International Journal of Engineering Innovation & Research
Volume 3, Issue 5, ISSN: 2277 – 5668

The Effect of Neural Network Models on Diagnosis of Bipolar Disorder

Mozhgan Mohammad Ghasemi
M.S. Student, Department of Computer and Informatics,
Payame Noor University, Tehran, Iran
Email: mozhgan_7327@yahoo.com

Mehdi Khalili
Assistant Professor, Department of Computer and Informatics,
Payame Noor University, Tehran, Iran

Abstract **– Now neural networks are used in several domains. One important application is the diagnosis process. This paper by using the neural networks can be taken a step in the diagnosis of bipolar disorder. Of the many ways such as interviews, patient records, relevant articles, books psychiatric. Etc. Parameters of this disorder have been identified. After identifying the parameters of bipolar disorder, the implementation of neural network models are discussed. MLP and RBF have models that used in this paper. At the end, the comparison between the results of the two models is done. And conclude the MLP model with the lower error (13.33%) than RBF model, can diagnosis the bipolar disorder.**

Keywords **– Bipolar disorder, ANN, Multilayer Perceptron, Radial Basis Function.**

I. INTRODUCTION

Neural networks are very good at a wide variety of problems, most of which involve finding trends in large quantities of data [1]. To streamline the diagnostic process in daily routine and avoid misdiagnosis, artificial intelligence Methods (especially computer aided diagnosis and artificial neural networks) can be employed. These adaptive learning algorithms can handle diverse types of medical data and integrate them into categorized outputs [2]. One of the application of neural network is the diagnosis of medicine. This is in their proof-of-concept stage, with the acceptation of a neural network that will decide whether or not to grant a loan, something that has already been used more successfully than many humans [20]. Mental disorders as a broad category of diseases known [3]. It is a group of diagnoses in the Diagnostic and Statistical Manual of Mental Disorders (DSM IV TR) classification system where a disturbance in the person's mood is hypothesized to be the main underlying feature [7]. Depression Types are a mood disorder classification [6], bipolar disorder is the subset of depression [].It also has a few actions in the diagnosis of bipolar disorder using neural networked done that so far have not had satisfactory results in this context. Here are a few of them are mentioned: In [14], the author presented a neuro-fuzzy approach-based classification algorithm, which distinguishes patients with depression from controls by a neuro-fuzzy network with a weighted fuzzy membership function (NEWFM) using the two times domain and four frequencies domain features of HRV .With a reliable accuracy rate of 95%, in this work the six HRV features were extracted and used as NEWFM input features for depression classification. Which indicates a significant association between depression and the autonomic nervous system. In [15], utilize ontologies and Bayesian networks techniques to build the inference model for inferring the possibility of depression. The author proposed an ontology model to build the terminology of depression and utilize the Bayesian networks to infer the probability of depression. In addition, the paper also proposes an agent-based platform and addresses the implementation issue. The result shows that it can be well-inferring in the depression diagnosis. In [16], ten different types of classification algorithms are applied to depression diagnosis and their performance is compared, through a set of experiments on SMRI brain scans. In the experiments, a procedure is developed to measure the performance of these algorithms and an evaluation method is employed to evaluate and compare the performance of the classifiers. In [17], a machine learning method is proposed for automatically finding psychiatric diagnostic rules. It is proposed that a genetic algorithm (GA) system can find symbolic, easily readable rules that could be used by psychiatric clinicians. Diagnosis of major depressive disorder is considered. A sample of 320 subjects with symptom information and pre-assigned diagnosis is used to train a GA model and two other statistical models, discriminant analysis and logistic regression. Each model is able correctly to classify more than 91% of cases. The GA model performs best of the three methods and yields readable, non-numeric rules. In [18], presents psyche system, a personal, cost-effective, multi-parametric monitoring system based on textile platforms and portable sensing devices for the long term and short term acquisition of data from selected class of patients affected by mood disorders. The acquired data will be processed and analysed in the established platform that takes into account the Electronic Health Records (EHR) of the patient, a personalized data referee system, as well as medical analysis in order to verify the diagnosis and help in prognosis of the illness.

In this paper trying has been considering a number of parameters for diagnosis of bipolar disorder and the data already prepared, paid to design a neural network by using the MLP and RBF models, that are of the most widely used models. Of the parameters that using in this paper, it can be noted to "Depressed mood" , "Disruption of appetite" , "Feeling of guilty" , "Lake of concentration" , "Lake of decision-making power" , "Decreasing of libido". Neural network training is designed with different percentages. The error of training different percentages is achieved for comparison with together. For training and test network uses the patient's record. And show that each

of the training, we are faced with the lowest error and shows which model is the optimization for diagnose bipolar disorder.

II. What is the Bipolar Disorder?

Bipolar disorder (BD), an unstable emotional condition characterized by cycles of abnormal, persistent high mood (mania) and low mood (depression), which was formerly known as "manic depression" (and in some cases rapid cycling, mixed states, and psychotic symptoms) [9 , 10]. Subtypes include: Bipolar I is distinguished by the presence or history of one or more manic episodes or mixed episodes with or without major depressive episodes [11]. A depressive episode is not required for the diagnosis of bipolar I disorder, but depressive episodes are usually part of the course of the illness. Bipolar II consist of recurrent intermittent hypomanic and depressive episodes or mixed episodes. Cyclothymiacs is a form of bipolar disorder, consisting of recurrent hypomanic and dysthymic episodes, but no full manic episodes or full major depressive episodes. [12]. Bipolar Disorder Not Otherwise Specified (BD-NOS), sometimes called "sub-threshold" bipolar, indicates that the patient suffers from some symptoms in the bipolar spectrum (e.g., manic and depressive symptoms) but does not fully qualify for any of the three formal bipolar DSM-IV diagnoses mentioned above [13].

III. Neural Network & Models

The main idea of machine learning WarenMcCulloch and Walter Pitts in 1940 by taking the model of the human brain neurons were raised [19]. Set the input weights of each neuron makes learning neural network is an artificial neural network can be a single layer or multiple layers , resistance and damage tolerance can be learned, being (i.e., the ability to adjust the weight LAN), generalize, because of the high speed parallel processing, coping with change. Feature of Neural network system and non-linear system model. This article is based on a neural network can be used as an efficient tool in identifying psychiatric patterns. [20].

A multilayer perceptron (MLP) is a feed forward artificial neural network model that maps sets of input data onto a set of appropriate outputs [19]. MLP consist of multiple layers of nodes in a directed graph, with each layer fully connected to the next one. Except for the input nodes, each node is a neuron (or processing element) with a nonlinear activation function. MLP utilizes a supervised learning technique called back propagation for training the network .MLP is a modification of the standard linear perceptron and can distinguish data that are not linearly separable [21]. In "Fig. 1" view of this model is visible.

In the field of mathematical modeling, a radial basis function network is an artificial neural network that uses radial basis functions as activation functions [22]. The output of the network is a linear combination of radial basis functions of the inputs and neuron parameters. Radial basis function networks have many uses, including function approximation, time series prediction, classification, and system control. They were first formulated in a 1988 paper by Broom head and Lowe, both researchers at the Royal Signals and Radar Establishment [23]. In "Fig. 2" view of this model is visible.

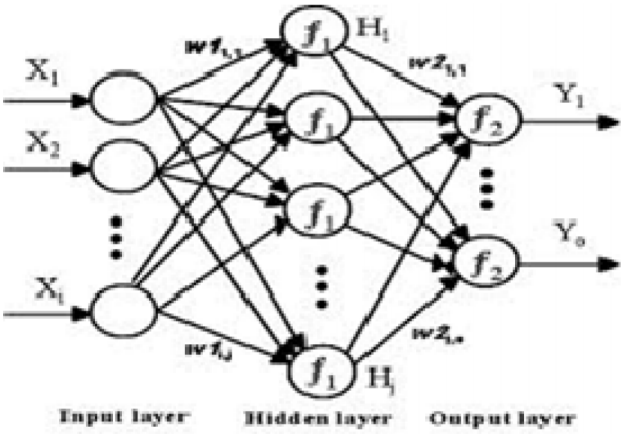

Fig.1. The view of the MLP model

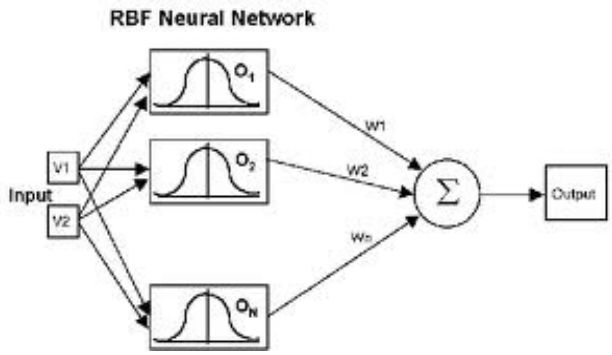

Fig.2. The view of the RBF model

IV. Algorithm of Suggested Method

After examining the records and interviews with psychiatrists and reading [24, 25, 26]. The number of cases is 340 pcs. The records of the psychiatric centers called "Taleghani Elam" is extracted. The number 12 parameters is extracted, that including : "Depressed mood", "Disruption of appetite", "Feeling of guilty", "Lake of concentration", "Lake of decision-making power", "Decreasing of libido", "Psychological distress", "Skipping of thoughts", "Decentralization", "Risky driving", "Excessive excitability", "using of drugs", "Increasing of educational activities" & "Much Happiness".

Outputs intended including: "Bipolar depression I", "Bipolar depression II", "Depression secondary" & "healthy".

"Fig. 3" shows the progress of the program. Which includes the following details: Parameters used in the above mentioned. The data have been divided into two parts: train and test. The part train for the implementation of neural network models used And the part test used to calculate the model's error. After calculating the error of

each models (MLP & RBF), the comparison of these errors is discussed, then selecting the optimization model for diagnosis bipolar disorder. That, if the error of MLP model is lowest of the error of RBF model can be select the MLP model for training. Else if the error of MLP model is bigger than RBF model, selecting the RBF model for diagnose.

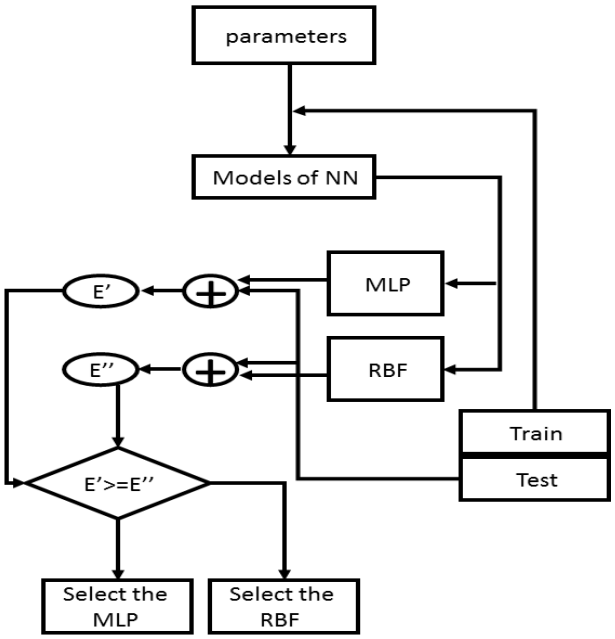

Fig.3. View of the diagram

V. Main Results

Due to the structure of each of the models used in this article (MLP& RBF) and the parameters required for the diagnosis of bipolar disorder, we have discussed the implementation of neural network. Implementation of neural network models in the MATLAB have been done.

We have training each of the models with different percentages of data. As can be seen from the results, while 70 percent of data used for training the network we will be faced with fewer errors.

5.1. Results MLP

Define This model uses 10 input neurons, 5 neurons in the middle and four output neurons for the four classes defined (depression, bipolar □, depression, bipolar □□, secondary depression and healthy), has been implemented. Also, the data that are used to train the network, are determined by the user. The data selected for training the network with respect to the user input, the command Randperm are determined. In "Fig. 4" the percentage error with respect to the training of the network stated. As can be seen in 70% of training percentage, happen the minimum error for MLP model. And for 40% training percentage the worst error appears. Regression graph of MLP model in the "Fig. 5" is visible. A regression graph or chart to determine the purpose of the simulation is to answer the y-axis and x A simulation solution of the target. Slope of the regression say. The mean square error compared to the same period as the Epoch shows. Training Chart Red Green Blue Test and Evaluation and Early stopping point is called the point shown by the amount of the assessment error is minimized.

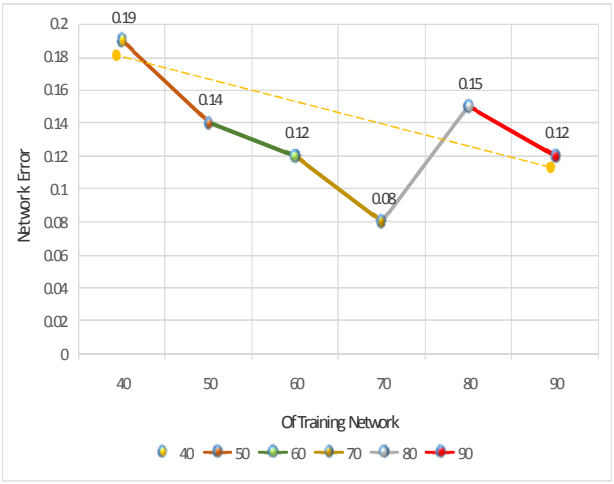

Fig.4. Network error of MLP model

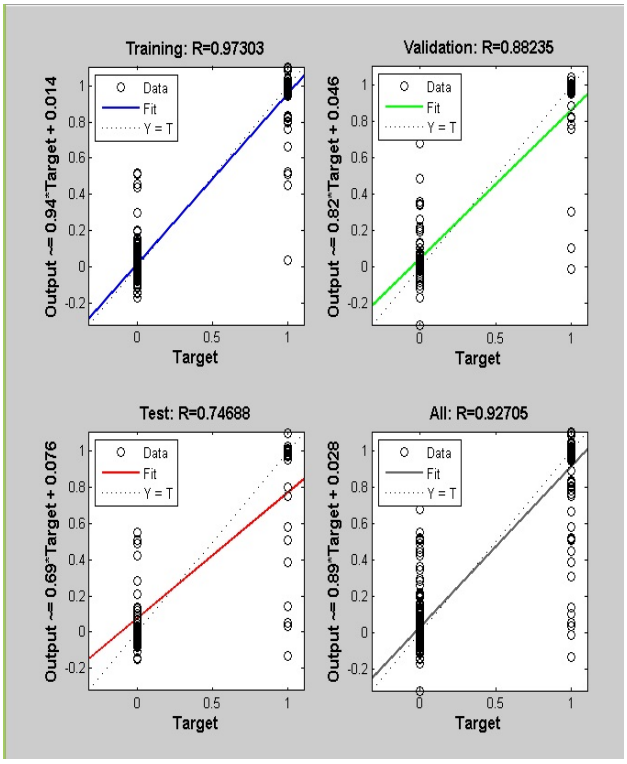

Fig.5. Regression graph of MLP model

4.2. Results by using RBF model

This model uses the coefficient of expansion (spread) the first one, add the number of neurons to display the target amount equal to 25 times the mean square error is zero, default values are the model has been implemented, as well, the percentage of data that Learning networks are used, are determined by the user. The data selected for training the network with respect to the user input, the command Randperm are determined. Regression graph of RBF model in the "Fig. 6" is visible. A regression graph or chart to determine the purpose of the simulation is to answer the y-axis and x A simulation solution of the

target. Slope of the regression say. The mean square error compared to the same period as the Epoch shows. Training Chart Red Green Blue Test and Evaluation and Early stopping point is called the point shown by the amount of the assessment error is minimized. In "Fig.7", the percentage error with respect to the training of the network stated. As can be seen in 70% of training percentage, happen the minimum error for RBF model. And for 50% training percentage the worst error appears.

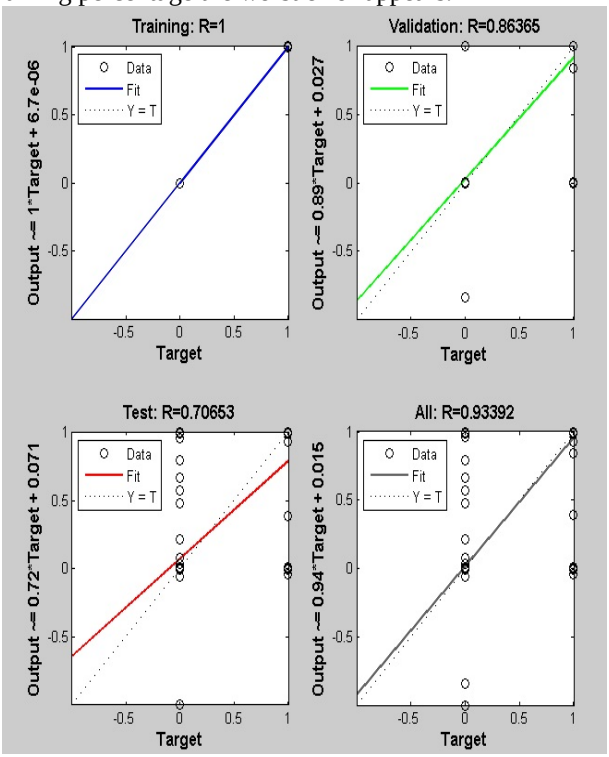

Fig.6. Regression graph of RBF model

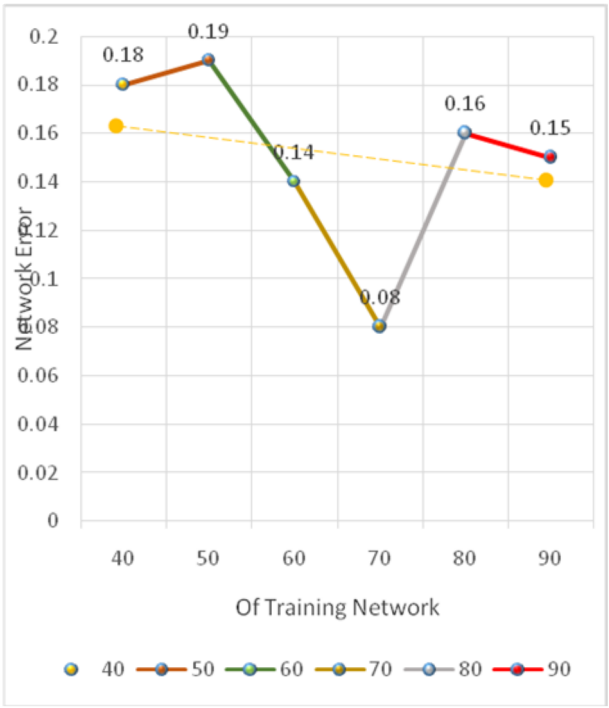

Fig.7. Network error of RBF model

4.3. Compare results

As a comparison between models can be occurred out errors in the model used. Here, we use this method for comparison between MLP & RBF models. "Table 1" shows a comparison between the models, and can be seen that, with using the MLP for training have the better detection for bipolar disorder. MLP model can diagnose with 13.3% error, while the RBF model has the 15% error in this disorder.

Table 1: compare errors of models

Error Network	Model
13.3%	MLP
15%	RBF

VI. Conclusion

This article has attempted to use the neural network models for diagnosis of bipolar disorder. The diagnosis is one of important applications of these networks have been investigated. After discovering the important parameters identified in this disorder, we have discussed the application of neural network models. Then compare the two models of neural networks to implement this disorders discussed. And conclude with 12 parameters of bipolar disorder and using the MLP model have the better diagnosis and error of this model is 13.3%. In fact, the goal of this article is a small step toward recognition powerful of neural network in diagnosis of metal illness.

References

[1] Fukushima, K., "Neocognitron: A self-organizing neural network model for a mechanism of pattern recognition unaffected by shift in position". Biological Cybernetics, vol. 36 (4), 2014, pp. 93

[2] American.Psychiatric.Association, “Diagnostic and statistical manual of mental disorder”, 4th edition, American. Psychiatric. Association, 2000 .

[3] Parry, P.I.; Levin, E.C., "Pediatric Bipolar Disorder in an Era of "Mindless Psychiatry"". Journal of Trauma & Dissociation, VOL. 13 (1), 2013, PP. 51–68.

[4] Podgornik, N, ‘Depression - a sociocultural way of manifesting women’s psychological crises’, Anthropological notebooks, vol. 18, no, 2, 2013, pp. 55-67.

[5] Katon.WJ, Lin.EHB, Von.Korff.M, etc.” Collaborative care for patients with depression and chronic Illnesses”. , N Engl J Med, vol. 363, 2012.

[6] Rashid, T.; Heider, I., "Life Events and Depression", 2012, Vol. 2(1), pp. 128-149.

[7] Pfening.A, Bschor.T, Baghai.T, etc. “S3 guidelines on diagnostics and therapy of bipolar disorders: development process and essential recommendations”, Vol.83 (5), Nervenarzt, 2012, pp.568–586.

[8] timothy.J, E.Jerry.Phares, etc, etc. “clinical psychology concepts, methods, & profession”, 6thed, Belmont. calif.wadsworth/ Thomas learning, 2001, pp.280-334.

[9] Zimmerman. M. “Would broadening the diagnostic criteria for bipolar disorder do more harm than good? Implications from longitudinal studies of subthreshold conditions”, Vol. 73(4), J Clin Psychiatry, 2012, pp.437–443.

[10] Anderson, IM; Haddad, PM; Scott, "Bipolar disorder." BMJ (Clinical research ed.), 2012, pp. 345.

[11] Parry, P.I.; Levin, E.C., "Pediatric Bipolar Disorder in an Era of "Mindless Psychiatry"". Journal of Trauma & Dissociation, VOL. 13 (1), 2013, PP. 51–68.

[12] Kipli, K., Sch. of Eng. Sch. of Inf. Technol., Deakin Univ., Waurn Ponds, VIC, Australia, Kouzani, A.Z., Yong Xiang, "An Empirical Comparison of Classification Algorithms for Diagnosis of Depression from Brain SMRI Scans", Advanced Computer Science Applications and Technologies (ACSAT), 2013 International Conference on, DOI. 10.1109/ACSAT.2013. 72, 2013, PP. 333-336

[13] Frances, A. & Jones, K. D.," Bipolar disorder type II revisited. Bipolar Disorders", VOL. 14, 2012, PP. 474-477.

[14] Zhen-Xing.Zhang , IT Coll., Kyungwon Univ., Sungnam, South Korea , Xue-Wei Tian , Lim, J.S." New algorithm for the depression diagnosis using HRV: A neuro-fuzzy approach", Bioelectronics and Bioinformatics (ISBB), 2011 International Symposium on, DOI. 10.1109/ISBB.2011.6107702, 2011.PP. 283-286.

[15] Yue-Shan.Chang ,Dept. of Comput. Sci. & Inf. Eng., Wan-Chun Hung , Tong-Ying Juang, "Depression Diagnosis Based on Ontologies and Bayesian Networks", Systems, Man, and Cybernetics (SMC), 2013 IEEE International Conference, DOI. 10.1109/SMC.2013.589, 2013,PP. 3452-3457.

[16] Kipli, K. , Sch. of Eng. Sch. of Inf. Technol., Deakin Univ., Waurn Ponds, VIC, Australia , Kouzani, A.Z. , Yong Xiang, " An Empirical Comparison of Classification Algorithms for Diagnosis of Depression from Brain SMRI Scans",Advanced Computer Science Applications and Technologies (ACSAT), 2013 International Conference on, DOI. 10.1109/ACSAT.2013.72, 2013, PP. 333-336.

[17] Chapman, C.N. , Dept. of Psychol., Tulsa Univ., Deaton, L. Harris, A., Robinson, N., " A genetic algorithm system to find symbolic rules for diagnosis of depression", Evolutionary Computation, 1999. CEC 99. Proceedings of the 1999 Congress on , VOL. 1, DOI. 10.1109/CEC.1999.781917, 1999, PP. 145-149.

[18] Paradiso, R. , Bianchi, A.M. , Lau, K. , Scilingo, E.P."PSYCHE: Personalised monitoring systems for care in mental health", Engineering in Medicine and Biology Society (EMBC), 2010 Annual International Conference of the IEEE, DOI. 10.1109/IEMBS.2010.5627469, 2010, PP. 182-193.

[19] phil.picton, “introduction to neural network”, Macmillan publishers limited, 1994.

[20] R.beale and T.Jackson, “Neural Network –An introduction neural computing”, institute of physics publishing, 1990.

[21] Filippo.Amato, Alberto.López, etc, “Artificial Neural Networks in Medical Diagnosis”, Vol. 11, Journal of Applied Biomedicine, 2013.

[22] B. A. Pearlmutter, "Learning state space trajectories in recurrent neural networks. Neural Computation", vo1. (2), 2011, pp. 263–269.

[23] Oyas.Wahyunggoro, Adhistya.Erna.Permanasari.”Utilization of Neural Network for Disease Forecasting”, Proceedings 59th ISI World Statistics Congress, 25-30 August 2013.

[24] Mana S, Martinot MLP, Martinot JL," Brain Imaging Findings in Children and Adolescents with Mental Disorders", a Cross-sectional Review J Eurpsy, VOL. 25, 2013, PP. 345–354.

[25] Parry, P.I.; Levin, E.C., "Pediatric Bipolar Disorder in an Era of "Mindless Psychiatry"". Journal of Trauma & Dissociation, VOL. 13 (1), 2013, PP. 51–68.

[26] Beck AT, Steer RA, Ball R, Ranieri W , "Comparison of Beck Depression Inventories -IA and -II in psychiatric outpatients". Journal of Personality Assessment , VOL. 67 (3), 1996, pp. 588–97.