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REVIEW

Suicidal risk factors and completed suicide: meta-analyses based on psychological autopsy studies

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Abstract The purpose of the present review is to evaluate the effects of common risk factors for suicide by meta-analyses using data extracted from studies based on the psychological autopsy method. We focused on five common risk factors of suicide: substance-related disorders, mood disorders, adverse marital status, adverse employment status, and self-harm behaviors. A total of 24 articles were identified from MEDLINE in which the crude odds ratio (OR) could be calculated for the above five risk factors through 30 April 2007, using such search keywords as "suicide," "psychological autopsy," and "case-control study." Overall, both substance-related disorders [OR = 5.24; 95% confidence interval (CI) = 3.30–8.31] and mood disorders [OR = 13.42; 95% CI = 8.05–22.37] were strongly associated with suicidal risk. Suicidal attempt and deliberate self-harm, which can directly lead to completed suicide, have been shown to be very strongly associated with suicidal risk [OR = 16.33; 95% CI = 7.51–35.52]. Effects of social factors such as adverse marital and employment status were relatively small. As substance-related disorders and mood disorders were strongly associated with an increased risk of completed suicide, the comorbidity of these two disorders should be paid a maximum attention. The effective prevention of suicide depends on whether we can successfully incorporate these personal factors as well as social factors into an adequate multi-factorial model.

Keywords Psychological autopsy · Suicide · Case-control study · Epidemiology · Meta-analysis

Introduction

Suicide is a serious problem all over the world. Approximately 1 million people are estimated to commit suicide per year [1]. Recent figures also show that more than 30,000 people commit suicide each year in Japan. Several epidemiologic studies [2–8] have indicated risk factors for suicide, such as depression, severe anxiety, substance abuse, poor interpersonal relationships including social isolation, inability to maintain a job, anhedonia, somatic diseases, financial problems, and personal or familial history of suicide.

These suicidal risk factors can be divided broadly into two categories, personal and social factors. The former are, for example, mental disorders, including genetic vulnerability (familial history of suicide), physical disorders, and psychological isolation. The latter include socioeconomic or familial factors, such as divorce, unemployment, and stressful life events. It can be assumed that the interactive effects of these two factors may attenuate personal tolerance against stressors and lead him/her to suicide. Kaplan and Sadock [9] show 13 major suicidal risk factors ranked according to their association with suicide. Alcohol dependence, prior suicidal behavior,

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depression, unemployed or retired, single, widowed, and divorced are included. These factors can be clearly defined independent of the study designs. The other factors except age and race, such as irritation, loss of physical health, or unwilling to accept help, are conceptually obscure; that is, they are likely to be defined differently by each epidemiologic study design and to be affected by the value system in each country with different cultural backgrounds.

To establish an effective suicide prevention model, the strength of association between those risk factors and completed suicide should be estimated by an appropriate statistical method. Meta-analysis is a useful statistical method in this regard. However, the commonly evaluated risk factors should be included in this analysis, because the combined effect of differently defined factors on suicide is difficult to determine.

As an effective method for identifying the risk factors associated with completed suicide, psychological autopsy is one of the most valuable research tools. Usually, face-to-face structured interviews or semi-structured interviews with family members of suicide victims or their next of kin are conducted in detail, with informed consent obtained beforehand. Sometimes, their close friends, sweethearts, supervisors, and doctors can be subjects for interview. In some cases, several months are needed for the interview period, during which the time for curing the bereaved families is included.

This retrospective approach of psychological autopsy can be given an epidemiologic case-control design by using appropriate controls. The selection of control subjects usually depends on the purpose of the study. Usually, accident victims (e.g., traffic accidents) or cases of natural death are compared with the suicide victims. This study design has come into wide use in Western and Oceanian countries, China or Taiwan in Asia. However, to our knowledge, no psychological autopsy studies have been conducted in Japan thus far. In order to gain reliable evidence, such a study should be widely conducted in Japan as well as overseas. Although social factors affected by the different cultural characteristics are difficult to compare to one another, it is necessary to provide basic information of relevant suicidal risk factors for promoting future Japanese psychological autopsy studies. For this purpose, the accumulated evidence regarding the commonly defined factors in the foreign psychological autopsy studies should be clearly summarized by the appropriate statistical method.

From this point of view, the aim of the present article is to review and evaluate associations between suicidal risk factors that are cross-culturally defined and completed suicide, based on the reports that use the method of psychological autopsy with case-control study design.

Methods

Identification and selection of relevant studies

We conducted MEDLINE, Current Contents and Web of Science searches using "psychological autopsy," "suicide," and "case-control study" as keywords to search for papers published from 1990 to 30 April 2007. A total of 61 studies were identified by the above keywords. One additional article was identified from the references cited in the first series of articles selected. Articles included in the meta-analysis were in the English language, published in the original, and had no obvious overlap of subjects with other studies (three non-English and one review article were excluded). We also excluded studies with the same or overlapping data by the same authors (two articles). Furthermore, for the purpose of this review, 13 articles dealing with only a specific population, such as those with mental disorders, were excluded.

As for the suicidal risk factors, we focused on the following four factors: mental disorders (mood disorders and substance-related disorders), marital status, employment status, and deliberate self-harm or suicidal attempt. As mentioned earlier, these factors were more commonly defined in each study compared with other factors, such as stressful life events or interpersonal problems, which are defined differently according to each study design. For instance, as many studies assessed mental disorders by the widely used standard diagnostic criteria, such as DSM-IV or ICD-10, the assessments of these disorders are considered to be homogenous.

The articles were limited to those in which the crude odds ratio (OR) could be calculated by 2×2 cross tables (19 articles excluded deal with case series or no relevant information on the concerned factors). Although almost all of the relevant studies selected age- or sex-matched control for each case, only crude ORs were extracted because the OR calculated by the conditional logistic procedure could not be reflected in the meta-analyses. Consequently, some particular factors, such as schizophrenia, had to be excluded in the present meta-analyses because there were no subjects with schizophrenia in the control groups in many studies, despite the fact that schizophrenia is one of the serious suicidal risk factors. A total of 24 articles were eligible in the present analysis.

Data extraction and assessment of study quality

For each study, characteristics, such as authors, year of publication, country of the study population, source of control population, number of cases and controls, diagnoses, diagnostic criteria in case of mental disorders, and crude OR, were noted.

In the main analyses, data were combined for the studies including subjects of different age groups or sex. The studies dealing with only single sex subjects (only men or women) were analyzed separately. Similarly, the analyses were conducted according to young or old age groups (both sexes combined). The definition of "young" used was 35 years or less and that of "old" was 50 years or more.

These sub-analyses according to age or sex were conducted as long as the number of eligible studies was three or more. The studies including both genders but limited in young or old population were also included in the main analyses.

The quality assessment of the studies included in the present meta-analyses was conducted with the following procedure. First, the internal validity of each study design included in the meta-analyses was verified. No study was included with an extraordinarily large sample size in which only the records of death certificates were used. Next, we checked whether the relevant risk factors were defined objectively, which is in turn related to the possibility of expansion of the psychological autopsy studies in Japan. In principal, the first author checked these study contents. The second and third authors advised the first author when data interpretation was difficult.

Meta-analysis

Data were combined using both fixed effects (the inverse variance-weighted method) and random effects (DerSimonian-Laird method) models [10]. The Cochrane Q statistics test was used for the assessment of heterogeneity. The fixed effects model is used when the effects are assumed to be homogenous, while the random effects model is used when they are heterogenous. In the absence of between-study heterogeneity, the two methods provide identical results. The presence of heterogeneity can result from differences in the selection of controls, age distribution, cultural values determined by religious ethics, and so on. The random effects model incorporates an estimate of the between-study variance and tends to provide wider confidence intervals (CIs) when the results of the constituent studies differ among themselves. As the random effects model is more appropriate when heterogeneity is present [10], the summary OR and prevalence were essentially based on the random effects model. The meta-analyses were performed on crude ORs, since the adjusted ORs were not comparable because of the inclusion of different covariates in the multivariate regression models or matching designs. Using individuals without the assumed risk factors as the reference group, we calculated ORs for individuals with those factors.

The Q statistic was considered significant for $P < 0.10$ [11, 12]. Publication bias is always a concern in meta-analysis. The presence of publication bias indicates that nonsignificant or negative findings remain unpublished. To test for publication bias, Begg's test [13] was used in the present main analyses including all populations, results of which were considered significant for $P < 0.10$. Numbers of studies including specific populations for sub-analyses were too few to test for publication bias, which always may be a possible limitation of combining data from various sources as in a meta-analysis. However, the idea of adjusting the results of meta-analyses for publication bias and imputing "fictional" studies into a meta-analysis is controversial at the moment [14]. Sutton et al. [14] concluded that publication or related biases did not affect the conclusions in most meta-analyses because missing studies changed the conclusions in less than 10% of meta-analysis. All of the calculations were performed using STATA Version 8.2 (Stata Corporation, College Station, TX) software.

Results

Substance (alcohol)-related disorders

Substance-related disorders are the category of mental disorders most prevalent among completed suicides as well as mood disorders documented by more than 20 major psychological autopsy projects [15]. These studies reported that the range of current prevalence of alcohol dependence/abuse preceding suicide was from 15 to 56% [15]. It should be noted that chronic alcohol dependence can promote depression, thereby resulting in much more drinking. Thus, interactive effects of substance abuse and mood disorder must be paid particular attention.

A history of alcoholism has been emphasized as a critical risk of suicide in many studies. Then in the present data extraction for meta-analyses, when data regarding alcohol-related disorders and other substance-related disorders were shown separately, both the data were combined as substance-related disorders. When data regarding only alcohol-related disorders were shown or complications of other psychoactive drug-related disorders were unclear, only the data of alcohol-related disorders were extracted as representative data of substance abuse. When the data of both alcohol and other substance-related disorders were combined in the studies, those combined data were extracted as any substance dependence/abuse.

As shown in Table 1, the crude ORs of the included studies [16–31] ranged from 0.14 to 56.39. The summary OR for alcohol/substance-related disorders among both sexes combined 14 populations were 5.24 (95% CI = 3.30–8.31). Statistically significant heterogeneity was observed ($P < 0.001$). On the other hand, Begg's test

Table 1 Substance (alcohol)-related disorders and suicide risk

Author, published year (reference no.)	Country	No. of cases/ controls	Age class, proportion of male (%)	Source of controls	Diagnosis	OR (95% CI)[a]	Diagnostic criteria
Lesage et al. 1994 [16][c]	Canada	75/75	Young, 100	Community	Alcohol abuse and dependence	4.03 (1.51–11.94)	DSM-III-R
Gould et al. 1996 [17]	US	120/147	Young, 79	Community	Substance disorder	4.70 (1.73–14.74)	DSM-III
Brent et al. 1999 [18]	US	140/131	Young, 77	Community	Substance abuse	12.73 (4.79–42.28)	DSM-III
Vijayakumar et al. 1999 [19]	India	100/100	All, 55	Community	Alcoholism and substance abuse	6.47 (2.70–17.05)	DSM-III-R
Appleby et al. 1999 [20]	UK	84/64	Young, 81	GP lists	Any alcohol or drug misuse	10.34 (4.01–29.60)	ICD-10
Foster et al. 1999 [21]	Ireland	117/117	All, 79	GP lists (deceased)	Psychoactive substance use disorder	5.25 (1.73–14.74)	DSM-III-R
Houston et al. 2001 [22][c]	UK	22/22	Young, 100	Hospital (DSH)	Drug/alcohol-related disorder	0.14 (0.14–0.89)	ICD-10
Wærn et al. 2002 [23]	Sweden	85/153	Old, 55	Community	Substance use disorder	56.39 (8.64–2337)	DSM-IV
Owens et al. 2003 [24]	UK	100/100	All, 67	GP lists	Alcohol or substance abuse	33.00 (5.10–1368)	ICD-10
Zhang et al. 2004 [25]	China	66/66	All, 73	Community	Alcohol abuse	2.77 (0.74–12.69)	DSM-III-R
Gururaj et al. 2004 [26]	India	269/269	All, 64	Community	History of alcohol consumption	5.48 (3.30–9.33)	Original interview
Pllevile et al. 2005 [27]	Canada	95/95	Old, 75	Community (deceased)	Alcohol use disorder	1.88 (0.54–7.43)	DSM-IV
Schneider et al. 2005 [28]	Germany	163/396	All, 58	Community	Substance-related disorders	3.43 (2.23–5.26)	DSM-IV
Kõlves et al. 2006 [29]	Estonia	411/411	All, 81	GP lists	Alcohol abuse and dependence	5.70 (4.14–7.85)	DSM-IV
Chen et al. 2006 [30]	Hong Kong	150/150	All, 64	Community	Substance abuse	17.79 (2.68–750)	DSM-IV
Zonda et al. 2006 [31]	Hungary	100/100	All, 67	Community (deceased)	Alcohol and substance dependence/abuse	0.73 (0.40–1.31)	DSM-IV
Summary[b]	No. of populations						
Total (both genders)	14	2,000/2,152				5.24 (3.30–8.31)	
						*$P < 0.001$	
Men	6	750/839				3.87 (1.85–8.13)	
						*$P < 0.001$	
Women	3	157/292				8.34 (2.18–31.82)	
						*$P = 0.119$	
Young	3	344/342				8.55 (4.76–15.37)	
						*$P = 0.306$	

GP general practitioner, *DSH* deliberate self-harm

*P for heterogeneity (Cochran Q test)

[a] Crude odds ratio and 95% confidence interval

[b] Based on random effects model

[c] Men only

revealed no significant publication bias ($P = 0.38$). The results also indicated that the association between alcohol/substance-related disorders and suicide in women was stronger than that in men (Table 1). This tendency was also observed in the young population.

Depressive disorders (including any mood disorders)

Depressive disorders have been shown to be one of the two major risk factors of suicide as well as substance-related disorders, and their interaction has been emphasized [15, 32]. Data regarding major depressive disorder, depressive episode, depressive symptoms, dysthymia, and bipolar disorder were extracted for the meta-analysis.

As with substance-related disorders, if the data of depressive disorders were clearly distinguished from other mood disorders without overlap, the combined data were used for the meta-analyses. When the data of both depressive and other mood disorders were combined in the studies, those combined data were extracted as any mood disorders. Thus, 17 studies were identified [16, 17, 19–25, 27, 28, 30, 31, 33–36].

Depressive disorders showed a very strong association with suicide risk, especially in old populations. Moreover, as with substance-related disorders, depressive disorders were also more strongly associated with suicide in women than in men, although the number of studies was not sufficient (Table 2).

Because both mood disorders and substance-related disorders have been regarded as especially important risk factors of suicide [15], these results of total populations in Tables 1 and 2 were plotted in Figs. 1 and 2, respectively.

Marital status

A lack of social support particularly from family members and others has been shown to be a suicidal risk [32, 37]. An adverse marital situation such as single, divorce, bereavement, and separation sometimes leads a person to social isolation.

The present meta-analyses including 15 studies [16, 19, 20, 24–27, 29, 31, 34–36, 38–40] revealed that having no spouse or cohabitant was statistically significantly associated with suicidal risk, although strength of the association was relatively weak compared with alcohol dependence/abuse or depressive disorders (Table 3). The results regarding old populations were not clear, mainly due to an insufficient number of relevant studies.

Employment status

Unemployment or retirement sometimes means losing something to live for. These factors can also be regarded as kinds of stressful life events that are objectively difficult to evaluate, but important suicidal risks. Often, they also reflect poor socio-economic status.

The results regarding employment status are shown in Table 4 [16, 20–22, 24–26, 29–31, 35, 36, 38–41]. Overall, strength of the association was similar to that of marital status with an approximately two- to three-fold increased risk of suicide. Again, the results regarding male and old population did not show any statistically significant association partly due to the fewer studies.

Previous suicide attempt or deliberate self-harm

These self-harm behaviors have been regarded as very important risk factors for suicide. Given that 10% of suicide attempters reattempt and complete suicide before too long, simple calculation shows that a previous suicidal attempt is associated with an approximately 370-fold increased risk of suicide considering the Japanese suicide rate in the general population [42]. A total of 11 studies could be identified for this subject.

Indeed, the present meta-analyses showed the strongest association of this factor with suicide among the above five risk factors (Table 5). Sub-analyses for the specific population could not be conducted because there were fewer than three studies.

As mentioned in alcohol dependence/abuse, the Q statistics for the assessment of heterogeneity for mood disorders, adverse marital and employment status, and self-harm behaviors were also considered significant. Again, no statistically significant publication biases were observed for those four risk factors by Begg's test in the main analyses including all populations ($P = 0.16$ for mood disorders, 0.50 for marital status, 0.74 for employment status, and 0.21 for suicidal attempt).

Discussion

As strategies for effective suicide prevention, two main models have been advocated [43]. Figure 3 shows the results of the present analyses applied to these two models. One is called the disease or simple model, which has been emphasized by clinicians, especially by psychiatrists [43]. This model means suicides are caused by mental disorders, mainly by depression. Thus, secondary prevention of the depression is regarded as greatly important.

The other is an interactive model based on the concept of health promotion in which a comprehensive approach, partnership among concerned groups, construction of network system, and suicide prevention program at the small community level are important [43]. Recently, from the public health points of view, this interactive model has

Table 2 Depressive (mood/affective) disorders and suicide risk

Author, published year (reference no.)	Country	No. of cases/ controls	Age class, proportion of male (%)	Source of controls	Diagnosis	OR (95% CI)[a]	Diagnostic criteria
Lesage et al. 1994 [16][c]	Canada	75/75	Young, 100	Community	Major depression and depression NOS	15.53 (4.95–63.34)	DSM-III-R
Gould et al. 1996 [17]	US	120/147	Young, 79	Community	Mood disorders	10.00 (4.14–27.47)	DSM-III
Vijayakumar et al. 1999 [19]	India	100/100	All, 55	Community	Mood disorders	10.78 (3.08–57.27)	DSM-III-R
Appleby et al. 1999 [20]	UK	84/64	Young, 81	GP lists	Major affective disorders	18.42 (2.73–777)	ICD-10
Foster et al. 1999 [21]	Ireland	117/117	All, 79	GP lists (deceased)	Depressive disorders	8.80 (3.63–24.26)	DSM-III-R
Harwood et al. 2001 [33]	UK	54/54	Old, 68	Hospital (deceased)	Depressive episodes	4.01 (1.68–9.68)	ICD-10
Houston et al. 2001 [22][c]	UK	22/22	Young, 100	Hospital (DSH)	Affective disorders	1.20 (0.31–4.68)	ICD-10
Hawton et al. 2002 [34][d]	UK	42/84	All, 0	Female nurses	Affective disorders	55.25 (15.95–203)	ICD-10
Wærn et al. 2002 [23]	Sweden	85/153	Old, 55	Community	Mood disorders	66.73 (26.67–172)	DSM-IV
Phillips et al. 2002 [35]	China	519/536	All, 63	Community (deceased)	Depressive symptoms	21.08 (14.62–30.70)	DSM-IV
Owens et al. 2003 [24]	UK	100/100	All, 67	GP lists	Depressive disorders	49.00 (11.82–424)	ICD-10
Zhang et al. 2004 [25]	China	66/66	All, 73	Community	Mood disorders	15.57 (5.23–54.81)	DSM-III-R
Chiu et al. 2004 [36]	Hong Kong	70/100	Old, 44	Community	Depressive disorders	59.24 (19.31–209)	DSM-III-R
Pllevile et al. 2005 [27]	Canada	95/95	Old, 75	Community (deceased)	Affective disorders	24.75 (9.79–69.39)	DSM-IV
Schneider et al. 2005 [28]	Germany	163/396	All, 58	Community	Affective disorders	5.63 (3.47–9.19)	DSM-IV
Chen et al. 2006 [30]	Hong Kong	150/150	All, 64	Community	Mood disorders	8.97 (4.61–18.26)	DSM-IV
Zonda et al. 2006 [31]	Hungary	100/100	All, 67	Community (deceased)	Major depression	2.75 (1.35–5.69)	DSM-IV
Summary[b]	No. of populations						
Total (both genders)	14	1,823/2,178				13.42 (8.05–22.37)	
						*$P < 0.001$	
Men	4	297/414				6.56 (2.65–16.28)	
						*$P = 0.011$	
Women	3	155/313				12.95 (3.06–54.83)	
						*$P = 0.001$	
Old	4	304/402				24.62 (6.43–94.20)	
						*$P < 0.001$	

GP general practitioner, *DSH* deliberate self-harm. NOS: not otherwise specified

*P for heterogeneity (Cochran Q test)

[a] Crude odds ratio and 95% confidence interval

[b] Based on random effects model

[c] Men only

[d] Women only

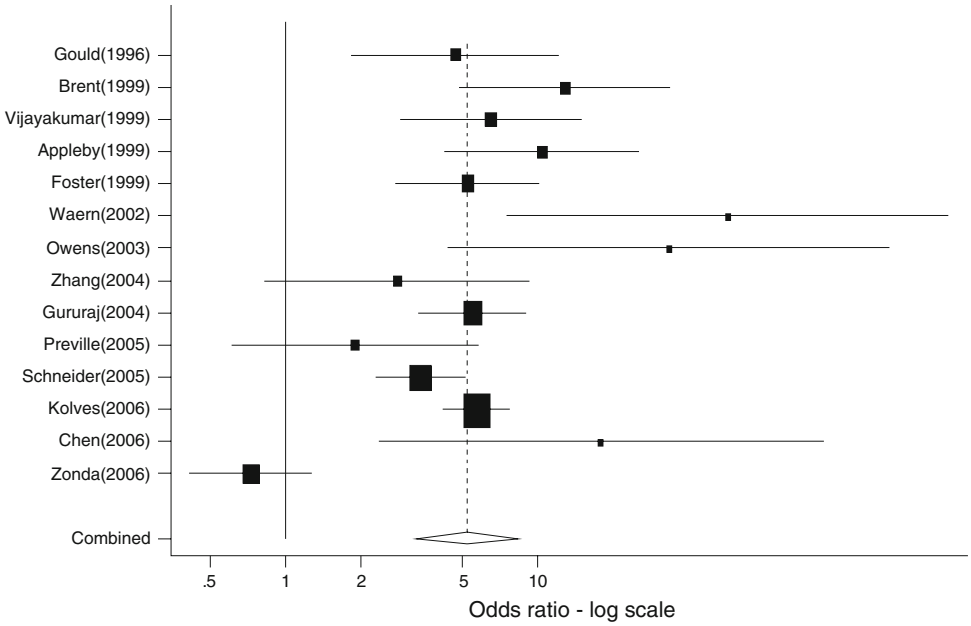

Fig. 1 Meta-analysis of 14 studies of substance (alcohol)-related disorders and suicidal risk (a forest plot). The center of a box and the *horizontal line* (logarithm) indicate the odds ratio (OR) and the 95% confidence interval (CI) in each study, with the areas of the boxes representing the weight of each study. The summary OR based on random effects model is represented by the middle of a diamond whose width indicated the 95% CI. The summary OR is shown by the *broken vertical line*. Statistical heterogeneity between studies was assessed with Cochran's Q test ($Q = 69.05$, $P < 0.001$). Summary OR = 5.24 (95% CI = 3.30–8.31)

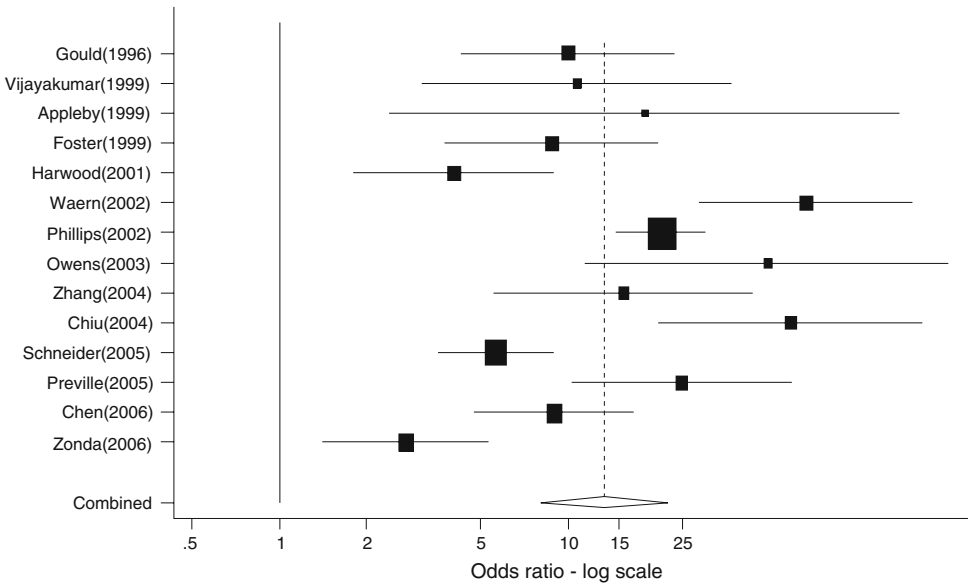

Fig. 2 Meta-analysis of 14 studies of depressive (mood/affective) disorders and suicidal risk (a forest plot). The center of a box and the *horizontal line* (logarithm) indicate the odds ratio (OR) and the 95% confidence interval (CI) in each study, with the areas of the boxes representing the weight of each study. The summary OR based on random effects model is represented by the middle of a diamond whose width indicated the 95% CI. The summary OR is shown by the *broken vertical line*. Statistical heterogeneity between studies was assessed with Cochran's Q test ($Q = 78.87$, $P < 0.001$). Summary OR = 13.42 (95% CI = 8.05–22.37)

been more evaluated for building up an effective strategy for suicide prevention than the disease model. The four personal and social factors included in the present meta-analyses are also considered to affect each other. A suicide attempt is reversible, but it is directly connected with the completed suicide. So it can be put beyond the interactive limits of the other four factors. This model is also associated with the primary prevention of depression.

Many suicide victims are considered to be in a depressive state when they take suicidal action. However, as mentioned above, depression is mediated by several social factors and other mental disorders. Chronic alcohol/substance dependence or social isolation, such as divorce or unemployment, makes a depressive state worse. Furthermore, a worse depressive state makes persons more likely to abuse alcohol or illicit drugs, and consequently lead them to divorce or dismissal. Such a vicious circle should be eliminated if possible even in the clinical setting. Thus, even clinicians or co-medical staffs should not be too much concerned about early detection or treatment of only depression for the prevention of suicide. They should also examine the patients' social backgrounds.

The present meta-analyses using studies by psychological autopsy revealed that five representative social and personal factors were associated with more or less significantly increased suicidal risk.

The psychological autopsy method involves several ethical issues [15]. Interviewing subjects who have recently

Table 3 Marital status and suicide risk

Author, published year (reference no.)	Country	No. of cases/ controls	Age class, proportion of male (%)	Source of controls	Marital status	OR (95% CI)[a]
Lesage et al. 1994 [16][c]	Canada	75/75	Young, 100	Community	Never married, divorced, widowed, or separated	1.00 (0.39–2.55)
Vijayakumar et al. 1999 [19]	India	100/100	All, 55	Community	Never married, divorced, widowed, or separated	1.63 (0.87–3.07)
Appleby et al. 1999 [20]	UK	84/64	Young, 81	GP lists	Not married or cohabiting	3.86 (1.80–8.31)
Cheng et al. 2000 [38]	Taiwan	113/226	All, 62	Community	Unmarried	1.90 (1.17–3.09)
Hawton et al. 2002 [34][d]	UK	42/84	All, 0	Female nurses	Unmarried	3.76 (1.57–9.36)
Phillips et al. 2002 [35]	China	519/536	All, 63	Community(deceased)	Never married, divorced, widowed, or separated	1.07 (0.82–1.39)
Owens et al. 2003 [24]	UK	100/100	All, 67	GP lists	Never married, divorced, widowed, or separated	5.19 (2.73–9.93)
Gururaj et al. 2004 [26]	India	269/269	All, 64	Community	Separated, divorced, or widowed	2.72 (0.64–16.05)
Duberstein et al. 2004 [39]	US	86/86	Old, 73	Community	Unmarried	3.92 (1.98–7.80)
Zhang et al. 2004 [25]	China	66/66	All, 73	Community	Unmarried	2.18 (0.93–5.25)
Chiu et al. 2004 [36]	Hong Kong	70/100	Old, 44	Community	Never married, divorced, widowed, or separated	0.72 (0.37–1.39)
Pllevile et al. 2005 [27]	Canada	95/95	Old, 75	Community (deceased)	Never married, divorced, widowed, or separated	4.21 (2.00–9.14)
Kõlves et al. 2006 [40]	Germany	163/163	All, 64	Community	Not married or cohabiting	2.96 (1.84–4.76)
Kõlves et al. 2006 [29]	Estonia	427/427	All, 80	GP lists (Community)	Not married or Cohabiting	2.29 (1.72–3.04)
Zonda et al. 2006 [31]	Hungary	100/100	All, 67	Community (deceased)	Never married, divorced, widowed, or separated	0.76 (0.41–1.43)
Summary[b]	No. of populations					
Total (both genders)	13	2,192/2,332				2.11 (1.50–2.98)
						*$P < 0.001$
Old	3	251/281				2.26 (0.71–7.24)
						*$P < 0.001$

GP general practitioner

*P for heterogeneity (Cochran Q test)

[a] Crude odds ratio and 95% confidence interval

[b] Based on random effects model

[c] Men only

[d] Women only

Table 4 Employment status and suicide risk

Author, published year (reference no.)	Country	No. of cases/ controls	Age class, proportion of male (%)	Source of controls	Employment status	OR (95% CI)[a]
Lesage et al. 1994 [16][c]	Canada	75/75	Young, 100	Community	Unemployed	1.24 (0.55–2.80)
Appleby et al. 1999 [20]	UK	84/64	Young, 81	GP lists	Unemployed	4.07 (1.56–11.86)
Foster et al. 1999 [21]	Ireland	117/117	All, 79	GP lists (deceased)	Unemployed	3.43 (1.46–8.71)
Cheng et al. 2000 [38]	Taiwan	113/226	All, 62	Community	Unemployed	2.22 (1.36–3.64)
Houston et al. 2001 [22][c]	UK	22/22	Young, 100	Hospital (DSH)	Unemployed	1.00 (0.25–4.06)
Phillips et al. 2002 [35]	China	519/536	All, 63	Community (deceased)	Housewife, retired, or unemployed	2.33 (1.66–3.28)
Owens et al. 2003 [24]	UK	100/100	All, 67	GP lists	Unemployed	2.36 (1.28–4.33)
Gururaj et al. 2004 [26]	India	269/269	All, 64	Community	Unemployed	5.53 (2.89–11.27)
Duberstein et al. 2004 [39]	US	86/86	Old, 73	Community	Unemployed on disability/retired	3.15 (1.50–6.75)
Zhang et al. 2004 [25]	China	66/66	All, 73	Community	Unemployed	1.44 (0.64–3.29)
Chiu et al. 2004 [36]	Hong Kong	70/100	Old, 44	Community	No job/retired	0.44 (0.17–1.17)
Kõlves et al. 2006 [40]	Germany	163/163	All, 64	Community	Illicit work, retired, or unemployed	2.10 (1.30–3.42)
Kõlves et al. 2006 [29]	Estonia	427/427	All, 80	GP lists (Community‘)	Illicit work, retired, unemployed, or other	3.10 (2.31–4.14)
Chen et al. 2006 [30]	Hong Kong	150/150	All, 64	Community	Unemployed	9.24 (4.81–18.45)
Harwood et al. 2006 [41]	UK	54/54	Old, 68	Hospital (deceased)	Problems related to occupation/retirement	9.22 (1.14–416)
Zonda et al. 2006 [31]	Hungary	100/100	All, 67	Community (deceased)	Unemployed/retired	1.94 (1.03–3.66)
Summary[b]	No. of populations					
Total (both genders)	14	2,318/2,458				2.71 (2.02–3.62)
						*$P < 0.001$
Men	3	193/193				2.80 (0.47–16.83)
						*$P < 0.001$
Old	3	210/240				1.99 (0.39–10.23)
						*$P = 0.001$

GP general practitioner, *DSH* deliberate self-harm

*P for heterogeneity (Cochran *Q* test)

[a] Crude odds ratio and 95% confidence interval

[b] Based on random effects model

[c] Men only

Table 5 Previous suicide attempt or deliberate self-harm, and suicide risk

Author, published year (reference no.)	Country	No. of cases/ controls	Age class, proportion of male (%)	Source of controls	Previous suicide attempt or deliberate self-harm	OR (95% CI)[a]
Appleby et al. 1999 [20]	UK	84/64	Young, 81	GP lists	Deliberate self-harm	31.67 (9.96–128)
Foster et al. 1999 [21]	Ireland	116/116	All, 79	GP lists (deceased)	Deliberate self-harm	13.97 (6.03–35.82)
Vijayakumar et al. 1999 [19]	India	100/100	All, 55	Community	Previous suicide attempt	5.17 (2.04–14.71)
Brent et al. 1999 [18]	US	140/131	Young, 77	Community	Previous suicide attempt	89.27 (14.60–3,613)
Cheng et al. 2000 [38]	Taiwan	113/226	All, 62	Community	Previous suicide attempt	6.50 (2.77–16.45)
Hawton et al. 2002 [34][c]	UK	42/84	All, 0	Female nurses	Deliberate self-harm	102.50 (20.46–931)
Phillips et al. 2002 [35]	China	519/536	All, 63	Community (deceased)	Previous suicide attempt	36.22 (14.89–114)
Owens et al. 2003 [24]	UK	100/100	All, 67	GP lists	Deliberate self-harm	63.30 (10.00–2,588)
Gururaj et al. 2004 [26]	India	269/269	All, 64	Community	Previous suicide attempt	38.77 (6.37–1,581)
Chiu et al. 2004 [36]	Hong Kong	70/100	Old, 44	Community	Previous suicide attempt	39.60 (5.89–1,657)
Zonda et al. 2006 [31]	Hungary	100/100	All, 67	Community (deceased)	Previous suicide attempt	2.27 (1.05–5.04)
Summary[b]	No. of populations					
Total (both genders)	10	1,611/1,742				16.33 (7.51–35.52) *$P < 0.001$

GP general practitioner

*P for heterogeneity (Cochran Q test)

[a] Crude odds ratio and 95% confidence interval

[b] Based on random effects model

[c] Women only

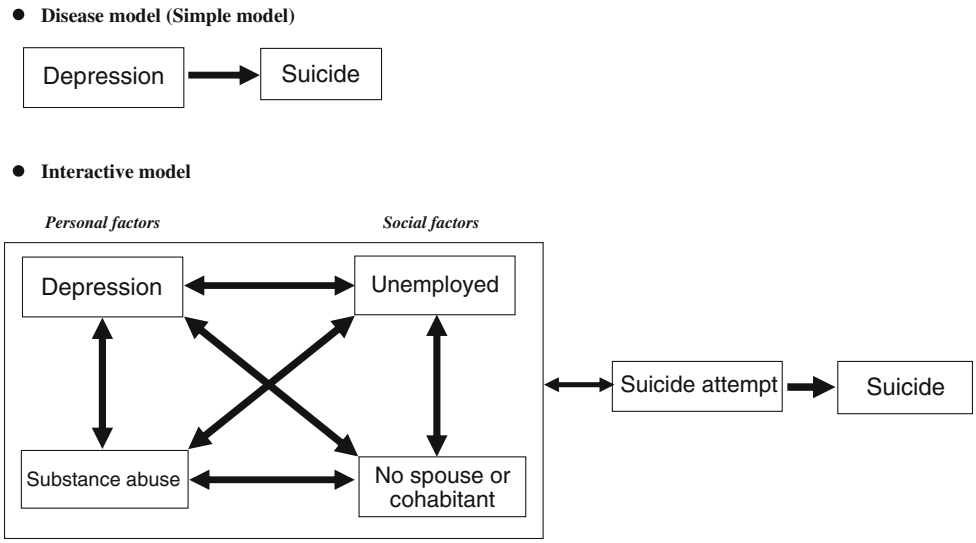

Fig. 3 Two models of suicidal pathway

lost their family member might lead to traumatic, anxiety- and guilt-provoking situations, and would sometimes thus be conducted in chaotic conditions. The psychological autopsy is usually conducted between 3 and 12 months after the suicide, in order to permit time for bereavement [15]. Many interviewers make the first approach very carefully, for example, by letter. However, whether the timing is right or wrong for contacting a bereaved family, much depends on the cultural set of values in each country or ethnic group. For instance, contact with the bereaved family of suicide victims is considered somewhat taboo in Japan. Furthermore, the bereaved family often wishes to conceal the fact that their close relative died by suicide. This may be the major reason why psychological autopsy studies have not been conducted in Japan.

Another ethical problem is the belief that the integrity of the deceased must be respected. This may sometimes be difficult, especially when the deceased suffered from a personality disorder or substance dependence. Unfortunately, as mental disorders are sometimes distorted by prejudiced opinion, these are often great obstacles to psychological autopsy. This matter also depends much on the cultural set of values in each country. This problem is also connected with the later-mentioned "heterogeneity" among the studies included in the present meta-analyses.

Limitations

Suicide itself is strongly affected by cultural differences and value systems. In Christian countries, for example, suicide is regarded as a sin. On the other hand, in Japan, suicide has been traditionally glorified in one aspect as traditional "Bushido." There are some extremists in specific new religious groups who endorse suicide as holy behavior. These differences in sense of value regarding suicide in various ethnic groups are of course closely connected with attitudes against suicidal risk factors, especially social factors [32]. This is a major limitation in the present meta-analyses in which groups from different cultures are included, although relatively common risk factors were selected. Indeed, as mentioned above, the Q statistics for the assessment of heterogeneity for all the risk factors proved to be statistically significant.

Another methodological limitation is that the simultaneous adjustment for several risk factors that are different in each study is impossible in meta-analysis. As mentioned above, several suicidal risk factors interact with one another, as seen in the example of alcohol dependence and depression, and the interactive model has been evaluated for building an effective strategy for suicide prevention. A statistically more adequate method, such as pooled analysis combining the original data, may be necessary for solving this problem. Furthermore, we had no choice but to neglect the original matching sampling of case-control design because only crude ORs calculated from 2×2 cross tables can be synthesized by meta-analyses. In this regard, the used effects in our meta-analyses may be somewhat distorted compared with the original ones and, therefore, should be carefully interpreted.

In the present study, sub-analyses for the specific population such as male or female, young or elderly did not show a clear association between relevant risk factors and suicide. A key reason is that the data available on these sub-groups were too few to obtain conclusive results. However, effects of some risk factors are obviously different according to the target population. For example, it is probable that socio-economic factors such as unemployment status may not cause stress in elderly people. On the other hand, the complex of somatic and mood disorders

may be a critical problem in the elderly because the incidence rate of somatic disorders increases as they grow old [44].

Finally, there may be some studies that could not be characterized by the keywords used in the present study, but conducted with designs similar to psychological autopsy studies. Because "psychological autopsy" is a special technical term, it actually reduces the number of relevant articles searched by keywords. This means that some biases may be included in the process of study selection. Furthermore, the direction of this selection bias is unclear.

Future direction

In spite of the above-mentioned limitations, the present results for each risk factor suggested the importance of identifying a high-risk group in light of the interactive effects of several risk factors. Among the five risk factors included in the present study, depression and previous suicidal attempt or deliberate self harm behavior are most strongly associated with suicide. These factors are closely connected with one another. Persons with both depression and previous suicidal attempt must be regarded as the highest risk group, and sufficient medical and social care should be supplied. They are easily regarded as a high-risk group in the medical setting. However, the effects of other environmental factors also should not be overlooked. Adequate family or social support may relieve the suicide risk in those people. An intervention study in a Japanese rural area with a high suicide rate suggested that the establishment of social capital is most important for suicide prevention [45]. Social capital means attachments to the community and relationships of mutual trust among people by reinforcing the network system among persons or groups in the community. Social isolation caused by divorce or unemployment is the very opposite of complete social capital.

The results of present meta-analyses suggested that both personal and social factors were associated with suicidal risk. This means a comprehensive approach is necessary for effective suicide prevention, but one must never underestimate the importance of secondary prevention of depression. Surely, depression is observed in many persons who commit suicide. Conventional and useful screening methods for depression are required especially in the clinical setting of community or workplace [46]. However, at the same time, the comprehensive viewpoint should not be downplayed in the public-health setting. Of course, this comprehensive (interactive) model works well for the prevention of suicide on the condition that the adequate model for each specific population, e.g., young or old, male or female, is established. Social and cultural factors may be underlying gender differences in the suicide rate; the rate for men is higher than women in many countries [47].

In this regard, a suitable prevention model among clinically specific populations, such as those with schizophrenia, should also be made. As mentioned in the "Methods" section, patients with schizophrenia are very few in the general controls. It is clinically more significant to clarify which factors, e.g., some specific symptoms or social factors, are associated with suicidal risk in patients with schizophrenia rather than verifying that schizophrenia itself is a risk factors for suicide. Factors related to suicidal risk in such a specific population can be extracted by using controls with the same diagnosis but without completed suicide or suicide attempt. For instance, symptoms related to suicide in patients with a major depressive disorder were revealed by comparing the patients of suicide victims with living patients as controls [48].

In the present Japanese circumstances, the success or failure of the establishment of the social capital depends heavily on the characteristics of the communities on which the social network can be developed. Establishment of the universal methodology is also needed. Furthermore, as mentioned in the "Limitations" section, suicide itself and its risk factors are strongly affected by the cultural mindset. To obtain the exact evidence, psychological autopsy studies in Japan should be conducted with careful consideration of the characteristics of Japanese culture. Needless to say, such studies must also be accompanied by due ethical considerations for suicide victims and bereaved families.

Appendix

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