Analysis of Factors Affecting Seasonal Affective Disorder in Public Environment and College Football Players Based on Computerized Neural Network Light Therapy

Qian Shi[1*]

Abstract

Seasonal affective disorder is a depressive affective psychiatric disorder that recurs at the same time of the year and seriously impacts people's daily work and life. The university stage is an important period for individuals to transition to social life, in which they are more vulnerable to negative life events such as academic performance pressure, interpersonal discomfort, and employment problems. Hence, the incidence of depression among university football players is at a high level. As an important timing factor, ambient light has a wide range of effects on various physiological and psychological functions, and its non-visual effects on mood have attracted particular attention from researchers. The illuminance, color temperature and wavelength of ambient light are important physical factors influencing mood. Abnormal light patterns such as short photoperiods, artificial light at night, and continuous light can lead to mood disorders. Light duration, time point, individual characteristics, subjective preferences, and genotype also modulate the mood effects of light. On the one hand, light signals are projected by intrinsic light-sensitive ganglion cells in the retina to brain regions involved in emotion regulation to directly influence mood. On the other hand, light signals indirectly influence mood by synchronizing internal physiological rhythms and their regulated hormone secretion, neurotransmission and sleep. The proposed method uses heart rate, exercise behavior, environment, and textual information from social platforms as raw data for mental health analysis; feature extraction of various types of information by convolutional neural network in artificial intelligence; and random forest algorithm as a classifier to determine the factors influencing seasonal affective disorder in college football players. The test and data analysis results show that the scheme described in the paper has a high recognition accuracy, which proves the effectiveness and feasibility of the scheme.

Keywords: Neural Network, Illumination Therapy, Seasonal Affective Disorder, Public Environment

1. Introduction

As the pace of people's life accelerates and the material living standard continues to improve, the pressure of life and study and social pressure also increases, and that seriously affects problems become prominent. Among them, depression is a mental disorder disease that seriously affects people's physical and mental health and causes social losses. Among the depressed people, the college football players group is one of the components, and the negative impact of depression in the college football players group is a little bit bigger than in other groups in society, which is not only related to the personal growth of college football players but also related to the future of the whole society, nation, and country. Many factors lead to depression among college football players, and environmental factors play an important role under many pressures such as study and employment and personal emotion, among which seasonal lack of sunshine is one of the environmental factors. Light therapy, a physical therapy method that uses artificial light or natural light to prevent and treat illness, was originally invented in response to research on seasonal affective disorder (Danilenko et al., 2019; Dauphinais et al., 2012; Szabó et al., 2004).

Seasonal Affective Disorder (SAD) is a depressive disorder with seasonal episodes in a cyclical pattern, usually occurring in late fall and winter. Prolonged depression may

[1]University of Queensland, St. Lucia, Australia

* Correspondence: Qian Shi, Email: qian.shi@uqconnect.edu.au

pose a serious risk to people's physical and mental health and greatly reduce their standard of living. In the United States, people with SAD are afflicted by heart disease for 1/3 of 1 year, which can occur in people of any age. Therefore, the study of the etiology, pathogenesis, and pathogenesis of SAD has profound and important significance in clinical practice for the treatment and prevention of seasonal mental disorders. SAD is also known as winter depression, and SAD is a subtype of unipolar and bipolar major depressive disorder. SAD is characterized by the annual recurrence of depressive episodes in specific seasons, mainly in winter, accounting for 10%-20% of the prevalence of major depression (Jason & Mitchell, 2022). The development of SAD is related to a variety of factors, but most factors come from the external environment, of which environmental factors account for more than 70%, such as social institutions, living and working environment and eating habits, etc. Some scholars believe that winter depression is mainly caused by insufficient light (Anderson et al., 2009; Jan et al., 1994; Levitt et al., 2002). Light is one of the indispensable conditions for the growth of all things, and also an important factor for human survival environment long-term dark environment will make people's mood low and lead to depression. Studies have shown that depressed people are generally born in the fall and winter months. And it has been suggested that SAD may be a measure of the severity of depression, with worsening of subjective sensory symptoms more pronounced in winter months.

Epidemiological survey studies have found that patients with SAD are more common in northern Europe, where the climate is cold, the days are short and the nights are long. Winter is long, and that symptoms rapidly resolve when patients move to the south. Epidemiological surveys in Northern Europe and the United States have also confirmed that the prevalence of SAD increases with increasing latitude. The duration of light also has some correlation with air ionization. Longer light time, higher air ionization; shorter light time, lower ionization. A survey of 66 cases of manic patients found that the monthly hospitalization rate was significantly correlated with the time of daylight in that month. It is thus proposed that the high degree of ionization of air in spring and summer tends to produce high concentrations of cations, which act on the body to inhibit the activity of monoamine oxidase and increase monoamines in the body, thus inducing mania (Bilu et al., 2019; Kaminski et al., 2015; Rohan et al., 2019). In contrast, negative ions have the opposite effect. This view supports the idea that SAD patients are prone to the onset of mania in autumn and winter, and remission or mild mania in spring and summer. Melatonin (MEL) is a hormone secreted by the pineal gland. After tryptophan is taken up by the pineal gland cells, it is converted into 5-hydroxytryptamine catalyzed by tryptophan hydroxylase, and the latter is synthesized into MEL by the action of various enzymes. Normal human blood levels of MEL show circadian rhythms, and when light is irradiated on the retina during the day, the supraoptic nucleus and the upper cervical sympathetic ganglion are inhibited. Thus, the sympathetic release of norepinephrine in the pineal gland is reduced. During darkness, light is reduced, sympathetic release of NE is increased, and MEL secretion is increased. In winter, when light hours are short, MEL secretion is relatively higher than in other seasons. The onset of SAD occurs mostly in autumn and winter, so it is presumed that the increased secretion of MEL is related to the onset of SAD.

Light is one of the important elements indispensables for human survival. Lack of light or unreasonable light can lead to a series of problems in the human body, and a typical example is seasonal affective disorder. Studies have found that many people living in the northern hemisphere experience mood and behavioral changes due to seasonal changes (Altmayer et al., 2019). Light therapy, a physical therapy method that uses artificial or natural light to combat illness, was originally invented in response to research on seasonal affective disorder. Specifically, light therapy is based on different light colors, different wavelengths of light, for different objects, according to certain methods to stimulate the vegetative nervous system and brainstem reticular structures, regulate nutrient metabolism, blood circulation and endocrine function, regulate the physiological cycle and improve symptoms (Geoffroy et al., 2019; Winkler et al., 2005; Yoshiike et al., 2020).

Studies have shown that light of different spectral compositions and different illumination levels produce different physiological responses in the human body. If the light is not properly selected can cause harmful photochemical reactions to cells and tissues. Most current

light therapy devices use fluorescent tubes that produce white light or the full daylight spectrum to achieve light intensities in the range of 2,500 to 10,000 lx. The fluorescent tubes in these phototherapy devices produce a degree of ultraviolet light that can cause acute or chronic damage to visual organs, such as keratitis or conjunctivitis, acute or subacute retinopathy, etc., while ultraviolet light has been shown not to increase the effectiveness of phototherapy.

2. Related work

2.1. Seasonal Affective Disorder in College Football Players

The Global Burden of Disease Collaborative Study found that affective disorders have become one of the most dangerous diseases to human health in the world today. According to the World Health Organization (WHO), 121 million people worldwide suffer from affective disorders, affective disorders are expected to become the second largest source of disease burden after coronary heart disease, accounting for 15% of the global burden of disease. Affective disorders are syndromes characterized by significant and persistent depressed mood as the main clinical feature. Approximately 15% of people with affective disorders eventually end up taking their own lives. The medical costs of treating depressive disorders in the United States, amount to $43 billion. The Asia-Pacific Summit for Psychiatric Science reports that the total economic burden of affective disorders in China amounts to 62.2 billion RMB (Dallaspezia & Benedetti, 2020; Gaynes, 2007; Rivarola et al., 2010).

With the increasing number of college football players and the increasing pressure of college football players study and employment, the probability of seasonal affective disorder among college football players is increasing, which brings serious challenges to social stability and college management, and the problem of seasonal affective disorder among college football players has attracted great attention from the society. Therefore, it is important to design an intelligent assessment of seasonal affective disorder for college football players to help administrators understand the changes of seasonal affective disorder and develop corresponding treatment plans according to the psychological status of college football players. Initially, an expert approach was used to measure seasonal affective disorder in college football players, which is highly subjective and costly.

Affective disorders are anticipatory tensions and worries that lack objective causes, an unpleasant emotional response that anticipates imminent catastrophe and is difficult to cope with, and almost all people experience varying degrees of affective disorder emotions under stress. Therefore, affective disorders are not all pathological, and only those that are excessive and interfere with normal life functioning are pathological affective disorders and require pharmacological treatment and psychological intervention. Generalized affective disorder, also referred to as generalized affective disorder, is a pathological affective disorder, and generalized affective disorder belongs to the category of neurological disorders. It is an affective disorder that is characterized by frequent persistent significant nervousness without a clear object or fixed content, excessive worry, and accompanied by significant autonomic hyperactivity, motor restlessness and excessive alertness, and belongs to the pathological category.

Excessive is an affective disorder that is more intense than normal, causing the patient to feel distressed and upset; persistent is an affective disorder that lasts for a long time and occurs with high frequency. Significant tension and uneasiness without a clear object and fixed content, comparing generalized affective disorder with other types of affective disorders, such as social disorder patients will only have affective disorder in front of people, compulsive hand washing that occurs in patients with obsessive-compulsive disorder is a panic about being contaminated (Rohan et al., 2020; Stanak & Strohmaier, 2020; Virk et al., 2009). Patients with generalized affective disorder are worried all the time and have affective disorder and annoyance about a series of unfixed objects, not about one or two situations. Pervasive affective disorder is a chronic affective disorder that takes more than 6 months to diagnose and usually lasts for several years, and patients suffer from this pathological affective disorder for a long time without relief. Although affective disorder is an adverse emotional experience, moderate affective disorder is a stressful physiological response to stress and is not a bad thing. For example, football players worries about their

grades before exams will motivate them to improve their study efficiency and eventually get the desired grades, and good grades are a reinforcement of football players emotional disorders before exams. However, when college football players present an excessive degree and duration of emotional disorders and worries about many aspects of school, work and health, and accompanied by the production of somatic symptoms such as restlessness, inattention, blankness, irritability, muscle tension discomfort, insomnia, etc., this emotional disorder, i.e., generalized affective disorder, seriously affects the daily life and psychological adjustment of college football players.

2.2. Light Therapy

The pathogenesis of depression is still unclear, and it is generally believed that it is the result of a combination of genetic and environmental factors. The main academic views are the monoamine hypothesis, the stress hypothesis, the neurodegenerative hypothesis, the genetic/genetic theory, and the seasonal depression theory (SAD), which suggests that the low sunlight in winter affects the abnormal secretion of melatonin by the pineal gland and reduces the synthesis of compound amines in the blood, thus affecting the physiological cycle of the body and leading to changes in mood and behavior. The main problems of drug therapy are effective in only about 70% of patients; it has poor long-term compliance and long-term treatment is necessary ("My wife suffers terribly from SAD (seasonal affective disorder). Other than light therapy, are there any other treatments that could help get her through the dreary winter months?," 2010; Praschak-Rieder & Willeit, 2022; Roecklein et al., 2020). The most effective treatment for depression has not been found internationally or nationally.

In 2002, Brown University discovered a third type of photoreceptor cells in the mammalian retina, which are involved in regulating and controlling changes in human vital signs, hormone secretion and arousal through visible light radiation entering the human eye. Such non-visual biological responses and effects are referred to as photobiological effects. Applied research based on photobiological effects is one of the international research hotspots today. The close correlation between light and seasonal depressive mood has been recognized by the academic community, but there is no consensus on the main elements of spectral band, light intensity, light duration, and light period specifically. In terms of spectrum, most researchers have concluded that white light and green light alone are therapeutically effective, and red light has little to no therapeutic effect. By comparing the therapeutic effects of green and red light on SAD, it was concluded that the antidepressant effect of green light is better than that of red light. It was shown that blue/green LED produced maximum inhibition (497 nm), and the difference in inhibition between ordinary light box (400-600 nm) and white LED light (460, 560 nm) was not significant. w applied strong light (10,000 lx) and weak red light (500 lx) for the treatment of SAD, it was found that the effect of strong light was not higher than that of red light. Low-intensity green light (200-400lx) was used to treat seasonal depression. Also, some studies have concluded that infrared light has the same antidepressant effect as white light. Ultraviolet waves in artificial light are not only ineffective but potentially harmful in the treatment of SAD, so they should be blocked when administering phototherapy to patients with SAD. Recent studies have shown that white light is more effective than red or blue light in treating seasonal affective disorder, but it is not certain which wavelength of the spectrum is effective in treating seasonal affective disorder (Graw et al., 1999; Hodges & Marks, 1998; May, 2020; Nussbaumer et al., 2015).

There is also no conclusive evidence regarding the intensity of light and the duration of light exposure. At present, the treatment of SAD generally uses white light with an illumination level of 1500-3000lx, but some apply less than 300lx of weak light or 10000lx of very strong light, and the treatment time is mostly at 6:00-8:00 or 18:00-20:00, 1~2h per day (if 10000lx is applied, the treatment time is reduced to 0.5h per day). However, researchers in Seattle found that morning light simulation with gradually increasing luminance (peak 250 lx) for 2 h per day for one week before waking up in SAD patients was effective in relieving the disease in SAD patients. Regarding the period of light treatment, some scholars believe that it takes effect in about 1 week, some believe that 10 days is a course of treatment, and some believe that it needs to last for 2-4 weeks to achieve a smooth antidepressant effect. The therapeutic response of 1 week and 2 weeks of phototherapy was compared by a 2500lx, 2h per day experiment, and the results showed no significant difference between the antidepressant results of 1 week of phototherapy and 2 weeks of phototherapy. Therefore, there is still a need for further in-depth research on the different arrangements of light cycle or

light therapy time. At present, China's indoor lighting remains mostly at the level of meeting the needs of basic visual functions, although some studies consider the photobiological effects, but also mostly from the impact on learning efficiency, the lack of health lighting research photobiological effects, especially the lack of seasonal daylight research on the physiological and psychological needs of college football players on indoor lighting (Friedrich et al., 2016; Huang & Sung, 2016; Kukhta et al., 2018; Melrose, 2016). Practice has shown that it is very difficult to completely cure depressive illnesses that have been clinically diagnosed. Currently, light therapy for seasonal depression (SAD) has been proven to be effective. Due to the vast geographical area of China and the large differences in light climate, it is important to consider light climate characteristics in different regions to determine lighting design standards, which also need further in-depth research.

2.3. Computer neural network and psychotherapy for college football players

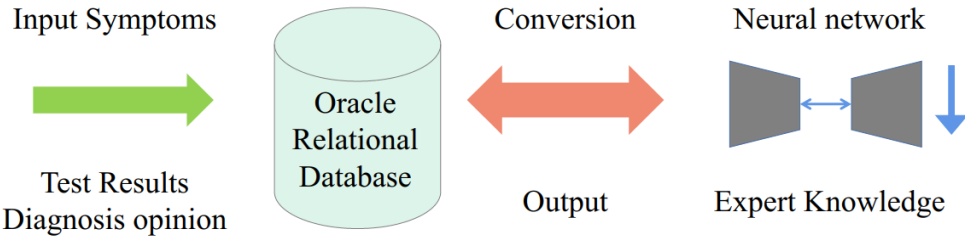

Figure 1 Schematic diagram of the psychological assessment system for college football players

Combined with relevant research, the application of artificial intelligence and big data in college football player's mental health education is mainly reflected in the following aspects. Mental health testing is a pre-project in the mental health education of college football players, which mainly conducts mental health tests for college football players and determines whether they have psychological problems through the analysis of test results. At present, colleges and universities have started to apply college football player's mental health assessment system as an important technical platform for football player's mental health testing. The system mainly integrates the use of artificial intelligence and big data and other analysis techniques to form the mental health assessment model of college football players, analyze the mental health assessment questionnaires submitted by the assessed subjects, and finally form the mental health assessment report as the basis for judging the mental health status of college football players. Figure 1 is the schematic diagram of the current psychological assessment system for college football players.

The system forms the key and core of the operation of the psychological assessment system by establishing a multi-class neural network system, the operation model of the psychological assessment system, and the data is stored in the Oracle relational database, in which each neural network is connected to the Oracle database system by programming (Tagaya, 2018a, 2018b). The expert knowledge forms the input and output nodes, and after the sample analysis of the expert. Then, the neural network has the function of automatically adjusting the contact weights between the nodes, and finally forming a stable state after the debugging of samples. Moreover, the psychological assessment system is highly intelligent and can find its shortcomings in repeated testing and learning and carry out the corresponding optimization path simulation to finally improve the psychological assessment model and the assessment's accuracy.

The current method of disease prediction is mainly based on logistic regression, which has been applied for many years and belongs to probabilistic linear regression and is a common method to deal with dichotomous data. It is used for epidemiological risk factor analysis, prediction and discrimination, dose-response analysis of drugs or toxicants in experimental studies, clinical trial evaluation and disease prognostic factor analysis. One of its advantages is that the significance of the parameters is clear, i.e., once the regression coefficient of a factor is obtained, the dominance ratio of the estimated relative risk at different levels of risk factors can be obtained, which facilitates the interpretation of the results to a large extent and is therefore suitable for epidemiological studies.

Nevertheless, there are some noteworthy problems with logistic regression. For the analysis of the same data, the independent variables are divided in different ways, and the meanings, magnitudes and signs of the parameters may change, leading to differences in the interpretation of the results.

Artificial neural network is a marginal interdisciplinary discipline integrating neuroscience, information science, computer science, and engineering science that has developed rapidly in recent years and is an advanced method for information processing with a parallel processing structure similar to the neural network of the human brain. With unique information storage, good fault tolerance, large-scale nonlinear parallel processing and powerful self-organization, self-learning, and self-adaptive capabilities, it has been applied to signal processing, pattern recognition, comprehensive evaluation, predictive analysis and other fields. Compared with domestic, there are more studies abroad using ANN for prediction of bipolar disorder. For example: early identification of bipolar disorder in combination with MRI, identification of bipolar depression based on suicidal behavior, and prediction of the efficacy of antidepressants in treating mood disorders. There is only one study on ANN for early identification of bipolar disorder in China. A retrospective study was used to screen the indicators related to bipolar disorder from the clinical characteristics and symptom scales of patients' first depressive episode as the input variables of the model, and different internal structures of neural networks were selected. The results of the study showed that the MLP neural network model had a sensitivity of 76.7%, a specificity of 75.0%, and an accuracy of 75.9%, which was better than the logistic regression model. It indicates that ANN can be applied to the early identification of bipolar disorder. Because it is a retrospective study, the comprehensiveness of the information investigated is insufficient, and the structure of ANN is complex, its application in the early identification of bipolar disorder still has room for further exploration.

3. Methods

3.1. Model Structure

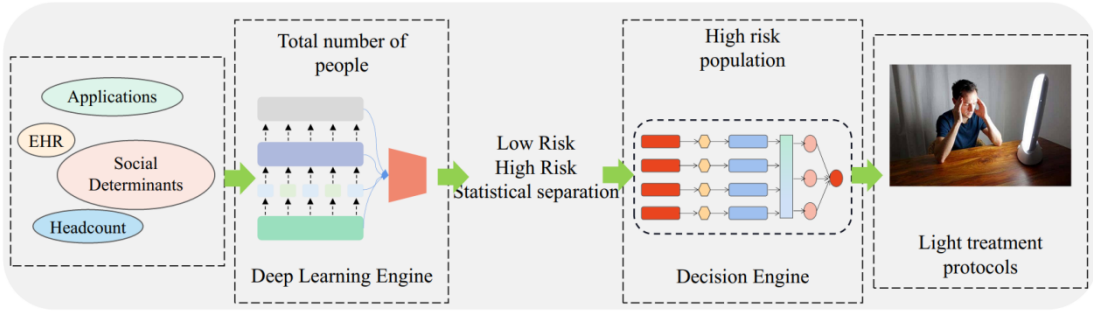

Figure 2 Method flow chart

An early warning system (EWS) is a tool used by health care providers to identify signs of serious or even potentially life-threatening clinical deterioration. An EWS can accurately identify high-risk patients and provide palliative interventions for these patients. Therefore, the core function of this paper to study seasonal affective disorder in college is to classify the identified student population into different risk clusters based on the probability of mental illness onset, and to generate timely light treatment plans for football player's at higher risk of onset based on risk threshold triggers. As shown in Figure 2, the system consists of 3 main steps: data warehouse construction, risk stratification, and light treatment plan generation. In the predictive model cohort, the retrospective cohort refers to football players who received counseling from a mental health professional in the previous year, while the prospective cohort refers to football players who received counseling from a mental health professional in the current year.

3.2. Light acquisition and control

The photoresistor adopts GL3526, which has the characteristics of small size, fast response time and stable output voltage to meet the needs of detecting seasonal outdoor light and digital signal fitting. The main control module presets the seasonal outdoor light intensity value in advance. The TLC549 converts the voltage into a digital signal and

transmits it to the main control module. The main control module converts the digital signal, accordingly, compares the converted value with the set value, and transmits the control command to the auxiliary control module. The data from the data acquisition module is subjected to image pre-processing, image segmentation, image feature extraction and image classification, and with the help of image recognition technology, it determines which stage of emotional disorder or which lesion is present in the current college football player's in that season, and uploads the seasonal emotional disorder situation and lesion of college football player's in different stages to the information storage module, the management module and the user terminal.

The management module sends the seasonal affective disorder of college football players from the data processing module to the control module according to the initial setting to send different instructions to adjust the light module position, light time, light level, and light quality. After that, the light environment configuration of high-quality college football player's emotion from the information storage system is deeply learned and iterated many times to find out the most suitable light environment for college students' emotion. The control module is constantly given instructions to change the operation of the position regulator and LED light module when college students have seasonal affective disorder, so that all college football players with seasonal affective disorder in the classroom are in the same light environment as much as possible. For the control module, first, adjust the light source position, light time, light level, and light quality according to the different instructions initially set; then, deep learning will be carried out on the college football player's ' emotional lighting environment and multiple iterations will be made to find out the most suitable lighting environment for college football player's emotions. The instructions are constantly updated when college students have seasonal affective disorder so that college football player's seasonal affective disorder can be cured quickly. The flow of the management module is shown in Figure 3.

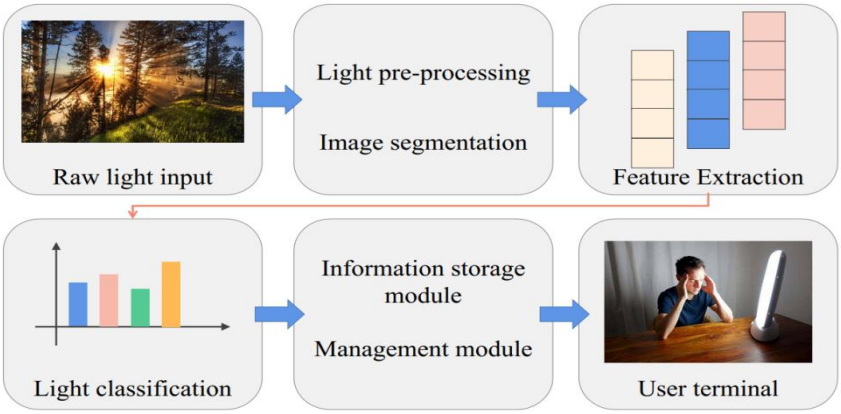

Figure 3 Data processing module flow chart

3.3. Illumination Feature Coding

To further enhance the visual effect of shading, we perform shading feature enhancement on the heavy illumination feature F_R in the heavy illumination decoder ψ_1. For this purpose, we introduce an additional shadow decoder ψ_3 that generates the corresponding shadow images from the implicit representations. Also, driven by the shadow generation task, ψ_3 will learn the rich shadow features F_S. Further, using the learnable weights $\{w_R, w_R'\}$, the enhanced heavy illumination features F_R' are obtained by adaptively fusing F_R and F_S, as shown in the following equation

$$F_R' = w_R F_R + w_R' F_S \quad (1)$$

Similarly, using the learnable weights $\{w_S, w_S'\}$, the enhanced shading features F_S' can also be obtained. Finally, F_R and F_S complement each other and enhance each other. For the three RGB channel images $\{I_R, I_G, I_B\}$T of the input image I, they are mapped to the high-dimensional features F using a third-order polynomial kernel function F_p.

$$F_p = K(I_R, I_G, I_B) = [I_R, I_G, I_B, I_R^2, I_G^2, I_B^2, \cdots, I_R I_G I_B] \quad (2)$$

Finally, the joint high-dimensional features F_p, and depth images are used as the input of the heavy illumination encoder to further improve the feature diversity of the input.

3.4. Predictive Model Construction

In this paper, student mental health data from the previous 12 months were recorded and processed, and various types of data were extracted in the original health records. To analyze relevant social factors, some measurable social factor variables were also considered. Overall, more than 15,000

characteristics were collected in the original data pool. A retrospective mental illness classification was used to construct a risk stratification model, a process that was completed in four stages. The feature filtering phase consisted of two steps: univariate filtering and multivariate filtering. In the univariate filtering stage, the characteristic p-values were first pre-filtered using a two-sided t-distribution test, and the characteristic values with $p < 0.05$ were retained. Then the OR (Odds Ratio) value of each feature was adjusted according to the age-sex logistic regression calculation, and only features with OR values in the interval greater than 1.5 and less than 2/3 were retained. In the multivariate filtering step, the algorithm is used to construct the multivariate model, and 117 features are finally used to construct the model. A deep neural network (DNN) consisting of an input layer (117 dimensions), three hidden layers (each 512 dimensions with a Tanh activation function) and a scalar output layer (one dimension with a Sigmoid activation function) was trained. The machine learning library Scikit learn in Python is used to perform a grid search for the parameters of the neural network, and the adjusted parameters include network depth, number of hidden layer cells, learning rate, and loss weights.

The parameters of the DNN were then adjusted using a weighted cross-entropy loss function to compensate for the error of misclassifying cases to the control group. To verify the validity and accuracy of the DNN model, a multiple logistic regression model with L-1 regularization and an model were trained as the benchmark models. The inputs of the two baseline models were identical to those of the DNN model, and parameters were selected by cross-validation. the DNN estimates were further mapped to positive predictive values (PPV), which can also be interpreted as risk scores for measuring the probability that an individual with a PPV equal to or greater than a specific value will incur psychological risk within the next year.

3.5. Decision interpretation

For a complex neural network model, determining the quantitative relationship between EHR and model decisions is a more important step, and in this study LIME (Local Interpretable Model-agnostic Explanations) algorithm was used to interpret the risk stratification results. For each patient, x is used to represent the patient's characteristics. M instances $\left(x^{(1)}, x^{(2)}, \cdots, x^{(M)}\right)$ were drawn around x by randomly and uniformly drawing non-zero elements of x. The interpretation of x was obtained by labeling these sample instances with a trained DNN as

$$\begin{aligned} \varepsilon(x) &= \arg\min_{g \in G} \Gamma(h, g) + \Omega(g) \\ &= \sum_{i=1}^{M} \left(h\left(x^{(i)}\right) - B x^{(i)}\right)^2 + \sum_j \left|\beta_j\right| \end{aligned} \tag{3}$$

where h denotes the trained DNN; g denotes the explanatory model, $\Gamma(h, g)$ denotes the fidelity of the explanatory models g and h, $\Omega(g)$ denotes the interpretability of this explanatory model, and β_j denotes the influence of a feature on the DNN decision of patient x. Thus, by comparing the values of the coefficients, it is possible to understand how the model makes decisions and the main features that affect patients. Further, if it is a positive influence, it means that the feature contributed to a positive decision; if it is a negative influence, it means that the feature contributed to a negative decision.

4. Experiments and Results

4.1 Experiment Setup

The experiment divided college football player's with seasonal affective disorder into four groups with different risk types, where the probability ratio SSLR (Stratum Specific Likelihood Ratio) represents the degree to which football player's prone to seasonal affective disorder are identified versus normal students. Table 1 shows the results of the comparison of different risk categories under different assessment models. In particular, the low-risk group had the highest number of football player's with the lowest probability of being at risk in the following year, 119 out of a total group of 109,793, with the lowest SSLR. The SSLR increased significantly in the high-risk group and peaked in the very high-risk group. A larger SSLR indicates a higher likelihood of having seasonal affective disorder in these two groups compared to the baseline model. In addition, the data on PPV and relative risk in the table also indicate this risk stratification.

The prediction model in the paper outputs the optimal light configuration by DNN based on light public environment data. Also, most college football player's with severe seasonal affective disorder had characteristics of having a diagnosed mental health condition problem, or having been treated with psychotropic medication, as well

as having physically suffered an injury. A total of 117 characteristics ended up being significant in the prediction model including 1 demographic characteristic, 1 clinical utilization indicator, 73 diagnostic codes, 24 procedure codes, 7 medication prescriptions, and 11 light public environment characteristics.

Table 1

Comparison of various assessment models for different risk categories

Grade	SSLR	PPV	Relative Risk
Low	0.630	0.37%	0.95
Medium	1.218	0.92%	2.43
High	9.5	1.61%	9.35
Very High	65.6	10.14%	59.02

The equipment used for the experiments was a server with Ubuntu 18.04 operating system, TITAN RTX graphics card with 24G video memory, Intel Xeon(R) Silver4210 CPU and 376GB of RAM. The deep learning framework used in this paper is the public PyTorch, and the chosen optimizer is Adam, which can adjust the learning rate as needed. The learning rate is set to 0.0002 at the beginning, the batch size is set to 4, the image size is 384×384×3, and the Epoch is set to 50, 80, and 100 for training respectively. It is found that when Epoch=80, the enhanced image is closest to the real image.

4.2 Experimental Results

The effectiveness of mental illness risk prediction has been affected by low prevalence. This is because a risk stratification model will not have a relatively high PPV value even if it can isolate high-risk people by identifying salient features. Therefore, in addition to PPV and AUC, SSLR analysis was formally introduced to assess the model. SSLR is an incidence-independent method that describes the change from prior probability to post-test probability in each risk category. Although the PPV in the high and very high-risk categories were 1.61% and 10.14%, the SSLR values for these two categories were 9.5 and 65.6. This implies that the post-test probabilities for the high and very high-risk categories were more than 9 and 65 times higher, respectively, compared to the pre-test. the SSLR method quantitatively measures the degree of high risk in a population and suggests that attention should be paid to the morbidity of that population. As shown in Figure 4, the study model in the paper is comparable to the EHR-only based prediction model for mental illness in terms of AUC and sensitivity. However, because of the lower actual prevalence of mental illness in the population, the model in this article has a lower PPV and a higher relative risk. Similarly, the model in the paper has a lower PPV but higher relative risk compared to other machine learning algorithms developed and tested using the case-rich Cohorts.

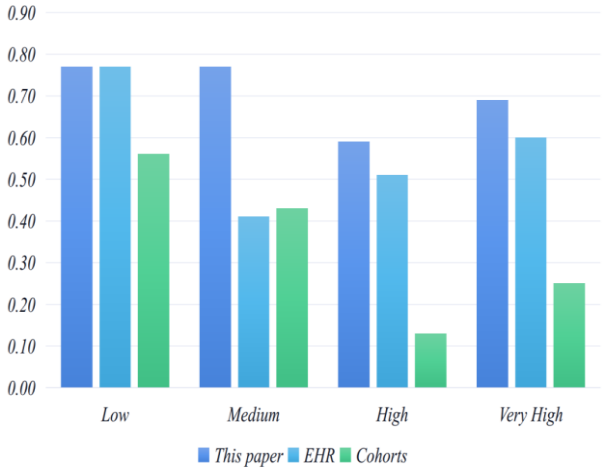

Figure 4 Comparison of evaluation models under different algorithmic models

Deep learning algorithms are suitable for discovering, learning, and identifying hidden explanatory factors of variation behind complex data while maintaining the utility of generalization. Deep learning can be used as a large-scale population screening tool. The EWS tracking developed in this study uses information from football player's most recent year of mental health data, combined with available regional data related to socioeconomic determinants, to predict the probability of developing mental illness over the next 12 months. Potential advantages of this approach include reduced manual case reviews and surveys and precise risk stratification based on absolute risk expressed as probabilities. School health care providers and counselors are reminded of the need to work with mental health professionals to develop better integrated care plans to enhance the effectiveness of risk mitigation interventions.

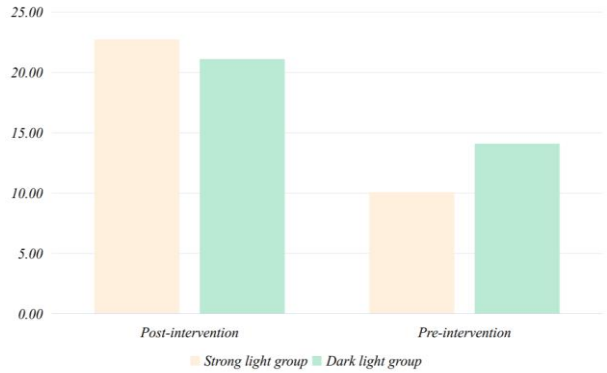

Figure 5 Comparison of HAMD scale scores between the strong light and dark light groups

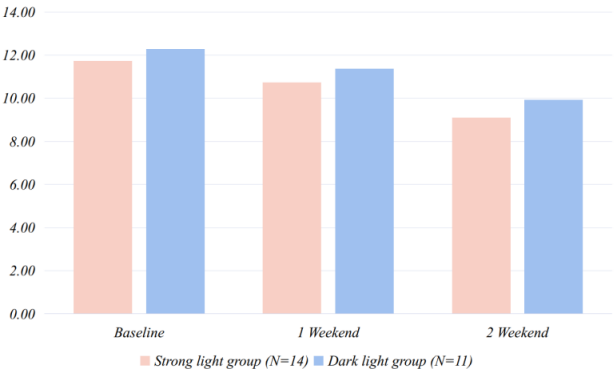

Figure 6 Comparison of PSQI scores between the two groups before and after treatment

The HAMD was developed by Hamilton in 1960, and this scale is the most widely used scale for clinical assessment of depressive states. There are three versions of this scale, and the version used in this study was the HAMD-17 item. There was a statistically significant decrease in HAMD scale scores after 2 weeks of treatment in both the bright light and dark light groups, and there was no statistical difference between the two groups after treatment (See Figure 5). The intra-group differences in PSQI scale scores were statistically significant ($P < 0.05$) between the intense light and dark light groups, and the inter-group and interaction differences were not statistically significant (See Figure 6). Intra-group comparisons between the strong light and dark light groups performed at week 1 and week 2 revealed no statistically significant differences in sleep latency, bedtime, total sleep between, sleep efficiency, and time to awaken after sleep between the two groups at week 1 and week 2 ($P > 0.05$). A between-group comparison between the strong-light and dark-light groups revealed no statistical differences in sleep latency, time spent in bed, between total sleep, sleep efficiency, and time awakened after sleep in weeks 1 and 2 (See Figure 7, Figure 8 and Figure 9).

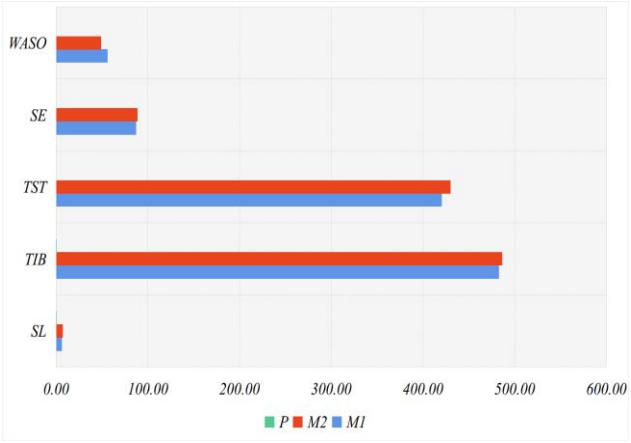

Figure 7 Comparison of sleep parameters between the two groups of patients in week 1 and week 2 of treatment

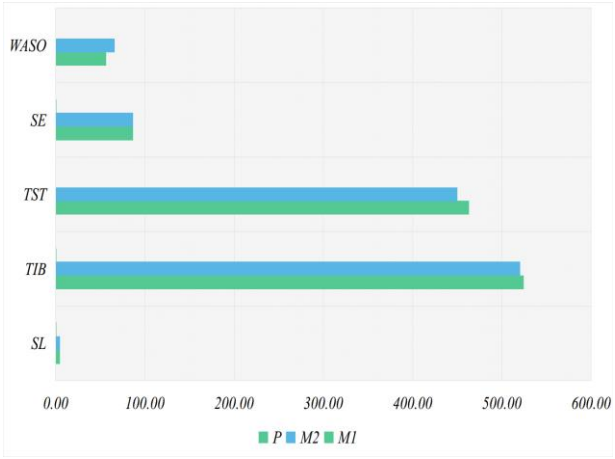

Figure 8 Comparison of sleep parameters in the dark light group between the two groups of patients at week 1 and week 2 of treatment

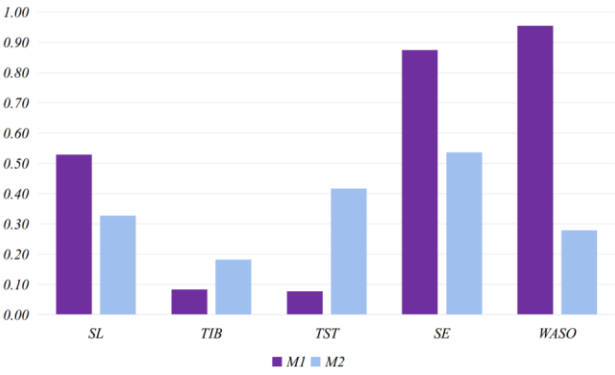

Figure 9 Comparison of sleep parameters between the two groups of patients in week 1 and week 2 of treatment

In this study, light therapy was administered to hospitalized

college football player's with seasonal affective disorder, and the HAMD scale scores of the two groups were assessed before and after treatment to compare the therapeutic effects of intense light therapy on college football player's with seasonal affective disorder. Two methods of assessing sleep, subjective (PSQI scale) and objective (somatic motion recorder), were used to study the effects of intense light therapy on the sleep of college football player's with seasonal affective disorder. The results showed that depressive symptoms improved in both the intense light and dark light groups at the end of the light treatment, but the degree of improvement was not statistically different between the two groups. PSQI scale scores decreased in both groups after treatment, but there was no significant difference compared between the two groups; changes in sleep latency, total bedtime, total sleep time, sleep efficiency, and post-sleep awakening time objective sleep parameters were not statistically different between the two groups during the light treatment.

There was no statistical correlation between the degree of improvement of depressive symptoms and the degree of sleep improvement. It was found that light treatment could effectively improve depressive symptoms in college football player's with seasonal affective disorder, and the degree of improvement in the strong light group was significantly greater than that in the dark light group. There are two possible reasons: first, the sample size of this study was small, which may have had an impact on the results; second, the timing, intensity, and duration of the intense light treatment conducted were inconsistent, and some studies have shown that different light parameters (including light intensity, light duration, and light duration) may all lead to differences in treatment effects.

5. Conclusion

At present, indoor lighting in China is still mostly at the level of meeting the basic visual function needs, although some studies consider the photo biological effects, but mostly from the impact on learning efficiency, lack of health lighting research photo biological effects, especially the lack of seasonal daylight research on the physiological and psychological needs of college football player's on indoor lighting. Practice has shown that it is very difficult to completely cure depressive disorders that have been clinically diagnosed.

Currently, light therapy for seasonal depression (SAD) is effective, and due to the vast geographical area of China and the large differences in light climate, it is important to consider light climate characteristics in different regions to determine lighting design criteria, which also requires further in-depth research. Seasonal Affective Disorder has a high incidence, and due to its recurrent nature, it seriously affects people's daily work and life.

As a non-invasive physical therapy with the advantages of effectiveness, convenience, safety, and mild side effects, light therapy has become the main means of treatment for seasonal affective disorder after nearly 30 years of research and development, indicating that appropriate light has positive therapeutic significance and broad therapeutic prospects.

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