Predicting Tendency for Suicide Based on Risk Factors and Ontological Identity Using Artificial Neural Network

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The purpose of this research was to offer a model for predicting the rate of tendency for suicide in individuals and also the importance number of the risk factors involved in suicide, using artificial neural network. Furthermore, the relationship between ontological identity and suicide was examined. Six hundred and ninety-eight participants (557 females and 141 males) in this research in Isfahan were selected by convenience sampling method. The age range of the sample individuals was 19 to 41 years ($M = 22.2$). In this research, an artificial neural network was offered to draw the relationship among 32 suicide risk factors. All the risk factors presented in former researches, besides ontological identity had a role in the network. The accuracy of classification of this network in predicting the tendency of suicide in various individuals was 90.5. Also, the importance number of the suicide risk factors was shown using neural network. Ontological identity obtained the first rank among all the risk factors. Therefore, this research confirmed the roles of all presented risk factors in former researches, besides ontological identity, in suicide and provided a hierarchy of risk factors in suicide.

Keywords: tendency for suicide, risk factors, ontological identity, artificial neural network

Introduction

Suicide is a phenomenon existing as long as human kinds have existed. Inconsistent with life principle, suicide has been condemned in all societies and cultures. Suicide is an action aimed at deliberate terminating of one's life and is committed consciously. A suicidal individual sends out some signals springing from suffering and stress (B. Sadock & V. Sadock, 2005). Suicide is a major problem in health and hygiene of society. About 9% of all deaths are due to suicide and nearly 1,000 suicides are committed each day all over the world (Levin, 2009). The rate of suicide has increased during the last 50 years. One million people die due to suicide each year in the world (Grzywa, A. Kucmin, & T. Kucmin, 2009). In spite of the facts, suicide is a complex and multi-dimensional phenomenon influenced by individual, social and cognitive factors. During last few decades, many studies have been done on suicide and the results have shown that suicide is correlated with

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multi-factorial risk factors including biological, psychological, social and family risk factors (Liu & Tein, 2005). Generally, there are two major reasons involved in suicide: (1) medical factors including physical illnesses, mental disorder and substance dependency; and (2) social factors including celibacy, unemployment, divorce, losing close relatives, parents' divorce, poverty, financial problem and rate of religiosity, etc. (Gelder, Mayou, & Geddes, 1999).

The first category shows medical factors related to suicide. Suicide is related to physical illness (Beautrais, Joyce, & Mulder, 1997; Heikkinen, Isometsa, Aro, Sarna, & Lonnqvist, 1995). According to Roy's (1999) research, 75% of suicide victims have had physical illness. In this study, almost 95% of patients who had committed suicide had some sorts of special mental disorder including depressive disorders (80%), schizophrenia (10%) and dementia (5%). Therefore, committing suicide is highly related to depression (Fergusson & Woodward, 2002; Lee, Wong, Chow, & McBrid-Chang, 2006). Also, based on research literature, suicide is related to anxiety (Yamada, 2007; Lee et al., 2006; Norton, Temple, & Pettit, 2008) and substance abuse disorders (Howard, Wang, & Yan, 2008; Wild, Flisher, & Lombard, 2004; Liu & Tein, 2005).

The second category constitutes social factors related to suicide. The most important factors related to suicide which have been mentioned in the former researches include: celibacy (Khorshidi, Yasemi, Asasi, & Zamani, 2004), divorce (Wyder, Ward, & De Leo, 2009), illegitimate sexual intercourse (Howard et al., 2008; Hallfors, Waller, Ford, Halpern, Brodish, & Iritani, 2004), unemployment and financial poverty (Beautrais, 2003; Nock, Borges, Bromet, Cha, Kessler, & Lee, 2008), rate of religiously (Shakery, Parvizi Fard, Sadeghy, & Moradi, 2004; Neeleman & Lewis, 1999) and urban life vs. rural life (Shams Alizadeh, Afkham Zadeh, Mohsen Poor, & Salehian, 2011; Salarilak, Entezarmahdi, & Abbasi, 2006; Ghamari, Zahed, & Navid, 2010). Furthermore, life stressors predicting suicide include close relatives' death (Larosa, Consoli, Hubert-Vadenay, & Leclesiau, 2005; Kushan, Shegerf, Rabbanizadeh, Heidary, Tofighian, & Maskani, 2007), divorce and parental arguments (Larosa et al., 2005), child abuse history and violence in family (Langhinrichsen-Rohling, Arata, Bowers, O' Brien, & Morgan, 2004; Nock & Kessler, 2006; Swahn & Bossarte, 2007), love relationship failure (Khalkhali, Rahbar, Fardmas'ood, & Jamadi, 2001), educational failure (Kushan et al., 2007; Lee et al., 2006). Also, committing suicide in close relatives and friends (Nock & Kessler, 2006; Swahn & Bossarte, 2007) and one's prior attempted suicide (Safa, Mahmoodi, Soltani Far, Saki, & Farhadi, 2006) increase the risk of suicide. Age and sex are considered effective factors in predicting suicide as well (Sadock, 2009). Studies show that most of the people committing suicide are aged between 20 and 24 years with an average of 25 years of age (Bradley, Gaynes, Carol, Ford, Paul, Jonathan, & Kathleen, 2004; Nock et al., 2008; Lubell, Kegler, Crosby, & Karch, 2007). Generally, the statistics show that suicide is the 11th cause of death in whole population and third cause of death in the population aged between 15 to 24 years (April, Tracy, Nadia, Sarah, Ted, & Thomas, 2008). Researches show that femininity is directly related to suicide (Troister, Links, & Cutcliffe, 2008), so that in some studies in Iran, the rate of committing suicide in women is twice as much as men (Zojaji, Yasami, & Layeghi, 2004; Zare, Nazer, & Sayyadi, 2010). Former researches have also shown that having a purpose in life and a reason for living is related to suicide thoughts, as a cognitive factor (Range & Penton, 1994; Ulmer, Range, & Smith, 1991; Frankl, 1971). Awareness from one's position in the cosmos brings about a profound sense of unity and relatedness to universe. This, as an anchor, can cause mental and physical health, life satisfaction and blissfulness (Eckstein & Kern, 2002). Ontological identity represents one's belief in origin of life, philosophy of being and his end of life, and has a close relationship with purposefulness and meaningfulness of life (Farahani, Rahiminezhad, Aghamohamadi, & Kazemi, 2011). In this research, the

relationship of this concept, i.e., ontological identity with suicide will be examined for the first time.

As mentioned above, a lot of research has been done in psychology and social sciences examining suicide all of which were seeking suicide-related risk factors somehow. A necessity for predicting the tendency for suicide is recognized, because suicide is an abnormal phenomenon in human kind's behaviors. Regarding the multiplicity of risk factors involving in predicting suicide, traditionally statistical approaches such as regression cannot be suitable for such purpose, because their assumption is just based on the linear relationship (Moore & Williams, 2002), but the neural network model, as opposed to traditional approaches for prediction, avoids simplifying relationship by combining predicting variables (Lucek, Hanke, Reich, Solla, & Ott, 1998). Therefore, in this research, all the mentioned risk factors in the previous researches in addition to the new variable, i.e., ontological identity in predicting the tendency for suicide will be examined by the neural network model and thus, a clear picture of predicting factors of the tendency for suicide will be depicted. Furthermore, in the previous researches, although the importance of the suicide-related variables has been examined, the rate of significance of these variables in the tendency for suicide has been examined less. So, in this research, the rate of the significance of the risk factors in predicting the tendency for suicide will be analyzed. Regarding the fact that, in this research, the new concept of ontological identity as a cognitive factor in predicting the tendency for suicide has been examined and it seems that this variable supports other cognitive factors, such as purpose in life and meaningfulness of life, then it is expected that this variable will gain a high rank in predicting the tendency for suicide. Therefore, the purpose of current research was: (1) constructing a neural network for predicting the rate of tendency for suicide based on risk factors and ontological identity in students; and (2) determining the importance number of factors in causing the tendency for suicide in students.

Method

Participants

Participants in this research were 800 university students who were selected by convenience sampling method in Isfahan. After skipping problematic questionnaires, the sample was limited to 698 people (557 females and 141 males). The age range of the sample was 19 to 41 years with the mean age of 22.2 years and a standard deviation of 3.34.

Instruments

According to biological, psychological, social and family risk factors involved in suicide which has been mentioned in the introduction in detail, some questionnaires and scales were selected in order to measure all these factors. These questionnaires and scales are as follows.

Demographic questionnaire. This questionnaire contains questions about gender, age, marital status, housing status, education, educational achievement, financial status of the family, the number of family members, order of birth, occupation, death of close relatives, one's appearance (face and body), allergic history, history of taking psychiatric drugs, history of using narcotics or psychedelic drugs, history of implication in the law, history of a family member's or close friends' or one's committing suicide, history of family violence, history of love failures, close relationship with the opposite sex, being a child of divorced parents, the rate of participating in religious ceremonies and the rate of recreational activities.

BSSI (Beck suicide scale ideation). BSSI is a self-report scale which has developed in order to reveal and measure the intensity of attitudes and planning for committing suicide. This scale measures the items, such as

death wish, tendency for suicide, duration and frequency of suicide thoughts, the rate of self-control preventive factors and one's preparedness for committing suicide. This scale contains 19 items within four-degree Likert scale (0 = "None", 3 = "Much"). Different studies have gained a validity of 0.87 to 0.97 for this scale using Cronbach's Alpha method and a validity of 0.54 using test-retest (Beck & Steer, 1991). In this research, a Persian form of this scale has been used which has been validated by Anisi, Fathi Ashtiani, Salimi, and Ahmadi (2005). The validity of Persian form of this scale was gained 0.95 using Cronbach's Alpha and 0.88 using test-retest method.

Brief form of DASS-21 (depression anxiety stress scale). P. F. Lovibond and S. H. Lovibond (1995) developed DASS in 1995 and reported three mental factors: depression, anxiety and stress using factor analysis. The items measure depression, anxiety and stress in the last week. DASS contains two forms: original form which contains 42 items and brief form which contains 21 items (seven items for each factor) within a four-degree Likert scale ("totally like me", "not at all like me"). The brief form of DASS was studied by Henry and Crawford (2005). These researchers have pointed to three factors of depression, anxiety and stress which have a reliability coefficient of 0.88, 0.82 and 0.90 for these factors, respectively. Persian form of DASS-21 was validated by Samani and Jokar (2007). These researchers have reported that Persian form of DASS-21 also contains three factors of depression, anxiety and stress and Cronbach's Alpha for these factors are 0.87, 0.85 and 0.75, respectively.

OIS (ontological identity scale). This scale was developed by Farahani et al. (2011), which includes 27 items within a five-degree Likert scale (1 = "Strongly disagree", 5 = "Strongly agree") according to three dimensions of "where do I come from", "where I am" and "where I go to" having been developed on an ontological viewpoint (items 1 to 9 for the dimension of "where I come from"; items 10 to 18 for the dimension of "where I am" and items 19 to 27 for the dimension of "where I go to"). Sample items are: "My coming to the world is not accidental and there is logic behind it" (where I come from); "Despite all the misery and difficulties, human beings can attain great purposes" (where I am); and "I like there to be a world after death but I'm not sure about it" (where I go to). The reliability of the ontological identity questionnaire was tested through both Cronbach's Alpha and test-retest methods and the obtained coefficients were 0.81 and 0.68 respectively. Also, the validity of this questionnaire was tested through concurrent validity and exploratory factor analysis. The concurrent validity was also tested through purpose in life scale and the correlation coefficient was significant (0.42) between the ontological identity and purpose in life questionnaires ($P = 0.001$). The exploratory principal component analysis with Varimax rotation revealed that this questionnaire has three factors which determine 43.32 of the total variance.

Statistical Method

Artificial neural network. Artificial neural network is a parallel distributive and voluminous processor which consists of simple processing units. This network is capable of learning from presented empirical knowledge in its inter-related units and can make use of the obtained learning (Kantardezic, 2002). Artificial neural network is a simplified model of human brain. In this model, neurons are the smallest constructive unite of artificial neural network. Each network consists of an input layer, an output layer and one or more middle (hidden) layers. Neurons of each layer are connected to next neurons by weights (Sabzevari, Mohammad Poor, & Zommodian, 2004). Through training process of the network, these weights and constant amounts, technically called bias, are added and they change continuously so that the error reaches its minimum level or

put simply, and root-mean-square error becomes minimum. For transferring outputs of each layer to the next layers, activation functions are used (B. D. Ripley & R. M. Ripley, 2006). There are different functions, the most famous of which include linear functions, sigmoid and threshold functions.

Results

Descriptive Result

The sample for this research included 698 students (557 females and 141 males), from whom, 545 students (78.1%) were in low-risk tendency for suicide group and 153 students (21.9%) were in high-risk tendency for suicide group, based on determined cutoff point. The mean age of the low-risk group was 22.06 years and the high-risk group was 22.31 years. The mean score of OIS for the low-risk group was 99.38 and that for the high-risk group was 92.72. Also, the mean scores of stress, anxiety and depression for the low-risk group were 4.85, 4 and 5.14, and for the high-risk group were 7.29, 6.49 and 7.29 respectively.

Network Specifications

In this research, MLP (multilayer perception) artificial neural network with back propagation algorithm was used. For determining the best activation function with various functions, the network was performed and optimal function was determined based on the minimum root-mean-square error. The function used in this model for the data of this research was hyperbolic tangent function. Seventy-two point four percent of subjects were used for training sample and 27.6% were used for testing sample. For evaluating this model, RMSE (root mean square of error) and under curve, surface ROC (receiver operating characteristic) were used. The specifications of MLP artificial neural network have been presented in Table 1.

Table 1

Specifications of MLP Artificial Neural Networks Used in This Research

Specifications of MLP neural network	
Number of neurons in the input layer	117
Number of hidden layers	1
Number of neurons in the hidden layer	3
Number of neurons in the output layer	2
Type of network function	Hyperbolic tangent
Type of network training	Back propagation
Mean square error	0.03
Number of training sample	385
Number of testing sample	147
Number of excluded sample	166
Number of repetition	1,000

Network Validity

Table 2 shows the results accuracy, sensitivity and specificity in two models of MLP.

Table 2

The Results Related to Accuracy, Sensitivity and Specificity in MLP

Model	Accuracy	Sensitivity	Specificity
MLP artificial neural network model	90.5	0.94	0.85

Under curve area ROC in artificial neural network for two low-risk and exposed-to-risk groups was obtained 0.938 that shows accuracy and significance of the classification. Figure 1 shows sensitivity and specificity of MLP artificial neural network. As it is seen in Figure 1, diagnostic sensitivity and specificity of MLP artificial neural network are 0.94 and 0.85 respectively, which shows that this model acts with a completely equal precision in diagnosing the individuals exposed to the suicide risk and individuals with low-risk.

Figure 1. Sensitivity and specificity in MLP model.

Table 3

The Importance Number of Existing Variables (Factors) in MLP Neural Network

Variable	Normalized importance (percentage %)	Rank	Variable	Normalized Importance (percentage %)	Rank
Ontological identity	100	1	Birth order	14.4	15
Stress	53	2	Rate of religiosity	14.3	16
Educational status	46.3	3	History of friends' suicide	13.3	17
History of committing suicide	31	4	Relationship with the opposite sex	12.2	18
Family violence	30.5	5	Death of a close relative	12.1	19
Anxiety	20.9	6	History of implication in the law	11.8	20
Celibacy	18.3	7	Recreational activities	11.7	21
Number of family members	18	8	Child of divorced parents	11.6	22
Financial poverty	17.6	9	Urban life	10.6	23
Educational average	17	10	History of suicide in family members	10	24
Satisfaction from one's appearance	16.5	11	Body fitness	8.6	25
Unemployment	16.4	12	Gender	8.4	26
Participating in religious ceremonies	16.4	12	History of psychedelic drugs use	6.5	27
Depression	15.3	13	Allergy	5.5	28
Housing status	15.3	13	History of using narcotics	5.2	29
History of educational failure	14.5	14	Love failure	2.9	30

Figure 2. Spider chart for the main heading of variables.

Table 3 shows importance number of existing variables in MLP neural network model.

As it is seen in Figure 2, all variables have roles and their importance percentages are specified. Among these variables, variables of ontological identity, stress, educational status, history of committing suicide, family violence, anxiety and celibacy respectively have the most impacts on artificial neural network in classifying the individuals with high and low risk of suicide tendency and the rest of variables have also been effective in predicting the tendency for suicide.

Conclusions

Researchers in different researches have introduced various factors as important risk factors in predicting suicide tendency using classical statistical models. The major merit of artificial neural networks used in this research is that it does not need the presupposition of being linear and we can model with it predictive models having different features and indeterminate functions (Koochakzadeh & Bahmani, 2005). The other merit of the artificial neural network is that it can be trained for performing a special function via moderating the amounts of weights among model factors. Artificial neural networks consist of factors that act parallel, and therefore, the pace of classifying is very high (Hagan & Dennutu, 2003). Also, artificial neural networks prevent over-simplification of the relationships (Figueroa & Cousseau, 2008). These merits make the use of this method preferable to classical statistical methods for prediction such as logistic regression. The first purpose of this research was that artificial neural network makes possible a reliable prediction for individuals exposed to high risk or low risk for suicide. Therefore, by using artificial neural network, various risk factors expressed in different researches were used to predict the rate of tendency of committing suicide. The results showed that the artificial neural network had an accuracy of 90.5 in classifying and predicting the high or low risk of suicide in different individuals in the testing phase. So, if the individual's characteristics are given to the network according to mentioned factors, an accurate prediction of the risk of the tendency for suicide will be provided. The later purpose of this research was to examine the importance number of the risk factors of tendency for suicide in Iranian student sample using an artificial neural network. In the other words, in the second part of the research, a hierarchy of the effective variables in the tendency for suicide in Iranian student was provided, using an artificial neural network (see Table 3).

The results of the previous researches show that the highest rate of committing suicide in Iran was found many individuals aged between 17 and 24 and with the increasing of age, the prevalence of committing suicide

decreases (Khazayee & Parvizi Fard, 2002; Khalkhali et al., 2001; Ghamari et al., 2010). It is worth mentioning that Iran has a youthful population and the youthfulness of the population dousing in one region can create an age bias. Therefore, it seems that the significance of the suicide-related risk factors in Iran is related to psychological state of this age group. Adolescents, due to characteristics, such as emotion lability, criticism in tolerance, frustration intolerance, romantic states and lovesickness, occupational and educational worries, independency need, the need for religion and life philosophy, the need for a sense of identity and knowing oneself and the need for having a goal in life (Khodayari Fard, 1996), show more fragility when encountering dire situations of life and feel that they have no way back. In this research, ontological identity was of the first importance. Ontological identity is an interdisciplinary construct that has bridged between self-psychology and philosophy. This construct has borrowed the concept of identity from self-psychology and the concept of ontology from philosophy. Generally, ontology answers to the questions about philosophy of life, such as “What position do I have in the universe as a human-being?”, “Where do I come from?”, “Why do I have come?” and “Where will I go to?” (Farahani et al., 2011). Identity is an image a person has from himself/herself and results from answering the question: “Who am I?” (Erikson, 1968). Identity includes different kinds of identities, such as individual, social, racial and national identity. Ontological identity shows a belief one that has about the origin of life, the philosophy of being and the end of one’s life (after life) and has a close relationship with life purposefulness and meaningfulness (Farahani et al., 2011). The former researches have also discovered the relationship between purposes in life and suicide (Ulmer et al., 1991), and have discovered the relationship between suicide and having reason for living (Linehan et al., 1983; Range & Penton, 1994) as well. Frankl (1971) suggested that asking about a person’s reasons for not choosing suicide was a useful method of inquiring into potential sources of meaning or purpose in his/her life. Therefore, it seems that the people who do not have a cognitive justification for coming to this world and living there will experience purposelessness and meaninglessness and are exposed more to suicide. Those, who assume their existences in this world as an accidental phenomenon and consider it futile and meaningless to live there, are more likely to commit suicide. In the other words, ontological identity can be in line with the adolescent’s authentic need for knowing the philosophy of life and knowing oneself more so that he/her can attach a goal and meaning to his life. The next factor which was ranked second in this research was the rate of stress. Individuals committing suicide have been exposed to more stressors in life (Katherine & Patricce, 2000). One of the reasons can be the fact that the individuals have not learned the effective coping skills in the life stressors, or they have evaluated the life problems direr and more intense due to the special personality characteristics and stressful experiences (Shakery et al., 2004). Also, it has been noted in various researches that individual that had committed suicide, experienced a lot of psycho-social problems a year before committing suicide. In a research done in Iran, the major problems before committing suicide were as follows respectively: problem with the partner, the family, financial, occupational educational and legal problems (Nojomi, Bolhari, Malakouti, Hakim Shoostari, Asgharzadeh Amin, & Posht Mashhadi, 2005). Also, other researchers have come up with other problems, such as love-relationship failures, a constant discord between parents and their divorce, emerging server prolonged physical illnesses (Ganji, 2000), the death of a close relative/friend, relationship with opposite sex, urban life and housing problems, a great number of family members and mental illnesses which have been mentioned in the introduction. The role of these stressors is different in committing suicide. Regarding the fact that our research sample was completely chosen from university students, the importance number of major stressors before committing suicide was obtained in Iranian university students (see Table 3). It seems that there is an

age-related pattern in life events before committing suicide. Age distribution of the life events showed that physical illness and the death of close relatives/friends are seen in upper ages more, and financial and interpersonal relationship problems are seen in lower ages more. For example, in the late adolescence and early adulthood, there is an increased tendency for establishing a constant and intimate relationship with an opposite-sex partner and, in the old age, there is an increased re-dependency on others and is accompanied with disability and illness (Heikkinen et al., 1995; Khalkhali et al., 2001). Also, the importance number of stressors is influenced by sex differences. The women experience stressors, such as marital discords, struggle with the family, emotional problems and educational failure more than other psycho-social stressors, while men experience occupational and financial problems more than other psycho-social factors before committing suicide (Shakery et al., 2004). In a research devised by WHO (World Health Organization) for examining individuals committing suicide in Karaj city in 2003, it was shown that 28% of those individuals had a prior record of attempted suicide and 15.4% had a prior record of committing suicide in the relatives (Nojomi et al., 2005). In this research as well, a record of attempted suicide ranked fourth and a record of committing suicide in friends and the family ranked 17th and 24th respectively, which shows the greater importance of a record of committing suicide as a risk factor for predicting the tendency for suicide. In a research done in Iran, it has been shown that 32% of suicidal individuals' relatives, thought the mental illness is the cause of their suicide but only 4% of the individuals had a record of going to a psychiatrist (Yasemi, Sabahi, Mirhashemi, Seifi, Azar Keivan, & Tahei, 2002). In this research as well, anxiety and depression were ranked 6th and 13th respectively but a record of using psychiatric drugs gained a rank of 27. In most Iranian and foreign studies, the women commit suicide more (Nojomi et al., 2005; Molavi, Abbasi, & Mohammadnia, 2006; Arefi, 2002; Dilsaver, Chen, Swann, Shoaib, & Krajewski, 1994), while in this research the sex variable gained a rank of 26 which shows in the Iranian students, the sex variable does not have a great predictability. An explanation for this is the high education of the women in our sample, since in the various Iranian researches, it has been noted that the rate of suicide decreases as the level of the education increases (Molavi et al., 2006; Safa et al., 2006; Khalkhali et al., 2001) and in this research also the education status factor was ranked third. Also, the rate of participating in religious ceremonies was ranked higher (12th) than the rate of religiosity (16th) in predicting suicide. At the end, it is necessary to note that other variables, such as personality features, genetic factors and other mental illnesses, e.g., OCD (obsessive compulsive disorder) plays a role in the rate of the suicide tendency in individuals, but in this research they were not dealt with. Also, the findings of this research pertain to the population of Iranian university students and, thus, in generalizing, those to other populations should be treated with caution.

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