P5-1

The prediction of temporomandibular disorders with deep learning

Wei Zou[1,2] | Bomin Mao[3] | Zubair Md. Fadlullah[4] | Kun Qi[1,2]*

1.Key Laboratory of Shaanxi Province for Craniofacial Precision Medicine Research, College of Stomatology, Xi' an Jiaotong University, Xi' an, Shaanxi, P.R.China

2.Department of Orthodontics, Stomatological Hospital of Xi' an Jiaotong University, Xi' an, Shaanxi, P.R.China

3.School of Cybersecurity, Northwestern Polytechnical University, Xi 'an, Shaanxi, P.R.China

4.Lakehead University-Thunder Bay Regional Health Research Institute (TBRHRI), Thunder Bay P7B 5E1, Canada

Background: Temporomandibular disorders (TMD) are one of the most common causes for orofacial pain and also have the potential to generate chronic pain. The etiology of TMD is still unclear, and its symptoms, signs and progression are extremely complex. TMD require early diagnosis and treatments, especially for combinations with other oral diseases. This study aims to develop an artificial neural network (ANN) model for predicting TMD based on clinical-collected data including clinical features, systematic medical condition, and psychosocial state.

Method: The popular data mining-based ANN was utilized to predict TMD with all 18 variables collected from patients as the input. The total dataset consists of 88 cases which are reviewed by Board-certificated orthodontists. 75% (66) cases are randomly selected as the training dataset, while the remaining 25% (22) cases are for test.

Results: Among the considered 88 cases, 58 (65.9%) were with TMD, while the left 30 (34.1%) without TMD. The number of male and female are 21 and 67, respectively, with an average age of 27.63 years. The calculation results illustrated the average sensitivity and specificity of the ANN-based TMD risk prediction through 10-fold-cross-validation analysis were 92.31% (95% confidence interval (CI), 62.09%-99.60%) and 88.89% (95% CI, 50.67%-99.42%), respectively. Moreover, the accuracy of ANN was 90.91% (95% CI, 78.90%-100.00%).

Conclusions: The results show the proposed ANN model could predict the TMD risks with a high accuracy rate, which indicate the potential of machine learning in oral and maxillofacial diseases screening and diagnosis. This study could provide dental care providers with a simple tool to find individuals' risk of TMD based on patient' s psychological factors, oral examinations, and systemic medical conditions.

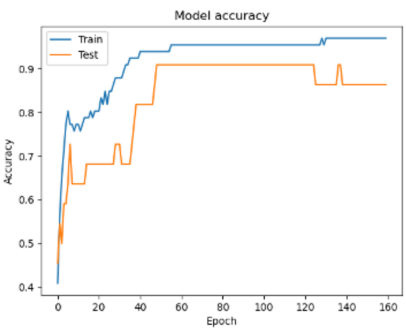

Figure.1 prediction accuracy

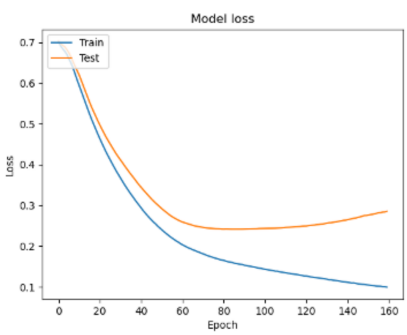

Figure.2 Training loss function

Total samples (88)	TMD	58
	Without TMD	30
	Male	21
	Female	67
	Average age	27.63
Training samples (66)	TMD	45
	Without TMD	21
	Male	15
	Female	51
	Average age	28.80
Testing samples (22)	TMD	13
	Without TMD	9
	Male	6
	Female	16
	Average age	24.14

Table.1 Summary of training and test sample

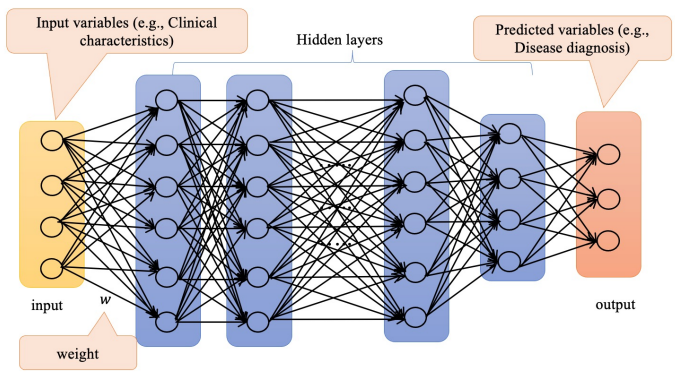

Figure.3 A Deep Learning Model (ANN) for Disease Diagnosis

Statistic	Value	95% CI
Sensitivity	92.31%	62.09%-99.60%
Specificity	88.89%	50.67%-99.42%
Positive likelihood Ratio	8.31	1.30-53.07
Negative likelihood Ratio	0.09	0.01-0.58
Positive Predictive Value	92.30%	62.09%-99.60%
Negative Predictive Value	88.89%	50.67%-99.42%
Accuracy	90.91%	78.90%-100.00%

Table.2 Prediction result of data set