Review Article

Suicide by Different Occupations

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Abstract

Suicides at workplace are rare. However, occupation generally determines suicide rates. The aim of this review is to examine the relationship between suicides and occupation. The review is based on 128 studies picked up from MedLine, PsychoInfo, and Google. The relationship between unemployment and suicides suggests that unemployed people have an increased risk of suicide. Physicians and nurses have an elevated risk of suicide and they use medicines as means of suicide more often than other professionals. There are many studies about suicides of soldiers, because armies keep exact registers of the reasons of deaths. In addition to soldiers, police officers used guns in their suicides more often than other professionals. There is variation between occupations in suicides. Work-related stress and burnout constitute one factor associated with suicide. Depression, in turn, is the most important factor related to unemployment and suicide. Having access to means of suicide increases the risk of suicide.

Introduction

Suicide is an act of killing oneself [1]. Suicides are a global problem of public health; WHO [2] estimated annually over one million suicide attempts, of which 800,000 resulted in death. However, suicides were very rare at workplaces [3]. In the united states, one percent of fatal occupational injuries registered in the census of fatal occupational injuries were self-inflected injuries (n=386) in 2003-2004 [4]. In 2014, 4,821 fatal occupational accidents were recorded in the census of fatal occupational injuries, of which 271 (5.6%) were suicides [5]. However, work-related suicides increased 22.2 percent between 1995 and 2010 in the U.S. [6]. In South Korea, only 0.4 percent of the suicide attempts occurred at industrial or construction plants [7].

Methods

In this literature review I examine the effect of occupation on work-related suicides. The search was done by cross-referencing the keywords suicide, work-related, and workplace. I conducted a search in several electronic databases: Medline (1966-2015), PsycoInfo (1980-2015), and Social Science Citation Index (1987-2015). Google Science was also used as a search base. The search

covered literature cited in the databases until December 2015. Languages were not limited. Additionally, relevant sources were identified through reference lists. A total of 348 references were found.

The inclusion criteria for this study were:

• All suicides had occurred at workplaces or the studies concerned occupations and suicides. Unemployment was regarded as a work-related factor.

• The studies had been published, most of them in peer-reviewed journals. Most of the studies reviewed were published in English.

• The study referred to suicides after 1960.

• There was no limit for the number of suicides, although the occurrence of at least ten suicides was recommended [8].

Suicide At Workplace

In the Japanese language there are two similar concepts of work-related death. Karoshi means death from overwork [9], whereas a work-related suicide is called Karojisatsu [10], which is also due to overwork [11]. These terms show the importance of work-related stress in Japanese working life.

Routley and Ozanne-Smith [12] define work-related suicide

as a suicide related to work through a work agent, work stressor, commercial vehicle (train and truck), or work location. One example of suicide at workplace was a 29-year old Portuguese man who hanged himself under the influence of ketamine and ethanol [13] and another example a Tunisian carpenter who killed himself by an electric saw [14]. Work-related suicide is problematic for workers' compensation, because it prevents recovery of compensation and the nexus between employment and injury is broken. However, the common law jurisdictions have removed most of the barriers for compensation in the United States, Australia, Canada and the United Kingdom [15]. Suicide of an employee can challenge even the most experienced supervisor or manager [16].

The thirty-four suicides in two years among employees of France Télécom can be seen as a symbol of systemic suicide from a previous corporate culture stressing only economic success [17]. Luauté [18] sees these work-related suicides as political expressions that need mass media to spread their effect. On the other hand, he [19] stresses that many popular books tend to deny the role that individual psychopathological factors play in these suicides. Pezé [20] maintains that in France Télécom there was a strong managerial process after suicides. In the area of Auvergne, 28 work-related suicides in the period of two years were registered in death certificates, social insurance funds, officers of the labor inspectorate or autopsy reports in forensic departments [21]. Over the period from 1976 to 2002, the age-standardized suicide mortality among French men was 25.5 per 100,000 men. The highest rate was found among employees working in human health and social activities (34.3), followed by public administration (29.8), construction (27.3), and real estate activities (26.7) [22]. Among the 20,452 employees of a French national utilities company, 73 committed suicide. An increased risk of suicide was found among employees with a persistently low occupational grade (HR = 2.57, 95% CI 1.08-6.15) [23].

In Victoria, Australia, work-related suicides were 17% of all Victorian suicides. Of work-related suicides (n=642), only 6.8% were committed at the workplace, whereas in 32% of cases the victim jumped in front of a moving train or heavy vehicle. Men committed 88.6% (95% CI 75.9-94.9) of suicides at workplace [12]. Of the suicides, 56% directly involved work stressors, 31% involved jumping in front of a moving train or heavy vehicle, 4% involved work agents, and 9% other [24]. Bullying at the workplace may lead to workplace suicides [25].

Based on U.S. government reports, work-related suicides increased 22% between 1995 and 2010 [6]. Based on the Census of Fatal Occupational Injuries, there occurred 1,719 suicides at American workplaces between 2003 and 2010. Men committed suicides at work more often than women (RR = 15.3, 95% CI 12.1-18.5). The highest suicide rate was found among employees aged 65-74 years (2.4 per 1,000,000, RR = 3.7, 95% CI 2.6-4.8).

Suicides at workplace were most often committed by employees in the protective service occupations (5.3), farming (5.1), and installations and maintenance (3.3). Almost half (48%) of the workplace suicides were done by firearms [26]. Based on the information from the Colorado Violent Death Reporting System (COVDRS), 52 suicides were committed by the working-age population between 2004 and 2006. Among men, employees in farming, fishing and forestry had the highest age-adjusted suicide rates (475.6 per 100,000), whereas women in construction and extraction had the highest suicide rates (134.3). Farmers and forestry workers had the highest suicide rates by firearms (50.18), healthcare practitioners by poisoning (14.25), and construction and extraction workers by hanging or suffocation [27]. Based on the Georgia Violent Death Reporting System, 4,616 violent deaths were registered during 2006-2009. Of them, 2,888 or 62.6% were suicides. The highest rate of violent deaths was found among farmers, fishers and forestry workers (80.5 per 100,000), while construction and extraction workers had the second highest rate (65.5). A current depressed mood (31.9%), a current mental health problem (29.4%) and an intimate partner problem (24.0%) were the most common suicide circumstances among employees [28]. In New Zealand, 2,042 suicides were registered between January 2001 and November 2005. Trades workers (adjusted rate 69,95% CI 42-95), agriculture, fisheries and forestry workers (67, 95% CI 38-96) and plant and machine operators (54, 95% CI 35-73) had the highest suicide rates. People not being in the workforce had a suicide rate double compared to all workers (adjusted rate 189, 95% CI 0-259) [29]. Oliffe and Han [30] wrote in their review that the highest suicide rates were found in male-dominated workgroups such as manual workers, farming and military work. An older review [31] showed that employees in chemistry, farming and law enforcement may have an elevated suicide rate.

In their meta-analysis of 34 studies, Milner and her coworkers [32] found that employees in elementary professions (e.g. labourers and cleaners) had the highest suicide risk (RR = 1.84, 95% CI 1.46-2.33). They are followed by machine operators and deck crew (RR = 1.78, 95% CI 1.22-2.60) and agricultural workers (RR = 1.64, 95% CI 1.19-2.28). The lowest suicide rate was found among highest skill-level group of managers (RR = 0.68, 95% CI 0.50-0.93).

In Britain between 2001 and 2005, coal miners (81 suicides per 100 000 worker-years), merchant seafarers (68), laborers in building trades (59) and window cleaners (46) had the highest suicide rates [33]. After the Asian financial crisis in the late 1990s the suicide rates increased both in Japan and in South Korea [34]. In the Iwate area, Japan, suicide attempters (n = 2,274) who got the idea on the same day had more often work problems (OR = 0.391) than those getting the idea earlier [35]. Two certified psychiatrists analyzed 22 work-related suicides in Japan in December 2004. They hypothesized that long working hours, heavy work-

loads and low social support cause depression, which led to suicide [10]. A psychological autopsy study of 31 Japanese working suicide-completers showed that they had a lot of alcohol-related problems (38.7%) and debt (41.9%) [36]. Just over half (52%) of Italian workers (n=102) who claimed exposure to mobbing at their workplace had some risk of suicide [37].

The analysis of U.S. government reports showed that the typical employee who committed suicide was a non-Hispanic male aged between 45 and 54 years who used machinery or vehicles or was a manager [6]. Stack [38] analyzed 9,499 suicides from 21 U.S. states from the 1990 national mortality detail files. An elevated risk of suicide was found among dentists (OR = 5.43), doctors (2.31), nurses (1.58), social workers (1.52), mathematicians and scientists (1.47), and artists (1.30), whereas the risk of suicide was lower among clerks (OR = 0.85) and farm workers (0.69) than among the general population. Most of the occupations with a high risk had high stress and responsibilities levels in their work. The data from Augsburg, Germany, included 6,817 employees of whom 28 had committed suicides in 1984-1995. A high adversity of chronobiological or physical working conditions increased the risk of suicide (HR = 3.28, 95% CI 1.43-7.54) [39].

Based on the Japanese government's 2010 national survey, suicides (n=4,898) among working-age (25-59 years) men were analyzed [40]. An age-adjusted risk of suicide was highest among administrative and managerial (IRR = 3.91, 95% CI 3.16-4.85), service (3.63, 95% CI 2.93-4.51), and agriculture (3.53, 95% CI 2.84-4.38) occupations, whereas among industries the risks were highest in mining (IRR = 23.9, 95% CI 19.4-29.4), fisheries (6.26, 95% CI 5.03-7.80), and electricity and gas (5.86, 95% CI 4.71-7.30). The authors gave no explanations for the very high suicide rates of mining workers. Based on the data of suicide deaths (n=3,661 suicides) from the Hellenic Statistical Authority, males had the highest risk of suicide among armed forces (age group 15-39, CMR = 5.68, 95% CI 2.08-12.20; age group 50-59, CMR = 25.97, 95% CI 2.97-89.24), whereas women working as clerks had the highest suicide risk (age group 50-59, CMR = 10.18, 95% CI 2.75-25.49) [41].

For 175 Hong Kong employees, of whom 63 had made a suicide, a psychobiological autopsy was done. It showed that a chronic impact from work (for example had been fired) increased the risk of suicide (OR = 1.46, 95% CI 1.04-2.05). However, a psychiatric illness had a mediation effect on the relationship between chronic impact from work and suicide [42]. Beautrais and her co-workers [43] examined 302 individuals who had made medically serious suicide attempts in the city of Christchurch, New Zealand. Currently unemployed attemped suicide four times more often than controls (OR = 4.2, 95% CI 2.6-6.8). However, only 7.3% of the attempts could be attributed to unemployment.

Suicide And Unemployment

Unemployment is a significant factor predicting suicide attempts. In his review Platt [44] concluded that empirical support for a direct causal link at the individual level between unemployment and suicide is weak. The effect of mental illness was missing from the studies before the 1980's.

Transition from employment to unemployment was associated with suicide attempts (n = 2,495) among residents of Helsinki, Finland. The highest risk of suicide attempts after getting unemployed was found among men aged 25-34 years (OR = 3.72, 95% CI 2.13-6.77) with low education (OR = 3.54, 95% CI 1.86-7.34) [45]. In the Korean Welfare Panel Study, 3,793 permanent employees at baseline (2011-2014) were divided to those who maintained permanent status, became full-time precarious workers, became part-time precarious workers, or became unemployed in the following year (2012-2015). Part-time precarious employees were more likely to have suicidal ideation (OR = 2.37, 95% CI 1.07-5.25) than those who remained permanent employees. Suicidal ideation was more common among those who became either full-time (OR = 2.33, 95% CI 1.09-4.99) or part-time (OR = 3.94, 95% CI 1.46-10.64) precarious employees compared to those who never previously thought dying by suicide. The authors [46] concluded that change in employment status from permanent to precarious employment may increase suicidal ideation.

Chen and his co-workers [47] made a psychological autopsy to 150 suicide cases in Hong Kong. They found that unemployment (OR = 10.19, 95% CI 5.18-20.02), indebtedness (OR = 7.88, 95% CI 3.39-18.31), single status (OR = 3.98, 95% CI 1.58-10.07), and lack of social support (OR = 0.31, 95% CI 0.20-0.47) explained the increased risk of suicide. Schneider and her co-workers [48] interviewed relatives of 163 suicide committers using the psychological autopsy method in the Frankfurt/Main area. Unemployment (OR = 16.8, 95% CI 3.7-77.0), retirement (OR = 2.3, 95% CI 1.1-4.5) and being at home (OR = 5.3, 95% CI 1.3-21.7) increased the risk of suicide. Based on the record linkage study of England in 1971 and 1981 (1,096 suicides), Lewis and Sloggett [49] found a strong independent association between unemployment and suicide (OR = 2.6, 95% CI 2.0-3.4). Transition from employed to unemployed increased the risk of suicide (OR = 2.39, 95% CI 1.79-3.19). About 7.4% of suicides could be attributed to unemployment.

In the U.S. during the Great Recession of 2007-2009, a strong positive correlation was found between unemployment rates and suicide rates, especially in states where the female labor participation was high [50]. Based on the National Violent Death Reporting System (NVDRS) of 2014, the effect of job, financial and legal problems on suicides increased from 32.9% to 37.5% between 2005 and 2010 among individuals aged 40-64 years. During the same period and in the same age group the number of suicides

using suffocation increased 59.5% [51]. An analysis of 62 suicides committed in an urban American county 1997-2000 showed that an anticipated eviction from home combined with unemployment was the most important pattern for suicide [52]. Unemployment and divorce rates predicted suicide rates for work-related suicides in Japan in 1978-1997, whereby financial and work-related reasons explained 28.9% of variation [53]. Employment, unemployment and non-labor force participation did not contribute to the level of motor vehicle suicides in the U.S. from 1960 to 1982 [54].

Although Platt's review earns credit, it is over 30 years old. Therefore I conducted a new review, shown in Table 1. It included six studies that had reported an odds ratio between unemployed and employed people. The subjects in these studies totaled 4,381. The simple mean of the odds ratios was 6.05. The weighted mean was calculated by multiplicating N of a single study with the odds ratio of this study and dividing by the total N. Then the sum of the values was 2.94. Both methods showed that unemployed people had a risk of suicide many times higher than than employed people.

Authors	Country	N	Subjects	OR	95% CI
Law [42]	Hong Kong	175	Employees (fired)	1.46	1.04, 2.05
Schneider [48]	Germany	163	Unemployed	16.1	5.9, 44.1
Beautrais [43]	New Zealand		Current unemployed	4.2	2.6, 6.8
Chen [47]	Hong Kong	150	Unemployed	10.19	5.18, 20.02
Ostamo [45]	Finland	2495	Unemployed	1.8	1.36, 2.40
Lewis [49]	England and Wales	1096	Unemployed	2.6	2.0, 3.4
USA	Average			1.31	1.3
Developing	countries	Average		0.57	0.41

Table 1 : Summary of Studies Reporting Unemployment and Suicides.

Suicides In Different Occupations

Doctors and nurses

A review [55] of nine studies that examined suicides of nurses between 1999 and 2004 found that all these studies showed that nurses had a higher frequency of suicides than the general population. Knowledge of suicide methods and easier access to medication were contributory factors for suicides of nurses. Agerbo and his co-workers [56] made a nested case-control analysis of 3,195 suicides and 63,900 controls in Denmark. The highest suicide risk was found among medical doctors (RR = 2.73, 95% CI 1.77-4.22) and nurses (2.04, 95% CI 1.34-3.11) when primary school teachers were the reference group. The explanation for the high risk of suicide was the increased use of self-poisoning by doctors and nurses. Later, they [57] found elevated suicides risk among nurses (RR = 1.90, 95% CI 1.63-2.21), physicians (RR = 1.87, 95% CI 1.55-2.26), dentists (RR = 2.10, 95% CI 1.58-2.79), and pharmacists (RR = 1.91, 95% CI 1.26-2.87), but not among veterinary surgeons (RR = 1.04, 95% CI 0.63-1.74). In Queensland, Australia, medical doctors committed 27 suicides and nurses 59 suicides from 1990 to 2007. Female doctors (RR=3.88, 95% CI 1.54-9.34) and nurses (RR= 2.24, 95% CI 1.34-3.74) had a significantly higher risk of suicide compared to educational professionals, whereas it was only male nurses that had an elevated risk of suicide (RR= 2.30, 95% CI 1.31-4.00), not male doctors (RR=1.23, 95% 0.72-2.10) [58]. In Austria between 1970 and 1992, the suicide rate of male physicians (70 per 100.000) was higher than that of the male population (38) and the suicide rate of female physicians (68) was higher than that of other women (22) [59]. However, in their review of literature, Bartram and Baldwin [60] calculated that the suicide risk of veterinary surgeons was approximately four times higher than that of the general population and twice that of other health care professionals.

In their systematic review, Lindeman and her co-workers [61] showed that the estimated relative risk of suicide among male doctors was 1.1 to 3.4 compared with the general population and 1.5 to 3.8 compared with other professionals, whereas female doctors made suicides 2.5 to 5.7 times more often than the general population and 3.7 to 4.5 times more often than other professionals. In Finland, the risk of suicide was twice as high for male doctors (n=17) as for other professionals (n=121, p=0.02) [62]. It was shown later that male physicians had a 4.5 times higher risk of suicide (n=35) compared with other male professionals (SMR = 2.4, 95% CI 1.7-3.3) but not with the general male population (SMR = 0.9, 95% CI 0.6-1.2). Finnish female physicians had a significantly higher risk of suicide (n=16) than other female professionals (SMR = 3.7, 95% CI 2.2-6.0) and females in general (SMR = 2.4, 95% CI 1.5-4.0) [63]. A questionnaire survey to 2,671 Finnish physicians showed that 22.1% of males and 25.9% of females had an intention of suicide at some time. Female radiologists (43%) and psychiatrists (33%), and male psychiatrists (31%) and neurologists (30%) had the highest rate of suicide attempts [64].

Having been harassed at work increased the suicide ideation (OR = 2.26, 95% CI 1.31-3.91) among Swedish medical specialists. Disengagement at work was highly associated with suicide ideation (OR = 2.90, 95% CI 1.75-4.80) [65]. Conflicts at workplace or work-related problems are one possible explanation for doctors' suicides [66,58]. Workplace violence (OR = 1.747, 95% CI 1.095-2.788) and pain syndrome (OR = 1.642, 95% CI 1.024-2.632) were risk factors of self-harm among 850 Hong Kong nurses [67]. In Hungary, the researchers [68] compared 298 female physicians and 109 male physicians to 1,754 white-collar workers. The prevalence of suicide ideas among both female (20.3%) and male (12.1%) physicians was significantly higher than that of the control groups (12.3% and 7.6%). Suicidal ideas were associated with long working hours (<8 hours), severe anxiety, work-related stress, and role conflict. In a survey to 701 veterinarians in Alabama, U.S., 11% of participants believed that suicide among veterinarians was a problem. In addition, 66% of the respondents indicated that they had been "clinically depressed" [69]. A survey of 396 staff members in a U.S. medical school showed that 27% of personnel were under total risk of suicide. Over 6% of the personnel had thought to take one's own life [70].

Agricultural workers

Agricultural workers are often exposed to pesticides, and especially an acute overexposure to anticholinesterase pesticides causes depression. Overexposed Australian agricultural workers did not commit significantly more often suicides (OR = 1.90, 95% CI 0.73-4.39, n = 90 suicide cases), although their risk of suicide was double compared to controls (n=270) [71]. A study of 84 farmers who had committed suicide in England and Wales between 1991 and 1994 showed that many of them had work-related problems and depression. Hanging and shotgun were the most commonly used methods in farmers' suicides [72]. In France, "Barométre Santé 2005" included 6,264 men and 7,389 women. The highest rate of suicide mortality was found among farmers (RR = 3.1 men, RR = 2.2 women) [73]. A later analysis of suicides committed by 417 French male and 68 French female farmers between 2007 and 2009 showed that suicides were the third most important cause of death. Compared to the French male population, the suicide risk of male farmers was 28% higher in 2008 and 22% higher in 2009 [74]. A questionnaire study of Finnish farmers (n=3,172) showed that subjects visiting a doctor because of any mental disorder had an elevated risk of committing suicide (n=20, OR = 5.6, 95% CI 1.7-18.5). Visiting a doctor because of alcoholism also increased the risk of suicide (OR = 13.2, 95% CI 1.4-121.7) and using psychotropic drugs had a similar effect (OR = 14.5, 95% CI 3.1-68.3) [75].

Seafarers

Among seafarers employed in the Isle of Man, two suicides were found between 1986 and 2005 [76]. Both victims killed themselves by hanging. The suicide rate among Isle of Man seafarers was 1.3 per 100,000, which was rather low compared to other British and international merchant fleets.

Police officers

In their review of 20 studies, Hem and his co-workers [8] found no elevated suicide rates among police officers in nationwide studies from France, Germany, and England and Wales. The other studies showed no significant differences in suicide rates between police officers and reference groups. The researchers noticed two shortcomings from earlier studies: 1) the sample sizes were rather small, and 2) the reference groups were inappropriate because of the healthy worker effect.

Based on the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI), it was shown that the highest relative risk of on-the-job suicide was among police officers and detectives in public service (RR = 6.99) and workers in military occupations (RR = 5.39) [77]. Violanti and his co-workers [78] examined 11,264 police officers and municipal workers in Buffalo, NY. Police officers committed 25 suicides and municipal workers 13 suicides between 1950 and 1990. Compared to municipal workers, police officers had a significantly (RR = 2.65, 95% CI 1.76-4.00) higher risk of suicide than of homicide and accidents combined. Most of police officers' suicides (N = 189) were committed by firearms (91%). Police departments with less than 50 officers had significantly higher suicide rates than those with over 51 officers (p<0.0001) [79]. Police officers committed 92 suicides in New York between 1934 and 1939. Current job stress and other job-related problems are connected to suicides, especially among alcohol abusers [80]. A questionnaire survey in the Baltimore Police Department showed that 7% of officers (n=1,072) reported suicide ideation [81].

A special case of work-related suicide is a suicide by cop [82]. In this case, a person approaches the police officer aggressively in order to force the police officer to shoot him/her.

Military Personnel

Many of the studies were done with military personnel, because armies usually have good registers of the deaths of their personnel.

Between 1980 and 1992, 3,178 suicides were committed in the U.S. armed forces, and 61% of the victims used a firearm. Collectively, military security and law enforcement specialists had a significantly elevated risk of suicide (OR = 1.25, 95% CI 1.02-1.53) [83]. Among the U.S. navy personnel in 1990-1995, the suicide rate (n=362) was higher (15.6 per 100,000) than in the comparable U.S. population (12.0). Males whose background was Asian, Pacific Islander, or Native American had a higher suicide rate than excepted (SMR = 149, 95% CI 100.60-213.12) [84]. Among U.S.

Army, Marine Corps and Navy recruits from 1980 through 2004, 46 onsite suicides were committed, resulting in a crude rate of 4.8 deaths (95% CI 3.6-6.4) per 100,000 recruit-years. The suicide rate was triple for males compared to females (RR = 3.7, 95% CI 0.9-15.2). Gunshot (39%), hanging (35%), fall/jump (22%), and drug overdose (4%) were the most common suicide methods [85]. In the U.S. Air Force in 1990-2004, 642 suicides were committed, which means overall SMR = 0.54 (95% CI 0.50-0.58). Women (SMR = 0.89, 95% CI 0.64-1.21) committed suicides more often than men (SMR = 0.52, 95% CI 0.48-0.57) [86]. Comparison of U.S. military and civilian data over 11 years showed that military rates (8.31 / 100,00 persons) were about 20% lower than civilian rates (12.31) [87]. Suicides of female soldiers (N=20) were more often related to workplace difficulties (OR = 2.62, 95% CI 0.94-7.31) than their suicide attempts (N=404). The same did not apply to male soldiers [88].

In the Irish Defence Forces, 63 suicides occurred between 1970 and 2002, which means 15.3 suicides per 100,000 citizens, whereas for male civilians at the same age (20-65 years) it was 18.3. Over half (53%) of the suicides were committed by firearms. A psychiatric diagnosis (OR = 11.9, 95% CI 3.3-42.6), being on morning duty (OR = 3.3, 95% CI 1.2-9.7), and being on military site (OR = 4.7, 95% CI 2.1-10.6) were risk factors for suicide [89]. A survey of 1,264 Danish deployed soldiers showed that unhappy childhood (OR = 7.53), lack of parental care (OR = 5.21), being wounded (OR = 5.68), and having break down during a mission were risk factors for suicide attempts [90]. Among Norwegian former peacekeepers (n=22,275), 73 suicides and 68 accidental fatalities were identified. No significant differences were found between suicide and alcohol-related fatality groups, although psychiatric problems and major depression were insignificantly elevated in the suicide group [91]. The suicide rate in the Finnish Defence Forces after World War II was 19.9 per 100,000 soldiers, which is lower than the suicide rate among male civilians of the same age group. A total of 60% of suicides were committed with a gun [92]. There were 50 witnessed suicides (in front of other people) among the 1,183 suicides in the U.S. Armed Forces during 15 years. Of the victims, 94% were men and reciprocal abandonment and violent divorce were the most common reasons for suicide [93].

Different Occupations

Among firefighters in Philadelphia, 11 suicides were identified between 1993 and 2014, of which two out of three (64%) were by guns. The suicide rate of firefighters (11.61 per 100.00) was lower than among the general adult male population (18.53) [94].

Miners in Queensland, Australia, committed 42 suicides during 18 years. They had a lower risk of suicide than men in other occupations (RR = 0.65, 95% CI 0.48-0.88) or than the working age male population (RR = 0.36, 95% CI 0.27-0.49) [95].

Suicides among artists were registered in the 21 U.S. States in the 1990 National Mortality Detail File. Artists committed 33.30 suicides per 100,000 artists, which was almost three times higher than in the general population. The odds ratio for artists was 2.12 (p<0.0001) [96].

Seiden and Gleiser [97] examined 28 female and 63 male suicides among American chemists. Isolation was the leading work-related factor for both genders, but with greater intensity among women (96% vs. 70%). While majority of women suffered sex discrimination, none of the men did. Cyanide was the most common method for suicide.

Suicide In Work Contexts

Men had much higher occupational suicide rates than women [32]. In the U.S., men committed 7.1. times more often suicides at workplace than women [3]. In Taiwan, the media reported more often work-related reasons for male suicides, whereas female suicides were more often related to mental illness and relationship problems [98]. Suicides at workplace were due to complex interaction between job factors such as stress and access to means like drugs and other risk factors such as age and a mental disorder [30].

Among European women, the higher psychiatrist density correlated with higher suicide rates. After controlling the gross national income, the same correlation was found also among men [99]. Among the working age population in Spain, an elevated risk of suicide was found in Barcelona (RR = 1.35, 95% CI 1.03-1.74), Bilbao (1.83, 95% CI 1.16-2.76) and Sevilla (1.77, 95% CI 1.21-2.52). These results reflected geographical and socio-economical differences between Spanish cities [100].

Exposure to physical intimidating at the workplace predicted suicide ideation two years (OR = 10.68, 95% CI 4.13-27.58) and five years (OR = 6.41, 95% CI 1.85-22.14) later among Norwegian employees (n = 1,613) [101]. Part-time work was associated with suicide attempts (OR = 1.59, 95% CI 1.37-1.87) among middle school students in the Korean Youth Risk Behavior Surveillance (n=75,238 students) in 2008 [102]. Job problems were related to 16.5% of suicides among adults aged 40-64 years in 2010 (n=18,670), based on the National Violent Death Reporting System (NVDRS) [51]. The increasing suicide rate in Korea was directly correlated with an annual increase of gross national product [11].

There were differences between occupational groups in the ways the four seasons influenced the ideas of committing suicide. In the province of Oulu, Northern Finland (n=1,359 suicides during 1988-1999), farmers committed suicides more often during spring (OR = 1.51, 95% CI 1.04-2.00), whereas the risk of suicide was significantly lower among indoor workers during summer

(OR = 0.69, 95% CI 0.40-0.98) and among forest workers during winter (OR = 0.57, 95% CI 0.15-0.98). Violent suicide methods (hanging and shooting) were used more often by farmers than by other professional groups [103].

Duff and Chan [104] found differences along career phases, when they interviewed 16 survivors of individuals who had committed suicide in North America. Early-career suicides were related to educational and work-related contexts with the emotion of hopelessness. Mid-career suicides emphasized despair based in failure when one lost his/her job. Late-career suicides were associated with transforming roles in retirement with discomfort with the loss of status and fear related to assumed new roles.

Suicides of pedestrians are a problem on railways. In their systematic review of 139 studies, Havarneanu and his co-workers [105] found 19 main preventative categories. Physical barriers were the most popular measure against both suicides and trespassing. However, only 22 studies gave support for the effectiveness of preventative measures. In Canada, 428 suicides at railway were identified from 1999 to 2008. Almost half of the suicide victims were unemployed (43.3%) and depression was related to 34% of the suicides [106].

In Japan, people were more likely to commit suicides on their birthday (RR = 1.50, 95% CI 1.46-1.55) than on other days, which supports strongly the "birthday blues" hypothesis [107]. Based on the Korean Community Health Survey (n=67,471) in 2008, it was found that 4.3% of males and 9.3% females had suicide ideation. Male and female employees working over 60 hours per week had an elevated risk of suicide ideation (males: OR = 1.51, 95% CI 1.26-1.83; females: OR =1.61, 95% CI 1.34-1.92). Shift work predicted suicide ideation only among female employees (OR = 1.45, 95% CI 1.23-1.70) [108]. Based on the Korean National Health and Nutrition Surveys (n=12,076), Yoon and his co-workers [108] showed that employees who worked over 60 hours per week had over 30% more suicidal thoughts than those working less than 52 hours per week (males: OR = 1.32, 95% CI 1.08-1.60; females OR = 1.44, 95% CI 1.20-1.74).

Researchers [109] found 4,209 suicide attempters from the Swedish Cause of Death Register during 2007-2010. Most of them (46.4%) had only a few months of sickness absence or disability pension in the five years before the suicide attempts, whereas 30.4% had more than 10 months of sickness absence or disability pension. Young men with higher education belonged to the first group, whereas older women with lower education were in the second group. When 87 suicide attempters were interviewed in a French university hospital, it was found that 51% of the patients considered intensive stress at workplace as one factor leading to suicide attempt [110]. At the General Hospital of Chennai in India, 607 suicide attempters were interviewed. 16% of them had attempted suicide previously. Work-related factors influence more

often attempt repeaters (38%) than first-timers (34%, p<0.003) [111]. Insufficient job control (OR = 2.22, 95% CI 1.02-4.74) and lack of reward (OR = 2.34, 95% CI 1.02-5.15) were associated with suicide ideation among 980 male subway drivers in Korea. In addition, conflict with passengers (p=0.022) and sudden stops due to emergency bell (p=0.007) were significantly related to suicide ideation [112].

Suicide Prevention

Participation in work life may protect from suicide ideation or consequences of suicides. Employed male youth in Taiwan (n=4,094 suicide attempts) were 33% more likely to have suicide hospital visits than their unemployed peers (OR = 1.33, 95% CI 1.23-1.44). On the other hand, labor force participation may increase the hazard of repeated suicide attempts (OR = 1.15, 95% CI 1.03-1.30) [113]. When Japanese local government officers and healthcare professionals received training in suicide prevention at their workplace, they thought more often that suicides can be prevented [114]. In another Japanese study (n = 225), a huge majority (97.6%) of office workers thought erroneously that "most suicide victims consult psychiatrists before their deaths" [115]. An occupational health nurse can help in the grieving process giving immediate guidance after the suicide of a co-worker [116].

An awareness campaign among Queensland construction workers (n=7,311) improved their suicide prevention awareness [117]. Later the researchers showed [118] that every Australian dollar invested in suicide prevention saved 4.60 dollars from costs caused by suicide.

In their review of suicide prevention at workplace and other settings, Takada and Shima [119] found 16 studies of prevention at workplace. Education and training of employees and managers or staff were both mentioned in four studies. These are also the most common prevention methods at schools. Later, Milner and co-workers [32] reviewed 13 intervention studies about suicide prevention at workplace. Because they found very few evaluated workplace prevention studies, it is not possible to make conclusions about the effectiveness of such prevention practices. A 1-hour community gatekeeper training improved 76 nonclinical University of Rochester hospital employees' knowledge about suicide (before 1.81+-0.78, after 3.09+-0.48, t = 13.89, p<0.0001) and self-efficacy to intervene with suicidal individuals (before 2.07+-0.79, after 3.09+-0.53, t = 12.96, p<0.0001). In addition, fifty-five observations were made of participants' behavior and approximately half of these (26 participants) showed satisfactory skills after the training (average 11.43, sd = 2.28) [120].

In British Columbia there worked 28,794 sawmill workers between 1950 and 1998. Of them 162 completed suicide, whereas 127 attempted suicide. Low psychological demand was associated with completed suicide (OR = 0.78, 95% CI 0.69-0.89) and low

social support was related to attempted suicide (OR = 0.73, 95% CI 0.54-0.98) [121]. Fathers' working conditions may also have had effect on their children's attempt to commit a suicide. Among children of male sawmill workers in British Columbia, father's employment in a job with low psychological demand was associated with completed suicides of their sons during their first 16 years (n=20, OR = 0.42, 95% CI 0.20-0.98). Father's low duration at the saw mill had a strong association with attempted suicide for their male children (n=81, OR= 0.92, 95% CI 0.87-0.98), whereas father's job with low control increased their daughters' attempts to suicide (n=145, OR = 0.90, 95% CI 0.81-0.99) [122]. When a child of the employee (n=11) commited suicide, the return of the parent to his/her workplace was difficult. Other employees did not know what to say to the parent. In Northern Ireland, none had experienced demands for early return to work [123].

Exposure to a magnetic field is unlikely to be either a necessary or sufficient cause of depression or suicide [124]. Among 6,820 nuclear industry workers in the Paducah gaseous diffusion plant in Kentucky, U.S., exposure to beryllium (HR = 2.3, 95% CI 0.5-8.0) and a high uranium concentration (HR = 2.7, 95% CI 1.2-6.1) caused an increased risk of suicide [125]. Above 8 hospital days after an occupational injury double (OR = 1.98, 95% CI 1.43-2.74) the suicide ideation among Taiwanese workers (n=2,001) [126].

In Australia, suicides are not usually accepted as compensable, because suicides are understood as self-inflicted injury. There are nowadays two exceptions: 1) a work accident caused so painful and penetrating injuries to the will of the worker that his/her persistence is intolerable, and 2) a worker develops a stress-related condition due to an event such as an unwelcome sexual advance or managerial behavior of an extreme kind [127].

Misclassification

The study made in California showed that 11% of suicides were misclassified as work-related, whereas 23% of controls were misclassified [128].

Conclusions

Workplace is the scene of suicide in very few cases only. Perhaps the presence of co-workers prevents the realization of suicide intentions. On the other hand, work tasks focus one's thoughts in matters other than suicide. Suicidal thoughts have a stronger influence when one is alone at home.

A strong long-term stress in work life may expose employees to suicidal thoughts. They do not see any other way out of their bad situation. Relieving stress may therefore help prevent suicides.

Unemployment increased the risk of suicide. My calculations showed that the suicide risk is 2 to 6 times higher for unemployed compared to employed people. Depression is the mediating factor between unemployment and suicide. Prevention of depression may also prevent suicides among unemployed people.

Men committed nearly 90% of work-related suicides. This reflects the fact that workplace is still a male-dominated place. However, it is easier to focus the prevention of suicides on a limited number of workplaces than to all individuals. Employment itself strengthens mental health and especially belonging to the workplace community counteracts depression.

Farming, fishing and forestry were the occupations with the highest suicide rate. Medical doctors and nurses had an elevated risk of suicide especially compared to teachers. They used medicines as a means of suicide. Military persons and police officers used guns more often than other professionals in their suicides. In other words, people used suicide methods that were easily available for them.

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