EasyChair Preprint

№ 5341

An Intelligent Psychiatric Recommendation System for Detecting Mental Disorders

Esma Nur Ucar, Sedat Irgil, Salih Tutun, Nilay Aras and Ilker Yesilkaya

April 18, 2021

An Intelligent Psychiatric Recommendation System for Detecting Mental Disorders

Esma Nur Ucar[1,3], Sedat Irgil[1], Salih Tutun[2], Nilay Aras[1], Ilker Yesilkaya[3],

[1] Balikesir Guven Private Health Laboratory Services Limited Company, Balikesir, Turkey
psk.esmaucar@gmail.com, drsirgil@gmail.com, nilaykocak3500@gmail.com

[2] Olin Business School at Washington University in St. Louis, Clayton, Missouri, USA
salihtutun@wustl.edu

[3] WeCureX AI Research Lab, DNB Analytics, Balikesir, Turkey
ilkeryesilkaya@dnbanalytics.com

KEYWORDS - Recommendation Systems, Feature Selection, Machine Learning, Psychiatric Diagnosis, Mental Health Disorders, Differential Diagnosis

ABSTRACT

Nowadays, despite all the remarkable developments in mental healthcare, there are many uncertainties in the diagnosis process. Even psychiatric interviews with detailed, well-timed, and good follow-up systems may not be sufficient for differential diagnosis. At the same time, the workload of specialists increases in this diagnostic effort and it becomes very difficult to receive medical services and manage the treatment process due to the insufficient number of specialists. These problems, increase the need for auxiliary systems that will help experts in the diagnosis, save labor, and time. For this reason, we proposed a new intelligent psychiatric recommendation system with the Comprehensive Psychiatric Differential Diagnosis Test (CPDDT), which we created to screen-differentiate psychiatric diagnoses. To guide the expert in the system, in addition to the axis one and axis two diagnosis groups that refer to clinical disorders and personality disorders in DSM-4, it was aimed to measure the areas that affect the course of the illness and the treatment plan of the specialist, such as functionality, memory or suicidal thoughts. Thus, CPDDT was created, which could detect 48 different diagnostic groups in 319 questions. The test then was applied online to 676 users via a web system produced by DNB Analytics and psychiatrists evaluated the results in the clinic. Afterward, the test results were then evaluated by the Evolutionary Simulation Annealing LASSO Logistic Regression. As a result of this algorithm, after determining the importance of each question in the scale, the questions with low impact were eliminated and the test was reduced to 147 questions with .93 accuracy. In addition, the algorithm also found the probability of each patient being sick. In summary, the new machine-learning-based CPDDT was finalized with the number of 147 questions and the algorithm was presented as a suggestion system to the diagnostic process of experts.

1 INTRODUCTION

Mental disorders start from childhood, follow the developmental periods, and continue their effects throughout life. Their negative effects on functionality and socialization, even academic success and business life have been shown in studies [20]. In addition to their individual effects on a person's life, mental illnesses have also been found to reduce the overall quality of family life [19]. When we go one step further, it has been observed that the mental illness of the person increases the susceptibility of his children to this illness 4 times [12]. All these reveal the importance of accurate diagnosis of mental illnesses and the necessity of treatment.

On the other hand, according to the report of The National Council for Behavioral Health in 2017, treatments are delayed significantly due to the lack of access to health services in the field of mental health, which leads to worse outcomes and higher costs. The main source of these delays is the shortage of experts. Experts working on this system also follow daily cramped programs and cannot allocate sufficient time to patients [11].

Moreover, the fact that the categories in different diagnostic groups share similar characteristics creates dilemmas in the diagnosis process [7]. These dilemmas can arise even in a structured and well-followed comprehensive assessment. [21]. In such cases, it is very important to act by making the right decision, because the first condition of effective treatment in the field of psychiatry as in every health field is to determine the correct differential diagnosis and, accordingly, the correct treatment and approach [13]. Studies have shown that self-report scales can help experts in the psychiatric diagnosis process and offer a solution to this problem [22].

In our research, an intelligent system has been proposed to assist experts in providing comprehensive information practically. First of all, the "Comprehensive Psychiatric Differential Diagnosis Test", which is a self-report scale that examines the mental health of the person in detail, was created. Within the scope of this scale; in addition to the axis one and axis two diagnostic groups that express clinical disorders and personality disorders in DSM-4, it was aimed to measure areas that affect the course of the disease and the treatment plan such as functionality, memory, attention or suicidal thoughts. Later, we developed an intelligent psychiatric recommendation system that shortened and developed this scale with high accuracy, using an online platform where experts could apply it practically to detect mental disorders and get results. This study is an introductory study of the proposed algorithm and also sets an example in terms of being adaptable to many healthcare services.

2 RELATED WORKS

Evaluation in the field of psychiatry includes examining whether the person has a mental illness and then determining the effect and severity accordingly. Although this decision can be made by the expert's subjective judgments, the completeness of the clinical judgment is ensured when the expert bases the evaluation on objective judgments with the help of psychiatric tests [2].

When the scales used in this field are examined, some of them are given in Table 1, it is seen that the scales used in clinical disorders and personality disorders are generally separated. MMPI is the most researched and used scale in personality measurements. MMPI consists of 566 questions and includes 10 clinical symptom pattern subscales [9]. Apart from this, another test that is used most on personality is the Rorschach Test. This is a projective test and the person is asked to interpret the ink blot [1]. However, the use of this test is rare because it requires detailed training, takes a lot of time for application and analysis, and projective tests are scientifically controversial [8].

When looking at clinical disorders, it is seen that scales aimed at measuring a single disease are in majority. For example, Beck Depression Inventory [16] is used frequently to measure depression, and Beck Anxiety Inventory [5] for the anxiety scale. Or ASRS (ADHD Self-Report Scale) is frequently used to measure attention deficit and hyperactivity disorder in adults [6]. There are many scales created in this way for various psychiatric diagnoses.

Scales that collectively include clinical disorders are less common. The most widely used of these is the SCL-90R, a Likert-type self-report scale, and it can measure 9 basic subscales in 90 questions [3]. Another one, the Brief Psychiatric Screening Scale, consists of 18 questions and roughly asks the frequency of one symptom in each question [4]. However, these scales are not comprehensive and practical enough. For this reason, they are rarely applied clinically, except for research.

Table 1 Examples of Scales Used In Psychiatry

Name Of The Scale	**Number Of Questions**	**Disorders or Structures Measured By The Test**	**Reference**
Beck Depression Inventory	21	Depression	[16]
Beck Anxiety Inventory	21	Anxiety	[5]
ADHD Self Report Scale	18	Attention Deficit Hyperactivity Disorder	[6]
Maudsley Obsessive Compulsive Inventory	37	Obsessive-Compulsive Disorder	[15]
Liebowitz Social Anxiety Scale	24	Social Anxiety Disorder	[10]
The Michigan Alcoholism Screening Test	25	Alcohol Use Disorder	[14]
Minnesota Multiphasic Personality Inventory	566	Hypochondriasis Depression Hysteria Psychopathic Deviate Mascculinity/Femininity Paranoia Psychasthenia Schizophrenia Hypomania Social Introversion	[9]

SCL-90R	90	Somatization Obsessive-Compulsive Interpersonel sensitivity Depression Anxiety Hostility Phobic Anxiety Paranoid Ideation Psychoticism	[3]

In our study, for the need for a comprehensive scale in clinical practice, we created the Comprehensive Psychiatric Differential Diagnosis Test. This test, which the specialist sends to the patient on a digital platform and the results are analyzed by artificial intelligence, provides the expert with comprehensive information about the person in a practical way. It is thought to fill the gap in the literature with the holistic perspective it provides.

3 METHODOLOGY

3.1 The general structure of the test

The Comprehensive Psychiatric Differential Diagnosis (CPDD) is a test that examines the mental state of the person in detail, created to be used as an assistant to the specialist for the psychiatric examination of the person. The test was created to measure 48 sub diagnoses listed in Table 2 in 319 questions. In these sub diagnoses, in addition to disorders such as personality disorders or anxiety disorders in DSM IV and V, subscales such as "suicidal thoughts", which are considered important for the treatment process, were also included.

The options of the scale, which is prepared as a 5-point Likert type, are determined as "Never", "Rarely", "Sometimes", "Often", and "Always" and are scored between 0 and 4. While the answer "never" is 0 points, then answer "always" assigns 4 points to the relevant subscale.

Table 2 Diagnostic Groups Included In The Comprehensive Psychiatric Differential Diagnostic Test

• Paranoid Personality • Schizoid Personality • Schizotypal Personality • Antisocial Personality • Borderline Personality • Histrionic Personality • Narcissistic Personality • Avoidant Personality • Dependent Personality • Obsessive-Compulsive Personality • Introvert Structure • Sociopathy • Decrease in Functionality • Decreased Insight • Cognitive Impairment(Memory) • Movement Disorders • Suicidal Thoughts	• Generalized Anxiety Disorder • Panic Disorder • Separation Anxiety Disorder • Agoraphobia • Social Phobia • Posttraumatic Stress Disorder • Acute Stress Disorder • Psychotic Disorder • Paranoid Schizophrenia • Dissociation • Sleeping disorders • Sexual Disorders • Lack of Attention • Impulsiveness • Alcohol Use Disorder • Substance Use Disorder	• Obsessive-Compulsive Disorder • Body Dysmorphic Disorder • Hoarding Disorder • Trichotillomania (Hair Pulling Disorder) • Misophonia • Illness Anxiety Disorder • Conversion Disorder • Somatic Symptom Disorder • Orthorexia Nervosa • Depressive Episode • Manic Episode • Seasonal Affective Disorder • Premenstrual Dysphoric Disorder • Hostility • Psychological Rigidity

3.2 Test Creation Phase

First of all, as a result of the literature review, the first draft of the Comprehensive Psychiatric Differential Diagnosis Test was created. The scales and sources used in determining the questions are as follows: DSM IV and DSM V in particular; SCL90R, MMPI, 5-Factor Personality Test, Beck Depression Scale, Hamilton Depression Rating Scale, Seasonal Pattern Assessment Questionnaire, Beck Anxiety Scale, Adult ADHD Self-Report Scale, Panic Disorder Severity Scale, Liebowits Social Anxiety Scale, Dissociative Experiences Scale, Social Functioning Scale, Yale-Brown Obsessive Compulsive Scale, Michigan Alcoholism Screening Test, Positive Symptom Rating Scale and Negative Symptom Rating Scale.

The created draft was forwarded to 15 psychiatrists and 1 assessment and evaluation specialist, and their opinions were received. The draft prepared as a result of this feedbacks was forwarded to an expert in terms of language and the necessary final arrangements were made and the draft was finalized.

3.3 Data Collection Phase

During the data collection phase, the website created by DNB Analytics was used. 676 people who came to the psychiatry clinic were registered on this website by the expert and a Comprehensive Psychiatric Differential Diagnosis Test was sent to them. People solved their own tests by clicking on the link sent to them via text message, and the artificial intelligence analyzed the test results of the person and sent a report to the expert. The information and test results of the persons are kept confidential and never shared, and their data are protected by recording them in the system with their protocol numbers.

3.4 Optimized LASSO Logistic Regression (ESALOR) Model

In this proposed model, it is aimed to optimize Logistic Regression (LR) coefficients by using evolutionary strategy (ES) and simulated annealing (SA) together. Stimulated annealing, a random search technique that uses single-base optimization, explores the neighborhoods of the primary solutions and searches for the appropriate solution space. Although the starting point can be determined randomly in this algorithm, it is stuck in the local optima because it scans the primary solutions at nearby points.

In the model we propose, a meta-heuristic optimization approach called "evolutionary strategy" is used to determine the primary solution. When ES is used while finding primary solutions, unlike SA, the algorithm is possible to go beyond the local optimum, allowing us to reach more accurate solutions. Thus, as seen in Eq. (2), the best model can be found by optimizing the coefficients with a hybrid meta-heuristic optimization approach.

On the other hand, regularization methods have proven to be effective in the overfitting problem that exists in the traditional Logistic Regression model.

$$F_x = \frac{1}{1+ e^{-(\beta_{n+1}+ \beta_1 x_1+\beta_2 x_2+\beta_3 x_3+\cdots+\beta_n x_n)}} \quad (1)$$

The x values in Eq. (1) represent each question in the test. Since there are 314 questions in the test, the value of n will be 314. β is a value between 0 and 1 and indicates the severity of each question. In this equation, β is unknown and the algorithm will determine the value. For example, if the value of β_1 as a result of the algorithm is 0, it means that x_1, that is the 1st question, does not contribute to the test and can be excluded from the test. A value of β close to 1 indicates that the importance of that question is high.

The ES algorithm was used when first determining the ß values in this formula. The values that were not attached to the local optima given by SA were later developed with LR and finalized. The importance of each question was determined in the most optimal way.

$$min_{\beta_0,\beta_1,\beta_2,\beta_3,\ldots\beta_n}\left(\frac{1}{2N}\sum_{i=1}^{N}\left(Y_i-(F_{Xi})\right)^2+\lambda\sum_{j=1}^{p}\left|\beta_j\right|\right) \quad (2)$$

The mathematical formula of the LASSO algorithm is given in Eq. (2). Here N is the number of test questions, Yi is the response in the test, and Xi is the data point. While λ is a non-negative regression parameter, β is the coefficient value of the regression model. Since the formulation as an objective function is not linear with absolute and square values, the evolutionary strategy-based simulated annealing algorithm is used when optimizing the formulation.

To summarize the proposed model with this information; Feature selection is done first, and the best feature subset is selected by using the filter and wrapper feature selection methods together. After determining the LASSO-logistic regression formulation for the problem, a simulated annealing model is started with the help of an evolutionary strategy algorithm. Then, as we optimized in the model, the coefficients of the LASSO model are optimized using the simulated annealing method based on the hybrid evolution strategy. In the end, the most suitable solution is chosen, and from the items in the test, the most distinctive items in measuring the mental health of the person are estimated with the LASSO model with optimal coefficients [17].

4 RESULTS

This study is the initial study of the proposed algorithm. In the current study, two separate results can be obtained from the algorithm: the severity of each question in the test and the probability of each patient being sick.

In the study, the first 2/3 of 676 data was used for training the model, then the remaining data was used in the test phase to check whether the algorithm works or not. During the training phase, the accuracy value was 0.93 for 450 data. Later, 226 data that were not included in the training were used in the test phase, and the algorithm predicted whether the individuals were sick or not with an accuracy of 0.71.

The importance of the questions, the β value in Eq. (1), was calculated separately for each question. As a result of this calculation, the questions with an importance value of 0,000 were removed because they did not create a discriminatory effect on the scale. The weight values of the remaining 147 questions are given in Table 3.

Table 3 The severity of each of the 147 questions found to be distinctive for the scale

Question Number	Weight Value	Question Number	Weight Value	Question Number	Weight Value	Question Number	Weight Value	Question Number	Weight Value	Question Number	Weight Value	Question Number	Weight Value	Question Number	Weight Value
2	0.010	**51**	0.002	**86**	0.007	**142**	0.003	**180**	0.004	**225**	0.002	**259**	0.004	**296**	0.003
8	0.013	**53**	0.020	**90**	0.001	**143**	0.005	**181**	0.007	**228**	0.007	**260**	0.004	**297**	0.012
15	0.004	**55**	0.017	**98**	0.019	**149**	0.018	**184**	0.007	**230**	0.027	**261**	0.005	**299**	0.016
16	0.007	**57**	0.002	**107**	0.002	**150**	0.028	**185**	0.008	**231**	0.020	**262**	0.002	**301**	0.013
20	0.010	**60**	0.006	**110**	0.002	**153**	0.008	**186**	0.005	**232**	0.002	**265**	0.002	**302**	0.001
21	0.006	**61**	0.004	**113**	0.004	**154**	0.001	**190**	0.016	**233**	0.006	**266**	0.001	**304**	0.008
22	0.010	**63**	0.017	**115**	0.002	**156**	0.006	**192**	0.010	**235**	0.004	**267**	0.003	**306**	0.003
23	0.005	**64**	0.003	**116**	0.002	**158**	0.013	**199**	0.004	**236**	0.011	**272**	0.006	**307**	0.008
26	0.004	**66**	0.009	**117**	0.006	**160**	0.006	**200**	0.018	**238**	0.005	**273**	0.013	**309**	0.001
28	0.007	**68**	0.005	**121**	0.006	**163**	0.001	**202**	0.008	**239**	0.003	**275**	0.006	**311**	0.002
30	0.002	**69**	0.015	**122**	0.011	**165**	0.015	**203**	0.002	**242**	0.004	**279**	0.005	**312**	0.005
31	0.005	**71**	0.004	**125**	0.002	**169**	0.006	**205**	0.001	**245**	0.007	**280**	0.002	**313**	0.008
33	0.005	**75**	0.007	**126**	0.015	**170**	0.012	**207**	0.003	**246**	0.005	**281**	0.005	**317**	0.011
35	0.001	**79**	0.003	**129**	0.012	**171**	0.005	**210**	0.007	**247**	0.003	**283**	0.006	**319**	0.004
40	0.004	**80**	0.003	**131**	0.010	**172**	0.003	**215**	0.002	**248**	0.004	**284**	0.008		
42	0.004	**81**	0.001	**132**	0.004	**173**	0.016	**216**	0.001	**249**	0.002	**285**	0.012		
46	0.003	**83**	0.006	**137**	0.002	**176**	0.007	**217**	0.007	**252**	0.001	**286**	0.004		
47	0.019	**84**	0.005	**139**	0.004	**177**	0.008	**219**	0.014	**255**	0.008	**290**	0.004		
48	0.11	**85**	0.013	**140**	0.002	**178**	0.006	**221**	0.010	**258**	0.006	**293**	0.002		

In summary, as a result of the algorithm, the Comprehensive Psychiatric Differential Diagnostic Test was reduced from 314 questions to 147 questions with an accuracy of 0.93. In addition, the model can predict whether or not people are sick with an accuracy of 0.71.

5 DISCUSSION AND FUTURE WORKS

In a world where digitalization continues to increase at a global level, modernization of the application and analysis of psychiatric tests is an inevitable element of the time. On the other hand, experts will of course continue to evaluate the analysis results presented by artificial intelligence. The aim here is definitely not to remove experts from the system, but to provide mental health to more people by suggesting a practical, helpful system that will reduce the workload of experts. In this system, where the number of patients is high and the number of experts is low, it is very important in terms of time and cost to send the tests online and analyze the results automatically. Also, the digital advancement of psychiatric tests will eliminate different types of applications and analyzes, and create a common use at the national level, making more accurate results and comparisons possible.

The weak point in both digital and traditional methods is that Likert-type scales are the basis for the statement of the individual. In psychiatric scales other than performance measures, it is generally accepted that the statement of the person is correct. In the digital platform, recording the time spent per question, changed options, and mouse movements on the website is a good alternative to overcome this weakness. These records automatically provide the expert with information such as the person's tendency to lie, or the haphazard tendency to answer the test, or the excessive time spent on the test, which may be associated with the obsessive-compulsive nature of the person.

Moreover, when a paper test is used manually in research, the test results of the participants must be entered into the system one by one. And in a well-structured study, the larger the number of participants, the greater the workload. In the proposed system, the test results of tens of thousands of people remain hidden and are ready for analysis without the need for an extra data entry. The coexistence of many test results about the person in the system makes it possible to evaluate the person more integrally with other tests. It is also very important for epidemiology studies that the tests can be delivered to people easily and the results are interpreted automatically. The aim of epidemiology is to improve health and reduce diseases by interpreting and using the information collected [18]. This system is capable of breaking new ground in epidemiology studies by allowing large amounts of data to be collected and analyzed most practically.

On the other hand, in the literature review, it was seen that scales for psychiatric disorders are generally specific to a single disease, and there is a need for a comprehensive scale. This study is pioneering in terms of providing a holistic perspective and evaluating diagnoses with factors affecting treatment such as functionality. However, it should be noted that although many diagnosis and sub-diagnosis groups are included in this test, there are diagnoses that have been left incomplete in order not to increase the number of questions, which was 314 at the beginning. Adding the diagnoses not added to the last version with 147 questions, and even creating a second scale that includes all the diagnoses in DSM would be a better development in the field. Incomplete diagnoses were determined to close this gap, and it is planned to create the "Comprehensive Psychiatric Differential Diagnosis Test 2", in which these diagnoses will be added later.

Moreover, it is thought that the fact that part of the data collection process overlaps with Coronavirus Disease may have affected the answers given to the questions of obsessive-compulsive disorder and anxiety disorders. For example, one of the questions is "I don't want to directly touch an object somewhere because I think other people have touched it before." To this question, someone who will say "Never" before the pandemic can answer "Often" to protect himself against the virus now. For this reason, the effect of Covid on the scales where data is collected during this period is inevitable.

Last but not least, this study is a preliminary example of the proposed system. Although the test we have created gives the expert information about 48 different diagnoses about the person, the algorithm does not examine the person in 48 different diagnoses yet. Since this was a preliminary

study, the algorithm has now shortened the scale by determining the significance of each problem, and also, the algorithm is currently only able to distinguish people as "sick" or "not" by determining the probability of people getting sick. Moreover, while the accuracy was 0.93 in the training phase where 450 data was used, it was 0.71 in the test phase with the remaining 226 data. The data collection phase is currently underway, and when the number of data increases, the accuracy value of the test phase is expected to increase above 0.90. In further studies where the data reached sufficient numbers, individuals found to be "patients" will be examined for each of the 48 subdiagnoses and the disease of the person will be determined.

6 CONCLUSION

The system recommended as an aid to experts within the scope of this study was sampled with a comprehensive screening test designed to be used in the field of psychiatry. The created test examines the mental health of people comprehensively and this system can be used both with this test and with other tests to be added. Its primary purpose is to assist the expert. The sampling of this system in this study, which makes it possible for health systems to digitalize, become practical and reach more people easily, is exemplary in terms of its adaptability to different health areas in the future.

REFERENCES

[1] S. J. Beck, "The Rorschach test and personality diagnosis," *American Journal of Insanity,* vol.*87,* no. *1,* pp. *19-52,* July 1930, doi:10.1176/ajp.87.1.19

[2] A. Burns, B. Lawlor, and S. Craig, "Rating scales in old age psychiatry," *Br J Psychiatry,* vol. *180,* no. *2,* pp. *161-167,* Feb, 2002, doi:10.1192/bjp.180.2.161

[3] L. R. Derogatis, K. Rickels, and A. F. Rock, "The SCL 90 and the MMPI: a step in the validation of a new self report scale," *Br J Psychiatry,* vol. *128,* no. *3,* pp. *280-289, 1976,* doi: 10.1192/bjp.128.3.280

[4] P. M. Dingemans, "The brief psychiatric rating scale (BPRS) and the nurses' observation scale for inpatient evaluation (NOSIE) in the evaluation of the positive and negative symptoms," *J Clin Psychol,* vol. *46,* no. *2,* pp. *168-174,* Mar. 1990, doi: 10.1002/1097-4679(199003)46:2<168::AID-JCLP2270460207>3.0.CO;2-L

[5] T. Fydrich, D. Dowdall, and D. L. Chambless, "Reliability and validity of the beck anxiety inventory," *J Anxiety Disord,* vol. *6,* no. *1,* pp. *55-61,* Dec. 1992, doi: 10.1016/0887-6185(92)90026-4

[6] R. C. Kessler *et al.,* "The World Health Organization adult ADHD self-report scale (ASRS): A short screening scale for use in the general population," *Psychol Med,* vol. *35,* no. *2,* pp. *2245-256,* Feb. 2005, doi: 10.1017/S0033291704002892

[7] L. Pina-Camacho, M. Parellada, and M. Kyriakopoulos, "Autism spectrum disorder and schizophrenia:boundaries and uncertainties," *Br J Psych Advances,* vol. *22,* no. *5,* pp. *316-324,* Sep.2016, doi: 10.1192/apt.bp.115.014720

[8] S. O. Lilienfeld, J. M. Wood, and H. N. Garb, "The scientific status of projective techniques," *Psychol. Sci. Public Interest,* vol. *1* no. *2,* pp. *27-66,* Nov. 2000, doi: 10.1111/1529-1006.002

[9] R. Mathias, "The Minnesota Multiphasic Personality Inventory (Book)," *J Pers Assess,* vol. *42,* no. *3,* pp. *332-333,* 1978, doi: 10.1207/s15327752jpa4203_28

[10] D. S. Mennin *et al.,* "Screening for social anxiety disorder in the clinical setting: Using the Liebowitz Social Anxiety Scale," *J Anxiety Disord,* vol. *16,* no. *6,* pp. *661,673,* 2002, doi: 10.1016/S0887-6185(02)00134-2

[11] National Council for Behavioral Health, "The psychiatric Shortage: Causes and Solutions," *National Council for Behavioral Health,* pp. *1-66,* Mar. 2017, Available:

https://www.thenationalcouncil.org/wp-content/uploads/2017/03/Psychiatric-Shortage_National-Council-.pdf?daf=375ateTbd56

[12] S. Pawlby, D. Sharp, D. Hay, and V. O'Keane, "Postnatal depression and child outcome at 11 years: The importance of accurate diagnosis," *J. Affect. Disord.,* vol.*107,* no. *1-3,* pp. *241-245,* 2008, doi: 10.1016/j.jad.2007.08.002

[13] E. Puricelli, B. O. B. Barreiro, A. S. Quevedo, and D. Ponzoni, "Occurence of dermoid cyst in the floor of the mouth: The importance of differendial diagnosis in pediatric patients," *J. Appl. Oral Sci.,* vol. *25,* no. *3,* pp. *341-345,* June 2017, doi: 10.1590/1678-7757- 2016-0411

[14] M. L. Selzer, "The Michigan alcoholism screening test: the quest for a new diagnostic instrument," *Am. J. Psychiatry,* vol. *127,* no. *12,* pp. *1653-1658,* 1971, doi: 10.1176/ajp.127.12.1653

[15] L. G. Sternberger, and G. L. Burns, "Compulsive activity checklist and the maudsley obsessional-compulsive inventory: Psychometric properties of two measures of obsessive-compulsive disorder," *Behav. Ther.,* vol. *21,* no. *1,* pp. *117-127,* 1990, doi: 10.1016/S0005-7894(05)80193-5

[16] L. Teri, "The use of the beck depression inventory with adolescents," *J. Abnorm. Child Psychol.,* vol.*10,* no. *2,* pp. *277-284,* 1982, doi: 10.1007/BF00915946

[17] S. Tutun, S. Khanmohammadi, L. He, and C. A. Chou, "A meta-heuristic LASSO model for diabetic readmission prediction," in *Industrial and Systems Engineering Research Conf.,* 2016, pp.*2228-2233.*

[18] W. M. Van Der Flier, and P. Scheltens, „Epidemiology and risk factors of dementia," *J Neurol Neurosurg Psychiatry,* vol. *76,* pp. *2-7,* Dec. 2005, doi: 10.1136/jnnp.2005.082867

[19] B. Walton-Moss, L. Gerson, and L. Rose, "Effects of mental illness on family quality of life," *Issues Ment. Health Nurs.,* vol. *26,* no. *6,* pp. *627-642,* 2005, doi: 10.1080/01612840590959506

[20] H. U. Wittchen, and F. Jacobi, "Size and burden of mental disorders in Europe – A critical review and appraisal of 27 studies," *Eur Neuropsychopharmacol,* vol. *15,* no. *4,* pp. *357-376,* Aug. 2005, doi: 10.1016/j.euroneuro.2005.04.012

[21] M. Zimmerman, "Broadening the concept of bipolar disorder: What should be done in the face of uncertainty?," Postepy Psychiatr. I Neurol., vol. *21,* no. *2,* pp. *88-90,* Oct. 2011, doi: 10.1002/j.2051-5545.2011.tb00048.x

[22] M. Zimmerman, and J. I. Mattia, "A self- report scale to help make psychiatric diagnosis: The psychiatric diagnostic sreening questionnaire," *Arch Gen Psychiatry,* vol. *58,* no. *8,* pp. *787-794,* Aug. 2001, doi: 10.1001/archpsyc.58.8.787