AI-Supported Treatment of Eating Disorders

Partners:

GGZ https://www.ggzoostbrabant.nl/

TU/e https://www.tue.nl/en/

Introduction

Eating disorders (ED) include Anorexia Nervosa (AN), Bulimia Nervosa (BN) and Binge Eating Disorder (BED). They are associated with great functional impairment, morbidity, and even have the highest mortality rate of any psychiatric disorder. ED are difficult to treat; only approximately 50% recovers after treatment and even after successful treatment relapse is high. This project investigates effective solutions to this problem using Artificial Intelligence (AI) techniques to support early detection, diagnoses and treatment of ED. A successful application of AI-based solution to treat ED will create a significant societal and economic impact, improve healthcare outcomes and save substantial costs associated with ED.

This overall project is divided in three main tasks and subtasks:

1) ***AI-based solution to estimate the individual risk of being affected with an ED (diagnostic)***
   a. *Screening in the general population*
   b. *Screening for ED in secondary / tertiary care settings for common disorders*
2) ***Predict disease course, patient outcomes, and response to treatment (prognostics)***
   a. ***Predictions tailored to individual patient responses to a treatment***
   b. ***Develop early warning scores for critically ill patients***
3) ***Combining research into ED and obesity with research into COVID-19***

The master student project will focus on one of these three subtasks.

Milestones, goals for the master projects

The student will develop a predictive model using data and support provided by the partner GGZ. The main goals/milestones of this project can be summarized as follows:

✓   State-of-the-art literature review of machine learning algorithms for risk assessment, diagnostics and prognosis of Eating disorders. (1-2 months).
✓   Determine the most important features needed for accurate predictions (1-2 month).
✓   Develop algorithm(s) to address one or more of the diagnostic/prognostic phases mentioned above. Experts from GGZ will help to improve the setup and accuracy of the algorithm and provide data. (2-4 months).

Detailed description of the three phases

1. **Estimate the individual risk of being affected with an ED (diagnostic)**
1a. **Screening in the general population**: Prevention focused at school adolescents (12+) – screening for risk factors and subthreshold ED and ED diagnosis. We expect that the prevalence rate is underestimated,

based on the fact that the majority of individuals experience the disease as ego syntonic or they have feelings of shame and do not want to be seen as ill, so the majority of adolescent who have AN, BN and BED do not enter the mental healthcare system. Some examples of AI supported screening for obesity or AN are presented in [1,2].

1b. Early detection: Screening for ED **in secondary / tertiary care settings for common disorders** (e.g., depression, autism, ADHD, anxiety disorders) can be challenging, as patients often have complex symptom profiles and false negatives are common (see for example [3]). In this project, we would like to develop a data driven AI approach to automate the process of ED screening in this care setting using also natural language processing of therapeutic reports.

2. **Predict disease course, patient outcomes, and response to treatment (prognostics)**

2a In **ED centers** there is considerable unexplained heterogeneity in the course and treatment response of ED patients. Therefore, in this project we will use various types of patient data collected by ED treatment centers to train AI models which can predict the ED's course and individual patient responses to treatment. We will do this by investigating network relations among core ED symptoms, anthropomorphic and laboratory findings, comorbid clinical symptoms and empirically supported transdiagnostic vulnerability and protective characteristics. Additionally, AI could help in generating new hypotheses, as we still lack comprehensive understanding of the etiology of ED. Some early research, as in [4], shows that early monitoring of the progression of treatment and its augmentation will be beneficial. Still more complex machine learning models applied on a wider spectrum of data variables are needed.

2b In ED centers with **inpatient treatment for very sick patients**: Given the high mortality rates of ED, it is of an utmost importance to develop early warning scores to determine critical illness for inpatients with anorexia nervosa. Some early results have been reported in [5]. In this project we want to extend this research by applying and validating developed models on data from Dutch ED centers and by further improving the early warning scores by developing new machine learning models which include additional data which characterize patient recovery or deterioration

3. **Combining research into ED and obesity with research into COVID-19**

Combining research into ED and obesity with research into COVID-19 by using machine learning may provide a unique opportunity to shed light on the susceptibility to COVID-19 and the immunogenicity of COVID-19 vaccines. Centralizing and integrating (worldwide) viral data will be beneficial to develop predictive diagnostic strategies and inform new hypotheses.

References

[1] Iceta, S., Tardieu, S., Nazare, J. A., Dougkas, A., Robert, M., & Disse, E. (2021). An artificial intelligence-derived tool proposal to ease disordered eating screening in people with obesity. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 1-5.

[2] Paul, S., Jandhyala, S. K., & Basu, T. (2018, August). Early Detection of Signs of Anorexia and Depression Over Social Media using Effective Machine Learning Frameworks. In *CLEF (Working notes)*.

[3] Liu, Y., Hankey, J., Cao, B., & Chokka, P. (2021). Screening for major depressive in a tertiary mental health centre using EarlyDetect: A machine learning-based pilot study. *Journal of affective disorders reports*, *3*, 100062.

[4] Treasure, J., Oyeleye, O., Bonin, E. M., Zipfel, S., & Fernandez-Aranda, F. (2021). Optimising care pathways for adult anorexia nervosa. What is the evidence to guide the provision of high-quality, cost-effective services?. *European Eating Disorders Review*.)

[5] Ioannidis, K., Serfontein, J., Deakin, J., Bruneau, M., Ciobanca, A., Holt, L., ... & Stochl, J. (2020). Early warning systems in inpatient anorexia nervosa: A validation of the MARSIPAN-based modified early warning system. *European Eating Disorders Review*, *28*(5), 551-558.)