobb, 2006). Given that such a classification is needed for statistical purposes, the European Railway Agency (2008) has developed guidelines for distinguishing suicides from trespassing accidents. Specifically, the evidence of suspected suicide includes factors such as a suicide note, behaviour demonstrating suicidal intent, previous suicide attempts or prolonged depression.

On average, 1,000 suicides per year have been committed in the 21st century in Finland (Official Statistics of Finland, 2011a). Compared with the neighbouring countries, suicides are more common per inhabitant in Finland than in Denmark, Norway or Sweden, but less common per inhabitant than for example in the Baltic countries or Russia (National Institute for Health and Welfare, 2008).

Official Statistics of Finland (2011b) shows that the most frequently used suicide method in Finland during 2006–2008 was hanging for men (32%) and poisoning with medicines for females (52%). Four to five per cent of all suicides were railway suicides. In other European countries the proportion of railway suicides has been relatively similar, for example 5% in Sweden (Rådbo et al., 2005), 6% in Austria (Deisenhammer et al., 1997), 7% in Germany (Baumert et al., 2005) and 5% in England and Wales (Symonds, 1994).

Railway suicides constitute a relatively small percentage of total suicides committed in Finland. However, the societal costs of suicides, as well as unintentional train-pedestrian fatalities, are high. In addition to the loss of human life, train-pedestrian collisions cause considerable delays (primary and secondary) to railway traffic and a serious work-related stress factor and trauma for engine drivers, other railroad and rescue employees and to people who witness the event (e.g. Mishara, 2007; Rådbo et al., 2005; Wildson, 2008). Specifically, the situation is traumatic to engine drivers who in most cases see the victim alive before the accident and the body afterwards (Cothereau et al., 2004).

Railway suicide is a highly lethal suicide method. Specifically, the studies conducted in the Netherlands (Van Houwelingen et al., 2010), Germany (Erazo et al., 2005; Schmidtke and Ober, 1991), Austria (Deisenhammer et al., 1997) Denmark (Lindekilde and Wang, 1985) and Australia (De Leo and Krysinska, 2008) showed that approximately 90% of all railway suicides result in death.

The main aim of this study was to describe the frequency of fatalities, timing of collisions and characteristics of persons killed in train-pedestrian collisions on Finnish railways.

The results should provide us with useful information on train-pedestrian collisions and make it possible to investigate similarities and differences between different types of events (suicide, accident, unknown). This knowledge in turn will help identify focal areas for future research, and help determine general preventive strategies for train-pedestrian collisions or separate strategies for different types of events. For example, Mishara (2007) indicated that prevention strategies for reducing trespassing accidents are not necessarily similar to those for preventing suicides, because as opposed to accidents, suicides consist of persons deliberately putting themselves in situations where they will be struck by a train.

2. Method

The analysis included train-pedestrian fatalities during 2005–2009. Five primary sources of data were used for the analysis: (1) the Finnish rail operator (VR Group Ltd.), (2) the Finnish Transport Agency, (3) Finnish Police, (4) the Rescue Department and (5) Statistics Finland. A combined database was established as follows: First, the number of events was based on police reports and death certificates received from Statistics Finland. These are the only official sources of information on the seriousness and intentionality of an event; however, the information did not match perfectly between them, and some cases were included in one but not the other. If a case was included in the Statistics Finland database but there was no police report, the cause was assumed to be an imperfect search function in the database of the Finnish police — specifically, a lack of necessary keywords for identifying all target cases. If a case was included in the database of the Finnish police but not in that of Statistics Finland, the assumed cause was insufficient information on the death certificate (e.g. train or railway tracks not mentioned). Thus all cases in both official databases were included in the combined database even if unconfirmed in one of them.

Secondly, the databases of other organisations provided specific information on the time of occurrence, place, victim's pre-crash behaviour and type of train involved. Consequently, the combined database included information related to time of occurrence, age and sex of the victim, place, victim's pre-crash behaviour, type of event, type of train, intoxication and mental health. Table 1 summarizes all included variables by source of information.

Table 1. Variables in combined database by source of information

Variable	Source of information
Gender and age	Statistics Finland, Finnish Police
Location and time	Finnish rail operator, Rescue Department, Finnish Transport Agency
Intentionality	Statistics Finland, Finnish Police
Pre-crash behaviour	Finnish Police, Finnish rail operator
Use of alcohol	Statistics Finland
Mental health	Statistics Finland, Finnish Police
Information on self-destruction	Statistics Finland, Finnish Police
Information on suicide note or farewells	Statistics Finland, Finnish Police
Train	Finnish rail operator

The final data included all cases from the police reports and death certificates of Statistics Finland that satisfied the criteria of intentional or unintentional train-pedestrian fatality. The unintentional fatalities of railway employees or those that had occurred at level crossings were excluded based on the classification of official railway statistics.

Information concerning intoxication (alcohol, medicines and drugs) was gleaned from the death certificates of Statistics Finland. Although the decision to measure the alcohol/medicine/drug level is made by the coroner, the measurement is done in almost all cases. Thus, all victims with no information on alcohol level were assumed not to be intoxicated. Specifically, alcohol and medicines are tested for in all victims and drugs generally in all victims except the elderly. A blood alcohol level of 0.05% or more is entered on the death certificate.

Information concerning mental health, self-destruction and suicide note or farewells was collected from the death certificates of Statistics Finland and from police reports. In several cases the information in the police reports was augmented based on interviews with close relatives.

The main results are presented in frequency tables. For more detailed insight into the results, the Finnish data was examined by gender, age and type of event (excluding unknown cases). Chi-square tests were applied to these analyses. Due to some age groups having a low number of observations the age groups were combined into two groups: less than 30 years and 30 years or more (excluding one unknown case).

3. Results

During the 5-year observation period, a total of 311 train-pedestrian fatalities occurred on the Finnish railway network. Of this number 264 (84.9%) were classified as suicides, 35 as

accidents and 12 as unclassified events. The overall number of completed suicides in the Finnish population covering the same time period was 5,109. Thus, fatal railway suicides accounted for 5.2% of all suicides over the 5-year period, ranging from 4.6% in 2006 to 5.7% in 2009.

3.1. Gender and age

Table 2 shows that in all types of train-pedestrian fatalities most victims were males (71% of suicides, 77% of accidents and 100% of unknown events). The male/female ratio for suicides was 2.4:1 and for accidents 3.4:1.

Table 2. Victim's gender and age by type of event.

Variable/level		Type of event			
		Suicide	Accident	Unknown	Total
Gender	Male	187	27	12	226
	Female	77	8	0	85
	Total	264	35	12	311
Age	0−9	0	1	0	1
	10−19	38	5	0	43
	20−29	66	13	5	84
	30−39	51	4	1	56
	40−49	39	4	1	44
	50−59	49	2	3	54
	60−69	14	2	0	16
	70−79	5	3	1	9
	80−89	2	1	0	3
	Unknown	0	0	1	1
	Total	264	35	12	311

Approximately half of the suicide victims (44.3%) were 20–39 years old and 51.4% of all accidents happened to people aged 10–29 years. There were no significant differences between genders or among age groups in incidence of accidents or suicides. In addition, there was no significant association between gender and age.

People who commit railway suicide are on average younger than people who choose some other suicide method (Figure 1). For example, the proportion of suicide victims under 40 years of age was 58.7% among railway suicides and 33.6% among all suicides. Figure 1 also shows that by comparison with the population, railway fatalities are substantially overrepresented (suicides at age 20–39 years and accidents at age 20–29 years).

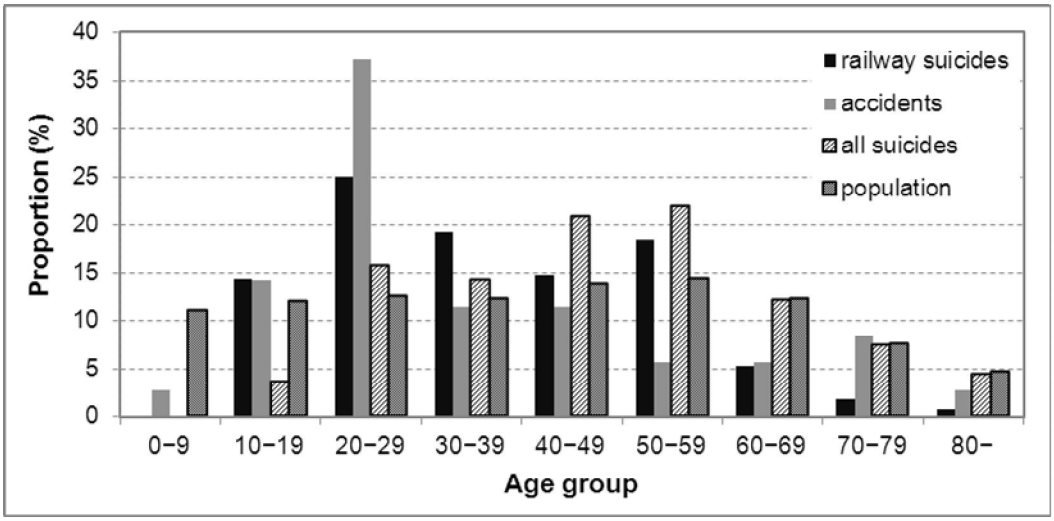

Figure 1. Train-pedestrian fatalities by age group. The comparison includes railway suicides and accidents during 2005–2009, all suicides in Finland in 2009 (Official Statistics of Finland, 2011a) and the population of Finland in 2009 (Statistics Finland, 2010).

3.2 Pre-crash behaviour

Table 3 shows that a majority of suicide victims waited on the tracks for a while before the train arrived (60.2%, if *unknown* cases were excluded). Less frequent behaviours included running or jumping in front of the train and walking in front of the train or along the tracks.

Table 3. Victim's pre-crash behaviour by type of event.

Behaviour	Suicide	Accident	Unknown	Total
Lying, standing, sitting, crouching or kneeling on the tracks (waiting/loitering on the tracks)	133	9	2	144
Running or jumping in front of the train	48	0	1	49
Walking in front of the train	20	2	0	22
Walking on the tracks	15	4	3	22
Crossing the tracks	2	10	0	12
Other	3	1	0	4
Unknown	43	9	6	58
Total	264	35	12	311

Accidents happened most frequently in situations when a person was crossing the track (38.5%) or was lying/sitting on the tracks (34.6%). In addition, some people were walking along the tracks. Interestingly, every victim except one who was lying/sitting on the tracks before the crash was intoxicated. There was no significant difference between genders or age groups in pre-crash behaviour of suicides or accidents.

3.3. Intoxication and mental health

Among all train-pedestrian fatalities, 153 victims (50.5%) were intoxicated by alcohol, medicines and/or drugs (Table 4). Males (55.5%) were more frequently intoxicated than females (37.3%) ($\chi^2(1)=7.90$, $p < 0.01$). Furthermore, the victims of accidents were more frequently intoxicated (68.6%) than in suicides (48.9%) ($\chi^2(1)=4.80$, $p < 0.05$). There was no significant difference between age groups in the frequency of intoxication.

Table 4. Victim's intoxication and mental health by type of event.

Variable/level		Type of event			
		Suicide	Accident	Unknown	Total
Intoxication	Alcohol, medicines and/or drugs	128	24	1	153
	No alcohol	134	11	5	150
	Unknown	2	0	6	8
	Total	264	35	12	311
Mental health	Depression	61	0	1	62
	Other mental health problems (often also include depression)	42	1	0	43
	No mental health problems	160	33	1	194
	Unknown	1	1	10	12
	Total	264	35	12	311

The suicide victims suffered from mental health problems much more frequently (39.2%) than accident victims (2.9%) ($\chi2(1)=17.50$, $p < 0.001$).

Female suicide victims suffered from mental health problems more frequently (58.4%) than male suicide victims (31.2%) ($\chi^2(2)=16.98$, $p < 0.001$) (*unknown* cases were excluded). There was no significant difference between age groups in the frequency of mental health problems of suicide victims.

According to close relatives interviewed by the police, 27.3% of suicide victims had tried to commit suicide previously or had threatened to do so. This behaviour was more likely for females (37.6%) than males (18.7%) ($\chi^2(1)=11.96$, $p < 0.01$). There was no significant difference between age groups in self-destructive behaviour.

Among the suicide victims, 18.2% left a suicide note and 5.3% said goodbye to their close relatives by SMS or phone call. There was no significant difference between genders or age groups in leaving farewells.

3.4. Time of occurrence

Train-pedestrian fatalities were quite evenly distributed by month (Table 5). Most suicides (52.3%) were committed in May, July, August, November or December and most accidents in March and November. However, due to the small amount of accidents the latter result should be interpreted with caution.

Both suicides (49.2%) and accidents (65.7%) occurred most frequently at the end of the week (from Friday to Sunday).

Table 5. Fatal train-person collisions by time of occurrence (month, day and hour) and by type of event.

Variable/level		Type of event			
		Suicide	Accident	Unknown	Total
Month	January	19	4	2	25
	February	14	0	0	14
	March	15	5	1	21
	April	24	2	2	28
	May	27	1	0	28
	June	18	1	0	19
	July	31	4	1	36
	August	26	4	3	33
	September	15	2	1	18
	October	21	3	0	24
	November	26	6	1	33
	December	28	3	1	32
	Total	264	35	12	311
Weekday	Monday	33	2	0	35
	Tuesday	32	4	0	36
	Wednesday	35	5	3	43
	Thursday	34	1	0	35
	Friday	41	7	2	50
	Saturday	44	9	4	57
	Sunday	45	7	3	55
	Total	264	35	12	311
Hour	0−3	21	4	1	26
	3−6	15	3	1	19
	6−9	15	4	2	21
	9−12	19	0	1	20
	12−15	35	1	0	36
	15−18	35	6	1	42
	18−21	37	2	0	39
	21−24	45	4	2	51
	Unknown	42	11	4	57
	Total	264	35	12	311

Suicides occurred most often in the afternoon, evening and after midnight. By contrast, accidents occurred most frequently during the afternoon rush hour (between 3 p.m. and 6 p.m.). The effect of age on hour distribution of suicides was statistically significant ($\chi^2(7)=19.40$, $p < 0.01$), with people less than 30 years old committing suicide most frequently during evening and night time (between 6 p.m. and 3 a.m.), whereas older people committed suicide most frequently between noon and midnight (Figure 2). There was no other significant difference between genders, age groups or type of events in time of occurrence (month, day and hour).

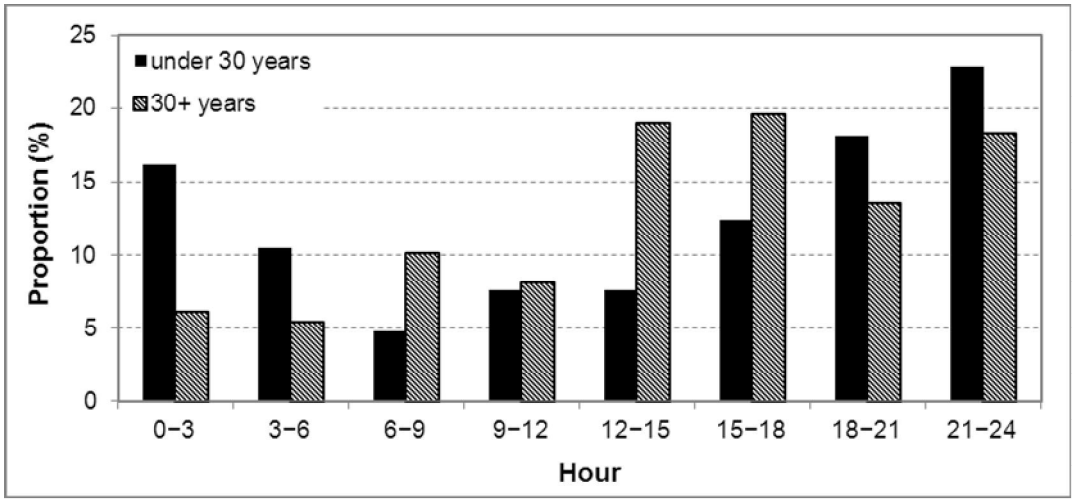

Figure 2. Railway suicides by age group and time of day (N=222).

3.5. Place, location and train

Train-pedestrian fatalities concentrated in areas where the population density is high and the train traffic is dense. Out of all train-person fatalities, 24.1% occurred at currently or formerly used railway stations or in their vicinity (no more than 100 metres away). The proportion is about the same for both suicides and accidents.

5. Discussion

The main aim of this study was to describe the frequency of fatalities, timing of collisions and characteristics of persons killed in train-pedestrian collisions on Finnish railways. The results showed that most of the victims were males in all types of fatal train-pedestrian collisions. The gender ratio for railway suicides is similar to that found in Sweden (Rådbo et al., 2005), Germany (Erazo et al., 2004) and Austria (Deisenhammer et al., 1997). In addition, the result showing that most of the people killed unintentionally in train-pedestrian accidents were males is supported by findings from other studies (e.g. George, 2007; Patterson, 2004; Rail Safety and Standards Boards, 2007). In summary, the results suggest that the Finnish gender ratios are pretty similar to those in earlier studies.

People who commit railway suicide are on average younger than people who choose some other suicide method. This has been found in many countries, such as Sweden (Rådbo et al., 2005), the Netherlands (van Houwelingen et al., 2010), Germany (Schmidtke, 1994) and Denmark (Lindekilde and Wang, 1985). The same applies to Finland, but the proportion of young suicide victims is even higher than for example in Sweden. Although no evident explanation for the high proportion of young suicide victims is available, Van Houwelingen et

al. (2010) have proposed that young people may choose railway suicide as a method due to the high levels of impulsivity at that age and not having access to alternative means, such as medication. Overall, these results suggest a special focus on young people in the prevention of railway suicides.

The majority of suicide victims seemed to be waiting in the vicinity of the track for a while before the train arrived. This result is in agreement with the Swedish (Rådbo et al., 2005), German (Dinkel et al., 2011) and Australian (De Leo and Krysinska, 2008) results. The accidents happened most often in situations where a person was crossing the track. This is in agreement with our earlier results showing that trespassers are typically looking for the shortest and fastest route or using an existing path (Silla and Luoma, 2009).

Among all train-person fatalities, almost half of the victims were intoxicated by alcohol, medicines and/or drugs. In addition, males – who consume 63% of alcohol in Finland (Mustonen et al., 2009) – were more frequently intoxicated than females. Furthermore, 39.2% of suicide victims had mental problems before the event. This was more frequent among female victims who also had tried to commit suicide or threatened to do so more often than males. Overall, these results are supported by earlier results. Specifically, an Australian study (De Leo and Krysinska, 2008) showed that a positive blood alcohol content was found in 47.3% of young suicide victims and in 29.8% of all train suicide victims. In addition, De Leo and Krysinska (2008) documented a psychiatric diagnosis in 40.4% of all train suicide victims. A considerable proportion (65%) of documented history of psychiatric disorder has also been documented in the Netherlands (van Houwelingen and Kerkhof, 2008) and in one county in Denmark (81%) (Lindekilde and Wang, 1985).

The proportion of intoxicated victims was even higher for accidents (68.6%) than for suicides (48.9%). The finding that many accident victims who were killed were intoxicated with alcohol or drugs is supported by several previous studies (e.g. George, 2007; Lerer and Matzopoulos, 1996; Patterson, 2004; Pelletier, 1997).

Train-pedestrian fatalities were not concentrated to any specific months, although somewhat lower frequencies of suicides were found for January to March. In Sweden more suicides were committed during the summer months (April to September) than during the winter months (October to March) (Rådbo et al., 2005) and in Australia almost half of railway suicides occurred during April-May and September-October (de Leo & Krysinska, 2008). The Finnish results might be related to environmental factors: During January, February and March the ground is typically covered with snow and thus access to railway tracks is more difficult than at other times of year.

Suicides occurred most frequently at the end of the week (from Friday to Sunday). Somewhat similar results were obtained in Australia where the highest frequencies of railway suicides were observed on Thursdays and Fridays (De Leo and Krysinska, 2008). In Sweden and other European countries, however, railway suicides happened more frequently during weekdays than during weekends (Rådbo et al., 2005). To some extent, the Finnish results might be explained by Finnish alcohol consumption statistics, which show that two thirds of the alcohol consumption is concentrated on weekends (Mustonen et al., 2009).

Railway suicides in Finland happened most often in the afternoon, evening and after midnight and people less than 30 years old committed suicide more frequently during evening and night time (between 6 p.m. and 3 a.m.), whereas older people committed suicide most frequently between noon and midnight. The results of earlier studies in Austria (Deisenhammer et al., 1997), Sweden (Rådbo et al., 2005) Turkey (Özdoğan et al., 2006), Germany (Erazo et al., 2004) and Australia (de Leo and Krysinska, 2008) are inconsistent. Overall, the results suggest that there are considerable differences between countries for the time of occurrence of railway suicides.

Both suicides and accidents concentrated in areas where population density is high and the train traffic is dense. Of all fatalities, approximately a quarter occurred at currently or formerly used railway stations or in their vicinity (no more than 100 metres away). Approximately the same result has been found in Sweden (Rådbo et al., 2005). In Australia 20.5% of suicides were recorded at stations (De Leo and Krysinska, 2008).

In conclusion, the present results show the main demographic groups and the type of behaviour that should be focused on. There is no reason to assume that train-pedestrian fatalities are unavoidable. By contrast, the effective prevention of railway suicides and accidents calls for a systems approach involving effective measures introduced by authorities responsible for urban planning, railways, education and public health. Such measures include limitation of pedestrian access to railway areas, public education, reward or punishment and various technical solutions (e.g. Lobb, 2006; Rail Safety and Standards Board, 2007).

Given that train-pedestrian fatalities are strongly concentrated near big cities where the population density is high and train traffic is dense, limitation of pedestrian access to the tracks could be used in these areas. High-risk locations should be identified and effective fencing or landscaping should be introduced; Silla and Luoma (2011) have shown that these measures can reduce trespassing by more than 90%. However, the effects of such measures on suicides might be more limited. As indicated by Law et al. (2009), simply restricting the access to railway lines has nothing to do with the attempter's suicidal intent. Thus, it is

possible that suicidal persons move to some other location with easier access to railway tracks or decide to use some other method. However, Rådbo et al. (2008) argue that there is little evidence to support that reducing availability to one method would simply transfer the problem to another method. As the attempt has been complicated or even inhibited by building a fence, it gives the person more time to think about their intended act and they will possibly also realise its irrationality. In addition, information about these hot spots can also be used to reduce train speed in high-risk areas.

Surveillance performed by station staff and/or technically has also been proposed as a measure to identify and intervene with potential suicide victims just before they attempt suicide (e.g. Dinkel et al., 2011; Mishara, 2007). Rådbo et al. (2005) pointed out that pre-suicidal behaviour such as walking and loitering close to or on the tracks enables the early detection of suicidal persons and potentially also enables timely intervention, such as early breaking of a train or intrusion of station staff.

The above measures can be supported by educational measures, such as the safety education of schoolchildren, since more than half of all railway accidents happen to people aged between 10–29 years and the ability of small children to perceive and assess the risks related to trespassing is limited (e.g. Silla and Luoma, 2012).

Public health organisations can play a significant role in the prevention of train-pedestrian fatalities as well, especially railway suicides.

The results of this study show that more than half of the railway suicide victims were intoxicated and a substantial number of victims suffered from depression or other mental health problems. The use of alcohol while sad or depressed conveys an increased risk of self-reported suicide attempts among young people not reporting suicidal ideation (Schilling et al., 2009). Therefore, improved public health policy focusing on the use of alcohol and drugs as well as on mental health problems would be an essential part of the strategy for preventing the overly frequent suicides and accidents that occur on railways. In addition, as already proposed by van Houwelingen and Kerkhof (2008), it is important to systematically and explicitly seek dialogue about suicidal intent with patients in mental health services. Many results of this study can be utilised to identify high-risk persons and assess various risks. For example, information on pre-crash behaviour will help better understand the behaviour of people who are at risk of committing a railway suicide: if a patient indicates a specific suicide plan including typical characteristics of railway suicide, this suggests that the plan might be quite likely. Furthermore, van Houwelingen and Kerkhof (2008) point out that it is important to discuss the negative consequences of a train suicide to the patients themselves, to their

friends, close relatives and also to frequent commuters. This discussion would aim at decreasing the perceived attractiveness of railway suicides, and all suicides in general.

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