CHAPTER 2
REVIEW OF LITERATURE

2.1 INTRODUCTION

A review of literature has been presented on depression data mining using ANN. This chapter highlights different groups of people affected with different types of depression.

2.2 DEPRESSION

Clinical depression may exist at different grades of disorder. The working ability has been lost when the patient has the ability to work with a difficult illness. Patients may also suffer from delusions and have suicidal thoughts [Elliot, 2003; Asli, 2004]. Noda, 2004, analyzed the use of robots for depression study in human.

The classification of depressive disorders is based on the diagnostic criteria of ICD-10 or DSM-IV. According to DSM-IV, unipolar forms of mood disorders are divided into three groups: MDD, dysthymic disorder, and depression not otherwise specified. The diagnosis of major depression requires a two-week period of depressed mood or loss of interest or pleasure together with at least four other symptoms such as fatigue or loss of energy, hopelessness, changes in appetite and weight, psychomotor retardation and agitation, inappropriate guilt, impaired concentration, insomnia or hypersomnia, and suicidal thoughts. The symptoms must not be related merely to substance use, bereavement or medical illness. In DSM-IV the severity of major depression is also categorized by the number of symptoms: mild, moderate or severe. The diagnosis of major depression is basically the same in DSM-IV and ICD-10; although, ICD-10 has one symptom less than DSM-IV and includes fatigue or loss of energy in the core symptoms. Dysthymic disorder is a chronic disturbance of mood in which
depressed mood occurs most of the day for at least two years. Depressive disorder not otherwise specified includes disorders with depressive features that do not fulfill the criteria for MDD, dysthymic disorder, adjustment disorder with depressed mood, or adjustment disorder with mixed adjustment and depressed mood.

Depression is a common public health problem that causes a remarkable amount of individual suffering, functional disability, and self-destructive behavior [Dmitri, 2000]. During lifetime, approximately one fifth of the population suffers from major depression [Kessler, 2003]. According to population surveys, the prevalence of clinically significant depression varies from 2.6% to 5.5% in men and from 6.0% to 11.8% in women. The prevalence of depressive symptoms is much higher, varying from 10% to 19%, among men and from 18% to 34% among women. It is estimated that only one third of the patients suffering from major depression in Finland receive treatment [Hamalainen, 2004].

In the National Comorbidity Survey (NCS) conducted in 1990-1992, the lifetime prevalence of major depression among US adults was 17.1%, and the 12-month prevalence was 10.3%. The National Comorbidity Survey Replication (NCS-R), conducted in 2001-2002, found a lifetime prevalence of major depression among US adults of 16.2%, and a 12-month prevalence of 6.6%. In a study conducted by Jacobi, 2004, the lifetime prevalence of any unipolar depression in the German population was reported to be 17.1% and the 12-month prevalence 10.7%.

There exist several epidemiological studies in which the epidemiology of depression has been studied in Finland. The most recent results regarding the prevalence of depression in Finland are from the ODIN study [Ayuso, 2001] and from the health 2000 study [Pirkola, 2005]. In the ODIN study the prevalence of MDD was 4.7% among urban subjects, 2.7% among men and 6.6% among women, and 4.1% among rural subjects, 4.3% among
men and 3.8% among women. In the Finnish health 2000 study the prevalence of major depression during the past 12 months measured by the Composite International Diagnostic Interview (CIDI) among subjects 30 years or more was 3.4% among men and 6.3% among women. With regard to young adults, in the Finnish health care survey of 433 young adults the 12-month prevalence of major depression was 9.4%; 8.1% among males and 10.7% among females [Haarasilta, 2001; Thomas, 2008]. In a study of 245 Finnish subjects aged 20-24 years the one-month prevalence of major depression was found to be 6.9%; 5.4% among males and 7.8% among females [Aalto, 2001].

Depression is a bio-psychosocial disease; there are several biological, psychological and social factors behind depressive disorders [Blazer, 2003; O’Keane, 2000; Kendler, 2002, 2006]. Major depression is suggested to be a familial disorder [Sullivan, 2000; Kendler, 2001]. The familiar disorder results partly from genetic influences, although environmental factors specific to an individual are also etiologically important [Pine, 2001]. It is known that the risk of depression is higher among first-degree relatives of individuals suffering from unipolar depression [James, 2005]. Major depression is suggested to be equally heritable in men and women [Kendler, 1999].

Early adverse life experiences influence the risk of later depression and many psychosocial factors such as physical disability, social isolation, and economical problems may predict depression [Korkeila, 2005; Pirkola, 2005]. In major depression there are often generating factors which may be current negative life events or losses together with genetic and personality factors that may result in depression. It can be stated that depression is a complex disorder that does not result from either genetic or environmental influences alone, but rather from the interaction of both of these factors.
As the size of data warehouses increase to several hundreds of gigabytes or terabytes, the need for methods and tools that will automate the process of knowledge extraction or guide the user to subsets of the dataset that are of particular interest is becoming prominent [Themistoklis, 2000]. Most clinical tasks require measurement and capture of numerous patient data, often on electronic media. The clinical application shows that it is possible to differentiate between patients suffering from schizophrenia, depression and normal healthy persons on the basis of Electroencephalograms (EEG) rhythms [Andrew, 2005; Ying, 2005].

Neurochemical changes play an important role in the etiology of depression [Malhi, 2005]. The monoamine hypothesis was presented in the 1960s suggesting that an important mechanism behind depression is dysregulation in the neuronal monoamines, noradrenalin, serotonin, and dopamine [Nutt, 2006; Stahl, 1998]. As reviewed by Hindmarch, 2002, the monoamine hypothesis is based on pharmacological observations that antidepressive medication raises the functional capacity of the biogenic amines in the brain. Although the monoamine concentrations increase in a few hours, clinical response to the antidepressive treatment comes later, usually in one to four weeks. It seems that much more complex dysregulation exists behind depression. The focus has moved away from single neurotransmitters to such areas as neurobehavioral systems, neural circuits and signal transduction [Thase, 2000].

Many hormonal abnormalities are related to depression. One of the most important biological factors in the pathogenesis of depression is dysregulation in the Hypothalamic Pituitary-Adrenal (HPA) axis [Natalia, 2007].

As reviewed by Barden, 2004, the secretion of glucocorticoids from the adrenal glands increases in reaction to stress. The secretion of glucocorticoids is regulated by corticotrophin via stimulation of the
Corticotrophin Releasing Factor (CRF), which is secreted from the hypothalamus.

Increased plasma corticotrophin release factor concentrations have been found among depressed individuals [Galard, 2002]. Elevated CRF concentrations have also been found in the locus ceruleus of depressed subjects [Bissette, 2003]. High cortisol concentrations may cause cortical atrophy in the brain and thus damage the negative feedback to the hypothalamus. Hyperactivity of the Hypothalamic Pituitary-Adrenal (HPA) axis is normalized by sufficient pharmacological treatment of depression.

One of the disorders is metabolic syndrome in which HPA axis abnormalities have been reported concurrently with other etiological factors [Eckel, 2005; Heiskanen, 2006]. Hypersensitivity of the HPA axis seems to associate especially with abdominal obesity [Bjorntorp, 2000; Carpenter, 2000] and an association also exists between intra-abdominal fat and depression [Roberts, 2002; Stunkard, 2003; Sueng, 2003]. The HPA axis is involved in the associations between depression and cardiovascular diseases and depression and diabetes mellitus [Musselman, 2003].

There are several hormonal and other biological factors that are suggested to be related to the pathophysiology of depression. As the prevalence of depression worldwide is greater among women than among men [Piccinelli, 2000]. It was suggested that gonadal hormones, especially estrogen, may play an important role in the pathophysiology of depression among women [Halbreich, 2007]. Estrogen treatment has been beneficial in treating depression especially in perimenopausal and postpartum depression [Ahokas, 2001; Rasgon, 2002]. Lowered follicular phase plasma estradiol levels have been found in women with depression. The prevalence of depression among women is also high in reproductive age when estrogen levels are high. The role of estrogen in depression is not clear and needs much more research. With regard to progesterone, as per the earlier review
there is no evidence on the effect of progesterone in the treatment of depression. It is suggested that progesterone may also have a role in the pathogenesis of depression.

Thyroid dysfunction has been found to be associated with depression. As per the earlier study, alterations in thyroid-stimulating hormone response to Thyreotropin-Releasing Hormone (TRH), an abnormally high rate of antithyroid antibodies and elevated Cerebro Spinal Fluid (CSF) TRH concentrations have been documented in depressed individuals [Sher, 2006]. Chronobiological disturbances are common in depression, and sleeping problems are one of the most common symptoms of depression. In addition, abnormalities in sleep EEG have been found among depressed individuals. The Rapid Eye Movement (REM) sleep latency has been shown to be shortened and the first REM sleep period lengthened [Berger, 2003]. A higher consumption of fish has been shown to be associated with a reduced risk of depression suggesting that omega-3 fatty acids may also play a role in the pathophysiology of depression [Tanskanen, 2001; Timonen, 2004].

Depression occurs together with many chronic somatic diseases [Evans, 2003; 2005]. As per research a medical illness may be a risk factor for depression, and depression itself may be a causal factor in many somatic diseases such as ischemic heart disease and stroke [Depression, 2009; Mark, 2007]. Depression may hamper recovering from a somatic disease and many patients do not receive appropriate treatment for depression. Depression may be difficult to recognize in patients with somatic symptoms or patients may be ashamed of depressive symptoms and unwilling to share them with a physician.

Depression has been shown to be a risk factor for cardiovascular diseases [Carney, 2002; Lett, 2004]. Depression increases the mortality in patients with coronary heart disease. As per the earlier study, the associations between depression and cardiovascular diseases are given in
Nationally Representative Mini-Finland health survey. The study was based on 5355 individuals diagnosed at baseline with chronic somatic diseases and mental disorders and followed for 6.6 years. Depression was associated with cardiovascular diseases at the baseline. In the follow-up, subjects with elevated depressive symptoms had a significantly higher risk of developing ischaemic heart disease. As reviewed by Rudisch, 2003, 17% to 27% of patients with coronary artery disease have major depression, and a much larger proportion have depressive symptoms.

The mechanism behind the association between depression and cardiovascular diseases is complex and unclear, although several interaction mechanisms were proposed. Joynt, 2003, introduced seven possible mechanisms for the relationship between depression and cardiovascular diseases such as non-compliance with cardiac rehabilitation programmes and medical regimens, clustering of risk factors (e.g. obesity, hypertension, smoking, diabetes, hypercholesterolemia), HPA axis hyperactivity and increased cortisol secretion, heart rhythm disturbances, elevated plasma levels of cytokines leading to atherosclerosis, platelet reactivity and psychological stress. As per the study, activation of the HPA axis may speed up the development of cardiovascular diseases by elevated cortisol and catecholamines which have also been found in depression. Recognizing and treating depression is important among patients with cardiovascular diseases. Ssris appear to be a relatively safe and effective treatment for depression in patients with comorbid coronary heart disease [Roose, 2003].

According to World Health Organization (WHO), diabetes mellitus is a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action, or both [Festa, 2007]. Type 1 diabetes mellitus comprises the majority of cases that are deficient and in which pancreatic islet beta-cell destruction is present
while type 2 includes the common major form of diabetes resulting from defect(s) in insulin secretion, almost always with a major contribution from insulin resistance [Reusch, 2002]. Depression has been shown to be associated with an increased risk of onset of diabetes mellitus [Eaton, 1996].

In the Epidemiologic Catchment Area (ECA) program survey with 3481 adults it was found that MDD predicted the onset of diabetes mellitus. As per the earlier review, depression is associated with biological modifications that may lead to increased sensitivity of depressed individuals to type 2 diabetes. The mechanisms behind the association between depression and diabetes are still unclear. Depression is associated with such metabolic abnormalities as increased release of catecholamines, glucocorticoids and growth hormone, alterations in glucose transport and increased secretion of cytokines. These can lead to insulin resistance and eventually to diabetes. Insulin resistance was suggested to be associated with depression [Timonen, 2005; 2006].

Most malignant cancers are experienced as life-threatening, and are thus significant stressors for individuals [Ge, 2001]. As reviewed by Spiegel, 2003, the prevalence of depression among cancer patients is high. It was suggested that chronic and severe depression may also increase the risk of cancer, speed cancer progression and increase mortality. In a recent Finnish cohort study of 10,892 women depression did not increase breast cancer risk during a follow-up of 6 to 9 years.

Patients with chronic pain often have comorbid depression [Campbell, 2003; Elisa, 2004. Depression may be a consequence of pain, but depression may also be manifested as a pain symptom. As per the study, long-lasting pain may produce several maladjusted coping responses that may in turn have an effect on how the pain is experienced. The same neurochemical transmitters may be involved in depression and pain.
Depression is common among post-stroke patients: the prevalence of major depression among hospitalized subjects has been found to be as high as 19% [Robinson, 2003]. Depression may also increase the risk of stroke. Treatment of depression among post-stroke patients is important, as it also enhances recovery from stroke and improves function and cognition. As reviewed by Kanner, 2003, epilepsy is the most frequent psychiatric disorder. Lifetime prevalence of depression among epilepsy patients is 6% to 30%, and the risk of dying from suicide has been reported as much as 10 times higher compared to his general population. Depression may be hard to recognize among epileptics as the symptoms are often atypical, which is why it is untreated and causes much suffering. In Parkinson disease, about 50% of the patients have depressive symptoms [McDonald, 2003].

Huurre, 2002, investigated long-term psychosocial effects of persistent chronic illness in a follow-up study of subjects aged 16-32 years. Adults with persistent chronic illness limiting daily life reported more depression and lower self-esteem than those with non-limiting chronic illness or healthy controls. No significant differences in psychosocial well-being were found between adults with any chronic illness and healthy controls. The associations between major depression and characteristics of chronic illness were studied in a general population study of 509 Finnish adolescents and 433 young adults. As a result, chronic illness, respiratory allergies, poor self-rated health and frequent sick-days were associated with depression. The associations were stronger in the younger age group [Haarasilta, 2005].

Within the northern Finland 1966 Birth Cohort, atopic disorders have been found to increase the risk of depression about two to three-fold when compared with subjects without a topic disorders [Timonen, 2002; 2003]. With regard to risk factors of cardiovascular diseases, depressive symptoms measured by Beck’s Depression Inventory during early adulthood have been found to be associated with higher levels of carotid intima-media thickness.
in men, but not in women [Elovainio, 2005]. In a study conducted by Elovainio, 2006, higher level of depressive symptoms were associated with higher levels of C-reactive protein (CRP) among young adults. A similar finding was found in the northern Finland 1966 Birth Cohort among men [Liukkonen, 2006], suggesting that an inflammatory process may contribute to the pathophysiology of depression.

Some previous studies have suggested an association between low birth weight and later depression or psychological distress [Wiles, 2005], but contradictory findings have also been presented [Osler, 2005]. In a study conducted by Gale CR and Martyn CN, birth weight and risk of psychological distress and depression at the ages of 16 and 26 years were examined. The results showed that women whose birth weight was ≤ 3 kg had an increased risk of depression at the age of 26 years compared with those who weighed >3.5 kg and men who weighed < 2.5 kg at birth were more likely to report a history of depression at the age of 26 years compared with men of normal birth weight.

Thompson, 2001, investigated the association between birth weight and depression in late life in the Hertfordshire birth cohort study of 882 subjects at the age of 68 years. As per study among men there was an association between low birth weight and risk of depression measured by the Geriatric Depression Scale while no association was found among women. In a Danish study of 12270 men, no relation between birth dimensions and later hospital-treated depression was found. In another study of the Aberdeen children of the 1950s low birth weight for gestational age was associated with adult psychological distress measured by four items from the 12-items specified. It was found that children born at full term but having low birth weight are at higher risk of psychological distress in adulthood.

The first menstrual period in girls is called menarche. The mean age of menarche is around 13 years [Weishui, 2000], and it is controlled by
genetic, environmental and psychosocial factors [Adair, 2001; Romans, 2003]. Growth in utero and childhood is associated with the age at menarche [Dos, 2002]. The hormonal mechanism behind menarche consists of the development of positive estrogen feedback on the pituitary and hypothalamus.

2.3 INTELLIGENT DATA MINING

ANN represents a useful technique for data mining applications [Decker, 1995; Lin, 1997]. It can be trained to properly represent various categories occurring in a data set. In large databases and data warehousing techniques, the size of data sets can be huge which may result in inefficient ANNs learning. It is useful to find an efficient and practical training set size without compromising the results. Two important issues play a major role in the learning process of an ANN. The first one is the proper selection of the data set size and the second is the sampling distribution of the data set. Many researchers have highlighted the importance of having adequate data to train, test and validate ANNs [Han, 1996]. Data mining applications have traditionally used inductive logic to extract rules describing various interesting conditions that occur in the data set. ANNs have been demonstrated to be an effective tool for mining large data sets and to extract relevant knowledge. Although many researchers do not associate the use of ANNs with rule extraction, successful results in extracting logic-oriented rules from the weights of a trained ANN have been demonstrated for a specific type of domains [Kantardzic, 1997].

ANNs are used for data mining [Horni, 1989; Becker, 1996] with the perspective of training and testing using a limited data set. A trained ANN is then used in conjunction with additional or unseen data sets for classification based upon its previous training phase. The ability of an ANN to generalize its learning is dependent upon the proper selection of its training and testing
data sets. Generalization features of ANNs are not trivial since in some conditions neural network gaps can occur [Kantardzic, 1999]. In other cases, ANNs can be over trained and it can reach a saturation level that increases its memorization ability rather than its generalization ability. Linda, 2001, described the relationship of intrauterine growth, maturity at birth, to age at menarche and disease risk.

Ryan, 2001, estimated the odds and prevalence of clinically relevant depression in adults with type 1 or type 2 diabetes. Depression associated with hyperglycemia and increased risk diabetic complications, relief of depression with improved glycemic control

Bernard Widrow, 1990, provided a detailed discussion on ANN. A machine learning method is proposed for automatically finding psychiatric diagnostic rules. It is proposed that a genetic algorithm system can find symbolic, easily readable rules that could be used by psychiatric clinicians [Don, 1993].

Ismail Babaoglu, 2010, studied to show a comparison of Multi-Layered Perceptron Neural Network (MLPNN) and Support Vector Machine (SVM) on determination of coronary artery disease existence upon exercise stress testing (EST) data. EST and coronary angiography were performed on 480 patients with acquiring 23 verifying features from each.

Ayuso-Mateos, 2001, assessed the prevalence of depressive disorders in randomly selected samples of the general population in five European countries. The study was designed as a cross-sectional two-phase community study using the Beck Depression Inventory during Phase 1, and the Schedule for Clinical Assessment in Neuropsychiatry during Phase 2.

Sinha, 2001, explained that ANN used nonlinear statistical modeling techniques to explore relationships in complex clinical situations. Their study compared predictive ability of a trained ANN model to that of physician
prediction of cranial Computed Tomographic (CT) scan abnormalities in children with head injury.

Jurg Ott, 2001, proposed for the analysis of association between single nucleotide polymorphisms and putative disease genes in case-control studies.

Bisaga, 2002, examined the association between menstrual functioning and Depressive Disorder Symptoms (DDS), Obsessive-Compulsive Disorder Symptoms (OCDS), and Eating Disorder Symptoms (EDS) in high school girls.

Aronne, 2003, explained about overweight and obesity which became an urgent public health problem in the United States: approximately 61% of the adult population (97 million adults) are overweight or obese, where overweight was defined as a body mass index (BMI) \( \geq 25 \) and obesity was defined as a BMI \( \geq 30 \).

Berger, 2003, explained that disturbed sleep is typical for most depressed patients and complaints about disordered sleep are the hallmarks of the disorder. Polysomnographic sleep research had demonstrated that besides impaired sleep continuity, sleep in depression is characterized by a reduction of slow wave sleep and a disinhibition of Random eye movement (REM) sleep.

Bissette Garth, 2003, studied about elevated concentrations of CRF in the locus coeruleus of depressed subjects. Research evidence that Corticotropin-Releasing Factor (CRF) played a role in the pathophysiology of major depressive disorder (MDD) had accumulated over the past 20 years.

Maria, 2003, explained geriatric depression was a common but frequently unrecognized or inadequately treated condition in the elderly population. They reviewed the important aspects of geriatric depression for the nonpsychiatric clinician.
Ritchie, 2003, determined whether optimizing neural network architecture using genetic programming as a machine learning strategy would improve the ability of neural networks to model and detect nonlinear interactions among genes in studies of common human diseases.


Ya Yang, 2004, found that the hippocampus, being sensitive to stress and glucocorticoids, plays a significant role in certain types of learning and memory. They explained hippocampus was probably involved in the increasing drug use, drug seeking, and relapse caused by stress.

Aro, 2005, found that depression and other psychological factors predict breast cancer was common, but there had been few epidemiological studies on that relationship.

Karpansalo, 2005, stated that mental depression is an important health problem in many countries. It reduced productivity at work and was the fastest increasing reason for early retirement, intervention studies in selected risk groups.

Alberti, 2006, explained a unified working diagnostic tool for the metabolic syndrome was used in worldwide clinical practice and in worldwide. So that from different countries can be compared.

Katherine, 2007, reviewed the literature regarding the relationship between mood disorders and fertility in women and identify variables that need further investigation. They examined primary studies found in a Pub-Med literature search on women, fertility status and mood from 1980 onwards.

Chun-Kit, 2007, studied the problem of mining frequent itemsets from uncertain data under a probabilistic framework. They considered
transactions whose items are associated with existential probabilities and gave a formal definition of frequent patterns under such an uncertain data model.

Yueh-Ming, 2007, attempted to use Artificial Neural Network (ANN) to predict those past histories from other eight current general factors, such as age, years of education, religion, family status, past psychiatry history, family psychiatry history, anxiety status and depression status. His study found that by using eight current general factors, RBF neural network models showed acceptable performance in detection of past suicide idea history as well as past self-harm history.

Ethan, 2007, examined whether older persons who live in areas that are conducive to walking are more active or less obese than those living in areas where walking is more difficult.

Laura, 2008, explained about polyamine pathway had an essential role in many cellular functions and had been implicated in pathological conditions. They suggested that polyamine system played a role in the etiology and pathology of mental disorders.

Roy, 2008, implemented a new theory for the internal mechanisms of the brain. It postulated that there are controllers in the brain and that there are parts of the brain that control other parts. The theory refuted the connectionist theory that there are no separate controllers in the brain for higher level functions.

Cohn, 2009, studied about that methods of assessing psychopathology depend almost entirely on verbal report (clinical interview or questionnaire) of patients, their family, or caregivers. They lack systematic and efficient ways of incorporating behavioral observations that are strong indicators of psychological disorder, much of which may occur outside the awareness of either individual. They compared clinical diagnosis of major depression with
automatically measured facial actions and vocal prosody in patients undergoing treatment for depression.

Andrew, 2010, examined query strategies that would provide an exhaustive search method to retrieve the most referenced articles within specific categories of critical care.

Yuriy, 2010, explained associative memory was such a fundamental and encompassing human ability (and not just human) that the network of neurons in our brain must perform it quite easily. Most importantly, they have demonstrated experimentally the formation of associative memory in a simple neural network consisting of three electronic neurons connected by two memristor-emulator synapses.

Chattopadhyay, 2011, stated that depression is a common but ominous psychological disorder that threatens one's quality of life. The screening and grading of depression is still a manual process and grades are often determined in ranges.

Tenorio, 2011, stated that Celiac Disease (CD) was a difficult-to-diagnose condition because of its multiple clinical presentations and symptoms shared with other diseases. Gold-standard diagnostic confirmation of suspected CD was achieved by biopsying the small intestine. They suggested that CDSS could be used to help in diagnosing CD, since the algorithm tested achieved excellent accuracy in differentiating possible positive from negative CD diagnoses.

Jason, 2012, presented 3 methods of performing pattern recognition on spatiotemporal plots produced by pharyngeal High-Resolution Manometry (HRM). The methods are classification models, including the Artificial Neural Networks (ANNs) Multi-Layer Perceptron (MLP) and Learning Vector Quantization (LVQ).

Antonio, 2012, presented a new approach to training Back-Propagation Artificial Neural Nets (BP-ANN) based on regularization and cross-validation
and on initialization by a Logistic Regression (LR) model. They have applied the approach to ten data sets of biomedical interest and systematically compared BP-ANN and LR.

2.4 RADIAL BASIS FUNCTION (RBF)

Schwenker, 2001, discussed that learning algorithms for radial basis function (RBF) networks are discussed. Whereas MLP are typically trained with back propagation algorithms, starting the training procedure with a random initialization of the MLP's parameters, an RBF network may be trained in many different ways. They categorize these RBF training methods into one-, two-, and three-phase learning schemes.

Alessandro, 2004, reported significant univariate associations between gene polymorphisms and antidepressant response in mood disorders. However the combined analysis of multiple gene polymorphisms and clinical variables required the use of nonlinear methods.

Marius, 2008, defined with the application of some probabilistic neural network (PNN) variants to discriminate between healthy people and people with Parkinson's disease. Three PNN types have been used in this classification process, related to the smoothing factor search: incremental search (IS), Monte Carlo search (MCS) and hybrid search (HS). The concrete application has provided diagnosis accuracies ranging between 79% and 81% for new, undiagnosed patients.

Lei Shi, 2009, explained the goal of perception was to infer the hidden states in the hierarchical process by which sensory data are generated. Human behavior was consistent with the optimal statistical solution to this problem in many tasks, including cue combination and orientation detection. They proposed a simple mechanism for Bayesian inference which involves averaging over a few feature detection neurons which fire at a rate determined by their similarity to a sensory stimulus.
Jyoti Joshi, 2012, mentioned that depression was a severe psychiatric disorder. Despite the high prevalence, current clinical practice depends almost exclusively on self-report and clinical opinion, risking a range of subjective biases. They focused on depression analysis based on visual cues from facial expressions and upper body movements.

2.5 FUZZY LOGIC

Beth, 1997, hypothesized that fuzzy logic could be used for pharmacokinetic modeling. Their objectives were to develop and evaluate a model for predicting serum lithium concentrations with fuzzy logic. Steady-state pharmacokinetic data had been previously collected in 10 elderly patients (age range, 67 to 80 years) with depression who were receiving lithium once daily.

Claudio, 1997, explained that the prediction of patient response to new pharmacotherapies for alcohol dependence has usually not been successful with standard statistical techniques. They hypothesized that fuzzy logic, a qualitative computational approach, could predict response to 40 mg/day citalopram and 40 mg/day citalopram with a brief psychosocial intervention in alcohol-dependent patients.

Magy Seif El-Nasr, 2000, proposed a new computational model of emotions that can be incorporated into intelligent agents and other complex, interactive programs. The model used a fuzzy-logic representation to map events and observations to emotional states. The model also includes several inductive learning algorithms for learning patterns of events, associations among objects, and expectations. They demonstrated empirically through a computer simulation of a pet that the adaptive components of the model are crucial to users' assessments of the believability of the agent's interactions.
Kielan, 2003, explained that the Salomon advisory system supports a depressive episode therapy and defined system makes it possible to assess the relative intensity of depression measured by the depressive episode characteristic symptoms set based on scientific criteria for ICD-10 classification, Hamilton's depression rating scale and fuzzy logic.

Pramila, 2007, presented an implicit human–machine interaction framework that is sensitive to human anxiety is presented. The overall goal was to achieve detection and recognition of anxiety based on physiological signals. The experimental results demonstrated the feasibility of the proposed anxiety-recognition methods. To the best of their knowledge, work was the first consolidated effort at fusing multiple physiological indices for robust, real-time detection of anxiety using pattern recognition methods such as fuzzy logic and regression trees.

Mila Kwiatkowska, 2009, presented a framework to model an assessment process for a complex and multidimensional syndrome such as depression. The fuzzy-logic approach allowed for the representation of quantitative imprecision of the measurements and the semiotic approach allowed for the representation of the qualitative imprecision of the concepts. They have applied this fuzzy-semiotic framework to two types of clinical measurements: the rating by the experts and the filling out of self-administered questionnaires.

McBurnie, 2007, introduced STEM-D, a fuzzy logic model for assessing depression in OSA patients that incorporates the multifactorial nature of depression. They studied nine existing questionnaires and created four categories of questions. They modeled the categories using fuzzy variables, with the output variable being the severity of a patient's depression. STEM-D will be used multiple times throughout treatment to monitor a patient's change in depressive symptoms as a result of OSA treatment.
Mehmet, 2010, explained that neurological disorders contain Parkinson’s disease (PD), epilepsy and Alzheimer’s; influence the lives of patients and their families. PD creates cognitive and state of mind disturbances. In their study, aimed to discriminate between healthy people and people with PD. ANN are widely used in biomedical field for modeling, data analysis, and diagnostic classification. Two types of the ANNs were used for classification: MLP and RBF networks. The other method was Adaptive Neuro-Fuzzy Classifier (ANFC) with linguistic hedges.

Victor, 2012, implemented a neuro-fuzzy-Case Base Reasoning (CBR) driven decision support system that utilizes solutions to previous cases in assisting physicians in the diagnosis of depression disorder. The system represents depression disorder with 25 symptoms grouped into five categories. Fuzzy logic provided a means for handling imprecise symptoms. The five best matched cases are subjected to the emotional filter of the system for diagnostic decision making. This approach derived strengths from the hybridization since the tools are complementary to one another.

Subhagata Chattopadhyay, 2012, mentioned that depression was a common but worrying psychological disorder that adversely affects one’s quality of life. It was more ominous to note that its incidence was increasing. In addition, grades of depression are often determined in continuous ranges, e.g., ‘mild to moderate’ and ‘moderate to severe’ instead of making them more discrete as ‘mild’, ‘moderate’, and ‘severe’. They attempted to differentiate depression grades more accurately using two neural net learning approaches such as BPNN(Back Propagation Neural Network) and ANFISS(Adaptive Network-based Fuzzy Inference System).

Anish, 2012, implemented application of soft computing techniques to automate depression diagnosis. In order to achieve our goal, an intelligent Neuro-Fuzzy model has been developed. It has been trained with a sample of real-world depression data. Experiments with test data reveal that the
Mean Squared Error in prediction was nominal for most of the cases. Such a system could assist the doctors to take decisions in much needed situations.

2.6 ECHO STATE NEURAL NETWORK

Michael, 2003, explained functional brain imaging that has been widely used to study the neural basis of perception, cognition, and emotion. They studied constitutes, to their knowledge, the first resting-state connectivity analysis of the default mode and provides the most compelling evidence to date for the existence of a cohesive default mode network. Their findings also provide insight into how this network is modulated by task demands and what functions it might subserve.

Michael, 2009, combined Diffusion Tensor Imaging (DTI) tractography with resting-state fcMRI to test the hypothesis that resting-state functional connectivity reflects structural connectivity. These 2 modalities were used to investigate connectivity within the default mode network, a set of brain regions—including Medial Pre-Frontal Cortex (MPFC), Medial Temporal Lobes (MTLs), and Posterior Cingulate Cortex (PCC) / Retrposlenial Cortex (RSC)—implicated in episodic memory processing.

Danuta, 2012, stated that family history of MDD increases individuals’ vulnerability to depression and alters the way depression manifests itself. Emotion processing and attention shifting are functions altered by MDD and family history of the disease; therefore, it was important to recognize the neural correlates of these functions in association with both factors.

2.7 BACK PROPAGATION NEURAL NETWORK

Zou, 1996, mentioned ANN as a potential powerful classifier, was explored to assist psychiatric diagnosis of the Composite International Diagnostic Interview (CIDI).
Price, 2000, introduced ANN, flexible nonlinear modeling techniques that test a model's generality by applying its estimates against "future" data. ANNs have potential for overcoming some shortcomings of linear models. The basics of ANNs and their applications to psychological assessment are reviewed.

YANG Sheng, 2005, defined that depression has become a kind of common psychological diseases with quicker life rhythm and stronger competition. Based on the BP neural network with dynamic architecture, a depression diagnosis system is developed by using VC++ techniques under the Windows environment. Adopting batch BP training algorithm, the learning efficiency and approach ability have been improved. In addition, test results using practical TCM syndromes data show that this system has a strong ability for classified, and potential for the diagnosis and cure of depression.

Ying-jie Li, 2006, explained about the clinical applications which showed that it is possible to differentiate between patients suffering from schizophrenia, depression and normal healthy persons on the basis of EEG rhythms. They described the application of two ANN approaches, BPANN and self-organizing competitive ANN for the discrimination of three kinds of subjects (including 10 normal control, 10 schizophrenic patients and 10 depressive patients), with EEG rhythms used as feature vectors.

2.8 DATA MINING

Hadzic, 2008, stated that data mining techniques can be used to efficiently analyze these semi-structured mental health data. Tree mining algorithms can efficiently extract frequent substructures from semi-structured knowledge representation such as XML. In this paper we demonstrate effective application of the tree mining algorithms on records of mentally ill patients. The extracted data patterns can provide useful
information to help in prevention of mental illness and assist in delivery of effective and efficient mental health services.

Irene, 2006, explained that clinical repositories containing large amounts of biological, clinical, and administrative data are increasingly becoming available as health care systems integrate patient information for research and utilization objectives. The initial results from that study suggested that these approaches have the potential to expand research capabilities through identification of potentially novel clinical disease associations.

Maja Hadzic, 2010, implemented an intelligent system based on data-mining technologies that can be used to assist in the prevention and treatment of depression. The system allowed for the different data to be analyzed in a conjoint manner using both traditional data-mining techniques and tree-mining techniques. Interesting patterns can emerge in this way to explain various processes and dynamics involved in the onset, treatment and management of depression, and help practitioners to develop better prevention and treatment strategies.

2.9 SUMMARY

This Chapter presents the review of literature related to depression using ANN and data mining. From the literature, it can be noticed that different analysis were used for categorizing depressions type. Based on the literature ANN has been chosen as the topic of research for depression categorization. Chapter 3 discusses the generation of depression data.