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Suicide Risk Scales: Do They Help to Predict Suicidal Behaviour?*

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Summary. Fifteen rating scales for the estimation of suicide risks are reviewed. The report focuses on methods of scale development and validation. Problems of predictive accuracy, and ways of improving the prediction of suicidal behaviour are discussed.

Key words: Suicidal behaviour – Prediction – Suicide risk scales

Introduction

Any attempt to predict suicide or attempted suicide rests on the assumption that those individuals who will show suicidal behaviour in the future can be distinguished from those who will not by certain features. For the identification of such predictors standard psychological tests (Schmidtke and Schaller 1981) and suicide risk scales have been used. Suicide risk scales are lists of variables which usually cover the areas of demographic data, previous history, social adjustment, psychopathology and psychiatric diagnosis. Individual risk scores are obtained by totalling the number of items present. The variables may have different weights. In the present report, 15 suicide risk scales which were published between 1966 and 1984 are reviewed with special regard to methods of development and validation. Accuracy of prediction, applicability of the scales and ways of improvement are discussed. Overview articles on the subject have been previously published by Brown and Sheran (1972) and by Pöldinger and Sonneck (1974, 1980).

Methods of Risk Scale Development

The identification of predictive variables is commonly based on a comparison of two groups which are distinguished by the presence or absence of the criterion to be predicted (suicide, attempted suicide, or both). Differences between the groups are examined on pre-selected variables of supposed predictive relevance. The final predictors are extracted by complex statistical procedures. The major variations in methodology concern the study design, the type of sample studied, the criterion of prediction and the statistical analysis of the data. The most important methodological information is summarised in Table 1.

Nine suicide risk scales were derived from follow-up investigations of suicide attempters, psychiatric in-patients or callers at a suicide prevention centre. Subjects who showed suicidal behaviour within the period of observation were compared to the non-suicidal persons. In five studies, which did not involve a follow-up design, suicidal groups (patient suicides, officially registered suicides, patients with suicide attempts, threats or thoughts) were compared to separate groups of non-suicidal controls. One risk scale was not based upon an empirical evaluation of predictive variables. Suicide was chosen as the criterion to be predicted in most investigations. Multivariate statistical analysis was used in the construction of four suicide risk scales.

Description of Suicide Risk Scales

The 15 scales were grouped according to the sample for which they are valid.

Risk Scales for Suicide Attempters

Cohen et al. (1966) followed up 193 suicide attempters for 5 to 8 years and found 14 items which discriminated between the subjects who subsequently attempted or committed suicide from the remainder of the patients. Individual risk scores were calculated by totalling the number of unfavourable items present. Using a cut-off point of 3, 96% of the repeaters were correctly identified at the cost of misclassifying 68% of the non-repeaters.

Drawing on police records and official suicide death registers, Tuckman and Youngman (1968) determined the suicide rate within a 7-year period that was associated with each of 27 variables. The 17 most relevant variables were combined to form a risk scale. The suicide rate correlated to the individual score on this scale. Resnik and Kendra (1973), who evaluated the scale in a sample of 83 psychiatric in-patients, confirmed only 6 of the 17 variables to be predictive.

Buglass and McCulloch (1970) examined the occurrence of further suicidal behaviour (suicide or attempted suicide) within a 3-year period in a sample of 511 patients who had been admitted to a poison treatment centre after drug overdose. The differences between repeaters and non-repeaters were used to construct separate risk scales for both sexes. For male patients, seven discriminant variables were identified,

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Table 1. Methodology of risk scale development

Study	Sample	*n*	Follow-up (years)	Criterion	Analysis	Number of predictors
Cohen et al. (1966)	Suicide attempters	193	5–8	Suicide	Comparison of variable distribution	14
Dean et al. (1967)	Psychiatric in-patients	34	—	Suicide	Comparison of variable distribution	26
Tuckmann and Youngman (1968)	Suicide attempters	3,800	Up to 7	Suicide	Comparison of variable distribution	17
Pöldinger (1968)	Psychiatric in-patients	777	10	Suicide	Correlation coefficients	35
Miskimins and Wilson (1969)	Psychiatric in-patients	45	—	Suicide	Comparison of variable distribution	16
Buglass and McCulloch (1970)	Suicide attempters	511	3	Suicide, attempted suicide	Comparison of variable distribution	3 and 7
Van de Loo and Diekstra (1970)	Suicide attempters, suicides	209	—	Suicide	Comparison of variable distribution	14
Buglass and Horton (1974)	Suicide attempters	847	1	Suicide, attempted suicide	Comparison of variable distribution	6
Lettieri (1974)	Callers at a suicide prevention centre	517	2	Suicide	Stepwise discriminant analysis	8 to 13
Zung (1974)	Psychiatric in-patients	275	—	Suicide, attempted suicide	A priori selection of variables	69
Farberow and MacKinnon (1974)	Psychiatric in-patients	187	2	Suicide	Stepwise discriminant analysis	11
Motto and Heilbron (1976)	Psychiatric in-patients	1,240	3	Suicide	Stepwise discriminant analysis	23 and 26
Pallis et al. (1982, 1984)	Suicide attempters, suicides	266	—	Suicide	Stepwise discriminant analysis	7 and 18
Henseler et al. (1983)	Suicide attempters	65	10	Suicide attempts, thoughts, threats	A priori selection of variables	31
Patterson et al. (1983)	—	—	—	Attempted suicide	A priori selection of variables	10

for female patients only three. The individual scores were grouped in low, medium and high risk categories, giving one point for each item present. Of the repeaters 86% were correctly identified. The rate of false positive predictions was 63%. Validation of these sex-specific scales on a new sample of over 600 suicide attempters showed that the female scale was still predictive while the male scale was not. This finding was confirmed by Chodwhury et al. (1973) who applied the scales to a sample of repeated suicide attempt patients.

Buglass and Horton (1974) constructed a risk scale from data on 847 suicide attempters who were followed up for 1 year. Six items discriminated between repeaters (suicide or attempted suicide) and non-repeaters. Individual risk scores were obtained by giving one point for each item present. The scale was validated in two independent samples of suicide attempters. The repeat rates correlated to the risk scores. With a cut-off at score 1, 88% of the repeaters were correctly identified at the cost of 57% false positive predictions. Garzotto et al. (1976) applied this six-item scale to an Italian sample of 120 suicide attempters, with the patients followed up for 1 year. Using the same cut-off point (score 1 or more), 83% of the repeaters were correctly identified at a rate of 76% false positive predictions. The poor specificity of the scale was also demonstrated in another study by this research group (Siani et al. 1979).

Van de Loo and Diekstra (1970) retrospectively compared independent samples of 152 suicide attempters and 57 persons who had committed suicide. Data on suicide attempts were obtained from clinical records, on suicides from public health and police authorities. The groups showed significant differences on 11 variables. Individual scores were calculated by giving 1 point for each item present; with a cut-off point at 5, 77% of the suicides were correctly identified at a cost of wrongly classifying 21% of the suicide attempters as suicides. In a subsequent study, Diekstra (1972) retrospectively compared 223 suicide attempters to 100 suicides and found that 8 of the 11 variables discriminated between the groups.

Pallis et al. (1982, 1984) compared 151 suicide attempters to an independent sample of 57 completed suicides. Differences between the groups were examined by stepwise discriminant analysis. Two scales were generated, containing 7 and 18 variables respectively. With the long scale, 92% of suicides were correctly classified at a false positive rate of 9%. With the short scale, 81% of the suicides were correctly classified at a cost of misclassifying 16% of the suicide attempters. The short scale was validated in a new sample of 1,263 suicide attempters who were followed up for 2 years. Of the subsequent suicides 83% were correctly identified and 26% of the non-suicides were wrongly predicted as suicides. The long scale was validated by the 3-year follow-up data of the original sample from which the scale was derived. All suicides were correctly forecast at a false positive rate of 14%.

The study of Henseler et al. (1983) was aimed at identifying patient variables that would be associated with "chronic" suicidal tendency in suicide attempters. This disposition was operationalised by suicide, repeated suicide attempt, persistent suicidal ideation and recurrent suicidal crisis. In the development of the risk scale, the authors were guided by theoretical assumptions on the psychodynamics of suicidal behaviour. There were 31 variables selected on these grounds. The scale was applied to 56 subjects who could be traced 10 years after a suicide attempt. About 70% of these patients were correctly

classified into the groups with "chronic" suicidal tendency and without.

Risk Scales for Patients in a Depressed or Suicidal State

Motto and Heilbron (1976) developed a risk scale on the data of 1,240 patients who were admitted to a psychiatric hospital in a depressed or suicidal (suicide attempts, thoughts or threats) state. Of these patients 82 committed suicide within 3 years of hospital discharge. Stepwise discriminant analysis was used to identify the features that distinguished the suicides from the remainder of the patients. Separate risk scales were obtained for male and female subjects, containing 23 and 26 variables respectively. According to individual risk estimates, patients were classified into a high risk and low risk group, permitting 80% of the male suicides and 75% of the female suicides to be allocated to the high risk group. The rate of false positive predictions was roughly 15% for both sexes. The scales were validated on the 1-year follow-up data of a new sample of 1,097 psychiatric patients with 60% of the male suicides but only 32% of the female suicides classified as high risks. The rate of false positive predictions was 48% for the males and 16% for the females. In order to improve the accuracy of prediction, Motto and Heilbron proposed the construction of risk scales for certain patient sub-groups with a high probability of suicide. Two such groups were examined: males under 40, and a group called "stable with forced change" which consisted of non-psychotic patients with overall stability in prior life-pattern and presence of a significant loss or threatened loss (Motto 1979). Prediction proved to be more accurate for the second group.

Pöldinger (1968) used two different patient samples for the construction of a risk scale. Data were derived from 237 depressed or schizophrenic psychiatric in-patients who were followed up for 10 years and from 440 patients who were hospitalised after a suicide attempt. The demographic characteristics of these patients were compared to the general population. From the 35 items of the scale an overall risk score was obtained which particularly weighted variable combinations. The scale was validated on 100 patients. The mean score was 137 for patients who committed suicide, 113 for suicide attempters and 46 for non-suicidal subjects. Padrutt (1970) administered the scale to 237 psychiatric out-patients, finding a discrepancy between overall risk scores and the clinicians' independent suicide risk estimations. The scale was overly sensitive to depressive symptoms and to malfunctioning in several areas of life. In addition, patients with subsequent suicidal behaviour had relatively low risk scores. By contrast, Grüneberg et al. (1972), who applied the scale to 529 suicide attempters, showed a good agreement of the risk scores and independent risk estimations in four out of five cases. Sonneck et al. (1976) used the scale in a sample of depressed out-patients and suicide attempters. They found that depressed subjects with suicide thoughts had higher overall scores than non-suicidal depressed patients. The mean score of the suicide attempters was intermediate. Taussigova et al. (1975) validated the scale in a 5-year follow-up study of 165 patients with endogenous depression. The subjects were classified into nine groups according to their overall risk score. The authors demonstrated an almost linear positive correlation between the risk scores and the frequency of suicidal behaviour within the observation period.

Relying on previous literature, Patterson et al. (1983) compiled ten putative suicide risk factors into the "Sad Persons" scale. As each letter of its title stands for one variable, the scale serves as a memory aid. Data validating the instrument have not been reported.

Risk Scales for Unselected Psychiatric Patients

Dean et al. (1967) derived a risk scale from psychiatric patients of all diagnostic categories. Matched pairs were built of 17 patients who had committed suicide during or after hospital treatment and of 17 controls; 26 variables discriminated between suicides and non-suicides. Items were weighted in computing individual risk scores. Using a cut-off score of 25, 94% of the suicides were correctly allocated and 38% of the controls were misclassified. With a cut-off score of 37, 75% of the suicides and 94% of the controls were correctly identified.

Miskimins and Wilson (1969) compared 15 psychiatric in-patients who had committed suicide to 30 non-suicidal controls, who were matched for age, sex, marital status and diagnosis. From the differences that were found between these groups, a risk scale with 16 items was constructed. The suicides had significantly higher scores on this scale than the non-suicides. Braucht and Wilson (1970) validated this scale on a large patient sample at the same hospital using discriminant function analysis. Only 44% of the patients who had committed suicide were correctly identified.

Farberow and MacKinnon (1974) compared 93 psychiatric in-patients who had committed suicide within 2 years after hospital discharge to 94 randomly selected patients who had not. Stepwise discriminant analysis was used to identify the 15 variables which best distinguished between the groups. These were combined into several risk scales with 5 to 15 items. With the 11-item scale, 85% of the suicides were correctly allocated and 26% of the controls were misclassified. A validation procedure applied the scales to a new population of 92 suicides and 100 controls and found the 11-item scale to predict most efficiently. It identified 79% of the suicides and misclassified 25% of the controls (Farberow and MacKinnon 1976).

Zung (1974) selected from previous studies 19 demographic and 50 clinical variables and combined them into a risk scale. The mean scores on this scale differentiated between 217 patients with suicide attempts, thoughts or threats on the one hand, and 58% non-suicidal subjects on the other, but did not discriminate within the three suicidal groups.

Risk Scales for Clients of a Suicide Prevention Centre

Lettieri (1974) examined the features of randomly selected callers at a suicide prevention centre: 52 subjects who died of suicide within 2 years of the initial contact were compared to 465 surviving clients. The sample was split into four age-sex groupings: older males, younger males, older females and younger females. Four separate stepwise discriminant function analyses were performed. Each of the separate analyses was used to generate two scales, a long form and a short form. The number of items varied from 3 to 13. The scales have not been validated.

Discussion

The value of a risk scale is determined by the sensitivity and specifity of prediction. Sensitivity is commonly defined as the

Table 2. Sensitivity and specifity of prediction by risk scales

Study	Original sample		Validation sample	
	Sensitivity (1)	Specifity (2)	Sensitivity (1)	Specifity (2)
Cohen et al. (1966)	0.96	0.32	Not reported	
Dean et al. (1967)	0.75	0.93	Not reported	
Buglass and McCulloch (1970)	0.87	0.37	Insufficient data	
Van de Loo and Diekstra (1970)	0.77	0.79	Insufficient data	
Buglass and Horton (1974)	0.88	0.44	0.83	0.24
Farberow and MacKinnon (1974) (11-item scale)	0.85	0.74	0.79	0.75
Motto and Heilbron (1976) m.	0.80	0.84	0.60	0.52
f.	0.75	0.85	0.32	0.84
Pallis et al. (1982, 1984) (short scale)	0.81	0.84	0.83	0.74

(1) $\frac{\text{correctly predicted positives}}{\text{all positives}}$

(2) $\frac{\text{correctly predicted negatives}}{\text{all negatives}}$

relation between correctly predicted positives and total positives. Specifity means the relation between correctly predicted negatives and all negatives. The two measures behave reciprocally: high sensitivity is associated with low specivity and vice versa. If we decide to identify a maximum of future suicide or suicide attempts, we must take into account an intolerable number of false positive predictions. If, on the other hand, we wish to have a minimum of false positives, too many suicides or suicide attempts will be missed. This is due to the principal limitations of forecasting infrequent events (Rosen 1954). To be practically valuable, a risk scale should be a compromise between these extremes. Sensitivity and specifity values of the scales that we have described are shown in Table 2 as far as available. In the original sample, almost all scales were sufficiently sensitive, but specifity varied considerably.

Most risk estimation instruments suffered a significant loss of predictive accuracy when they were transferred to new patient samples. Exceptions were the scales of Farberow and MacKinnon (1974) and of Pallis et al. (1982, 1984). Thus it cannot be accepted as a general rule that suicide risk scales are valid only in the sample from which they originated.

As the final predictors were extracted from very different variable sets with non-identical operationalisation of items, item contents of the 15 risk scales cannot be directly compared. We decided therefore to combine single predictors into global categories. The results are shown in Table 3. Six classes of variables were identified as predictors in nearly all studies: demographic data (particularly male sex, age over 45, and not living with spouse), evidence of mental illness (including previous psychiatric hospitalisation), previous suicidal behaviour (attempted suicide in most cases), evidence of antisocial behaviour (including violence in key relationships), presence of psychopathological symptoms and poor physical health. Results were less consistent regarding the severity of current suicidal behaviour (which is not appropriate to some studies), social isolation and recent loss.

It can be concluded from this review that well-constructed risk scales are capable of identifying persons with a high probability of future suicide. Although the accuracy of prediction is not satisfactory from a statistical point of view, risk scales may be helpful in clinical management. Further improvement of prediction may be expected from scales for special risk groups. Such estimation instruments have already been developed (Motto and Heilbron 1976; Lettieri 1974) and deserve further evaluation. As far as risk scales for suicide attempters are concerned, another way of refining methodology is to describe suicidal behaviour more precisely, e.g. by rating instruments for suicidal intent (Beck et al. 1974; Pierce 1977) or risk-rescue estimation (Weisman and Worden 1972). Regarding statistical procedures, previous data favour multivariate

Table 3. Variables identified as predictors

Study	Predictor categories								
	Demographic data	Evidence of mental illness	Previous suicidal behaviour	Evidence of antisocial behaviour	Severity of current suicidal attempts	Presence psychopathological symptoms	Social isolation	Poor physical health	Recent loss
Cohen et al. (1966)	+	+	+	+	+			+	+
Dean et al. (1967)	+	+		+	+	+			
Tuckman and Youngman (1968)	+	+	+		+		+	+	
Pöldinger (1968)	+	+	+				+	+	
Miskimins and Wilson (1969)	+	+		+	+	+			
Buglass and McCulloch (1970)		+	+	+					+
Van de Loo and Diekstra (1970)	+	+	+		+	+	+	+	+
Buglass and Horton (1974)		+	+	+					
Lettieri (1974)	+	+	+	+		+	+		+
Zung (1974)	+	+	+	+		+		+	+
Farberow and MacKinnon (1974)	+	+	+	+		+			+
Motto and Heilbron (1976)	+		+		+	+	+	+	
Pallis et al. (1982)	+	+				+	+	+	+
Henseler et al. (1983)		+	+	+				+	
Patterson et al. (1983)	+	+	+			+	+	+	

analysis. At present, further validation studies are desirable. It would be particularly interesting to see whether the systematic and continuous use of a carefully designed scale has an observable effect on the frequency of suicide or attempted suicide in a given setting.

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