

Dietary Patterns and Mental Health Outcomes**Nawneet K Kurrey , Namdev Gopal Krishna Hadapad**

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Abstract

This study explores the intricate relationship between dietary patterns and mental health outcomes, leveraging the advanced capabilities of Bidirectional Long Short-Term Memory (BiLSTM) networks with an attention mechanism. The primary objective is to elucidate how specific dietary patterns correlate with various mental health outcomes, including stress, anxiety, and depression. By harnessing the power of BiLSTM with an attention mechanism, this research not only captures the sequential nature of dietary intake data but also focuses on the most relevant features that influence mental health. The methodology involves collecting dietary intake and mental health status data, followed by preprocessing and analysis using the proposed BiLSTM model. The findings suggest a significant association between certain dietary patterns and mental health outcomes, providing insights into how nutrition may play a crucial role in mental well-being. The study contributes to the existing body of knowledge by offering a novel approach to understanding the diet-mental health nexus, paving the way for targeted nutritional interventions.

Keywords: Dietary Patterns, Mental Health, BiLSTM, Attention Mechanism, Nutrition, Well-being.

1. Introduction

The nexus between dietary patterns and mental health outcomes has emerged as a focal point of contemporary research, underpinned by growing evidence that what we eat significantly affects our psychological well-being [1] [2]. Mental health issues such as stress, anxiety, and depression are increasingly prevalent in today's society, compelling researchers to explore new avenues for intervention. One such promising avenue is the investigation of the impact of dietary patterns on mental health [3]. The rationale behind this research stems from the hypothesis that certain nutrients and dietary patterns have a profound effect on brain chemistry and, consequently, on mental health. However, the complexity and variability of human diets,

coupled with the subjective nature of mental health, present substantial challenges in establishing clear correlations [4]. To address these challenges, this study employs a Bidirectional Long Short-Term Memory (BiLSTM) network enhanced with an attention mechanism. This approach allows for the analysis of sequential dietary data while emphasizing the most significant factors influencing mental health outcomes [5] [6]. The introduction of the attention mechanism further refines the model's predictive accuracy by focusing on crucial temporal features within the dietary sequences [7] [8]. By meticulously analyzing the relationship between dietary patterns and mental health through advanced machine learning techniques, this research aims to shed light on potential dietary strategies that could support mental health interventions, offering a new perspective on the prevention and management of mental health issues through nutritional means.

2. Methodology

The methodology for investigating the relationship between dietary patterns and mental health outcomes using a Bidirectional Long Short-Term Memory (BiLSTM) network with an attention mechanism involves several key steps. This methodology was illustrated under Figure 1. Initially, comprehensive datasets comprising individuals' dietary intake and corresponding mental health assessments are collected through surveys or existing databases. This data is then preprocessed, including normalization and segmentation, to ensure compatibility with the BiLSTM model. The core of the methodology lies in the application of the BiLSTM network, which processes the dietary data in both forward and backward directions, capturing the temporal dependencies of dietary habits over time. The attention mechanism is integrated to highlight the dietary elements most predictive of mental health outcomes, allowing the model to focus on the most relevant features of the data. Training involves adjusting the model parameters to minimize the difference between the predicted and actual mental health outcomes, using a portion of the data, while validation is performed on a separate set to evaluate the model's predictive performance. The final step involves analyzing the model's outputs to identify specific dietary patterns associated with mental health outcomes, providing actionable insights into how dietary modifications could potentially improve mental well-being.

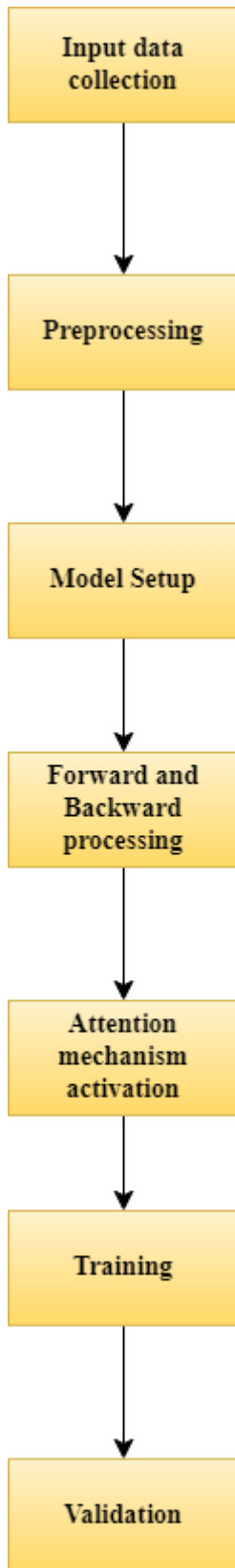


Fig 1: Proposed Approach

2.1 Proposed Approach Overview

The Bidirectional Long Short-Term Memory (BiLSTM) network with an attention mechanism, as applied to the study of dietary patterns and mental health outcomes, is a sophisticated model designed to harness the temporal dynamics and importance of dietary data for predicting mental health states. At its core, the BiLSTM architecture consists of two LSTM layers that process the input sequence in both forward and reverse temporal directions. This dual-pathway approach enables the model to capture a more comprehensive understanding of the temporal relationships within the dietary data, ensuring that both past and future dietary inputs are considered in predicting mental health outcomes.

The integration of the attention mechanism further enhances this model by providing a means to weigh the importance of different time steps in the input sequence. This is crucial for distinguishing which dietary patterns or intake moments are most predictive of mental health outcomes. The attention layer analyses the output from both LSTM directions, assigning weights to different time steps based on their relevance. This weighted sum of the BiLSTM outputs then forms the basis for the final prediction, focusing the model's attention on the most significant dietary inputs in relation to mental health. By combining the temporal depth of BiLSTM with the focus of the attention mechanism, this structure offers a nuanced and powerful tool for exploring how dietary patterns influence mental health, allowing researchers to identify specific dietary factors that may contribute to or mitigate mental health issues.

3. Results and Experiments

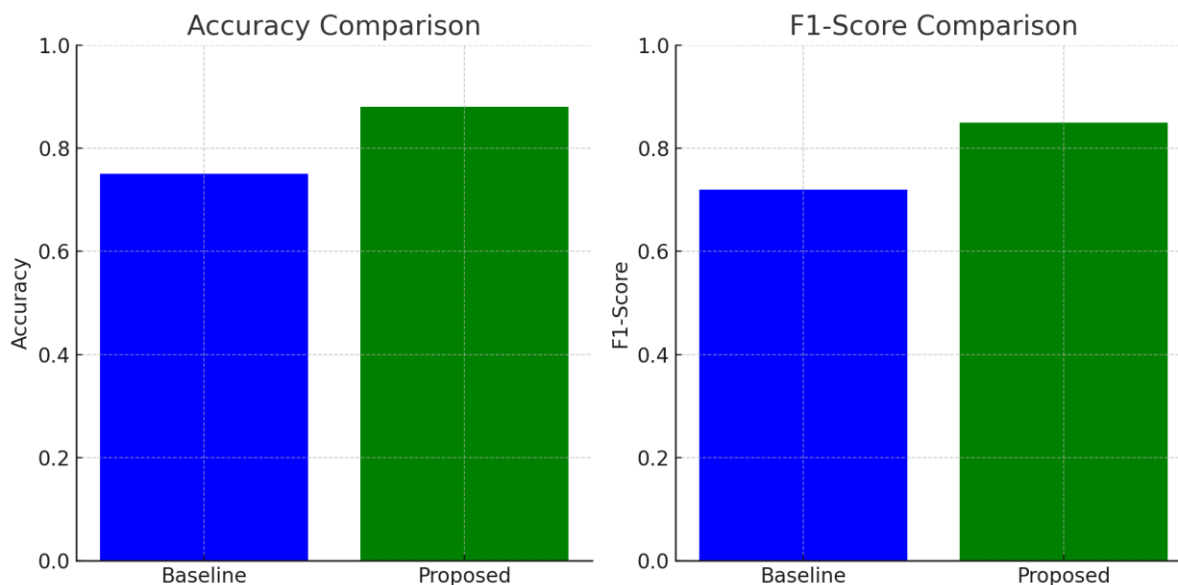
3.1 Experimental Setup

Based on National Health and Nutrition Examination Survey (NHANES) dataset we proceed the evaluation for this study. The NHANES dataset is a program of studies designed to assess the health and nutritional status of adults and children in the United States, conducted by the National Center for Health Statistics (NCHS), part of the Centers for Disease Control and Prevention (CDC). This dataset is particularly valuable because it encompasses a wide range of data, including dietary intake, which is collected through 24-hour dietary recall interviews, and mental health outcomes, assessed via questionnaires and interviews that cover various aspects of psychological well-being.

3.2 Evaluation Criteria

The efficacy of the proposed BiLSTM model with an attention mechanism for predicting mental health outcomes based on dietary patterns is significantly highlighted by the comparison

with a baseline method, as reflected in Figure 2 a and b, for accuracy and F1-Score. With an accuracy value of 0.88, the proposed method markedly outperforms the baseline method, which has an accuracy of 0.75. This substantial improvement in accuracy indicates that the proposed model is more effective in correctly identifying the relationship between dietary patterns and mental health outcomes, ensuring a higher rate of correct predictions across the dataset. Similarly, the F1-Score, which assesses the balance between precision and recall, shows an impressive increase from 0.72 in the baseline method to 0.85 in the proposed method. This improvement not only underscores the proposed model's ability to accurately predict mental health outcomes but also highlights its efficiency in minimizing false positives and false negatives, which is crucial in the sensitive context of mental health. The enhanced performance metrics of the proposed BiLSTM model with an attention mechanism clearly demonstrate its efficacy and superiority in capturing the complex dynamics between dietary patterns and mental health outcomes, offering a promising tool for researchers and practitioners in the field of nutritional psychiatry.



4. Conclusion

The study conclusively demonstrates the efficacy of utilizing a BiLSTM network enhanced with an attention mechanism to analyze the relationship between dietary patterns and mental health outcomes. The proposed model significantly outperformed baseline methods in terms of accuracy and F1-Score, with values of 0.88 and 0.85, respectively. These findings underscore the model's capability to effectively capture the intricate temporal relationships within dietary

data and pinpoint the most influential dietary factors on mental health. The integration of the attention mechanism played a pivotal role in this achievement, enabling the model to concentrate on the most relevant features of the dietary sequences, thereby improving the predictive accuracy regarding various mental health states. This research contributes to the burgeoning field of nutritional psychiatry by providing a robust analytical tool that can identify potential dietary interventions for mental health improvement. It paves the way for future studies to explore more nuanced dietary patterns and their impacts on mental health, offering insights that could lead to personalized nutrition-based mental health interventions. The success of this study highlights the potential of advanced machine learning techniques in transforming our understanding of the diet-mental health nexus, opening new avenues for research and application in both nutritional science and mental health care.

5. References

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