

# Which mental health risk factors are the most important for predicting and preventing Alzheimer's Disease ?

Using a Neural Network designed to be effective on small datasets and interpretable to predict Alzheimer's Disease (AD) and it's most prevalent mental risk factors

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## BACKGROUND

- Psychological factors and mental health disorders have been suggested to influence the risk of developing Alzheimer's disease (AD) [1].
- Given the significance it is vital to uncover the influential mental risk factors associated with the disease.
- This research holds the promise of uncovering key insights into the most important mental risk factors, alongside comparison to metabolic and lifestyle risk factors, which can inform targeted interventions and preventive strategies

## DATA

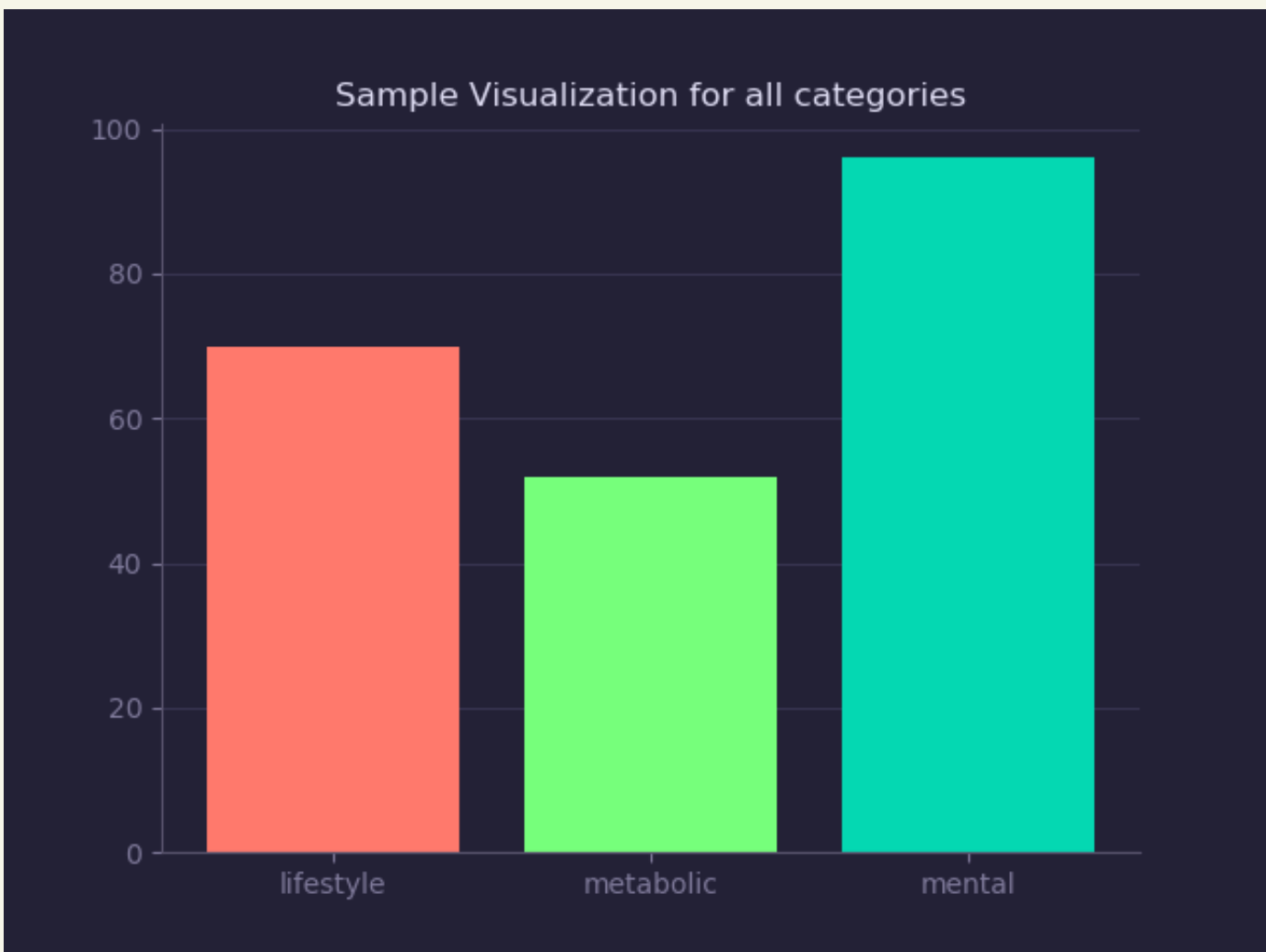
- We used the UK BioBank dataset, a large long-term biomedical database that were collected in the United Kingdom (UK). The UK BioBank follows about 500,000 volunteers in the UK. Participants filled out an automated questionnaire about their lifestyle and medical history.
- We utilized data from the UK-Biobank, consisting of 1049 patients diagnosed with AD and 1049 non-diagnosed patients for sex and age class balancing.
- We focused on individuals who were diagnosed with AD approximately 8-12 years from the recruitment to the study. In Addition, the age data of were excluded to prevent bias.

## METHODS

### LSPIN MODEL

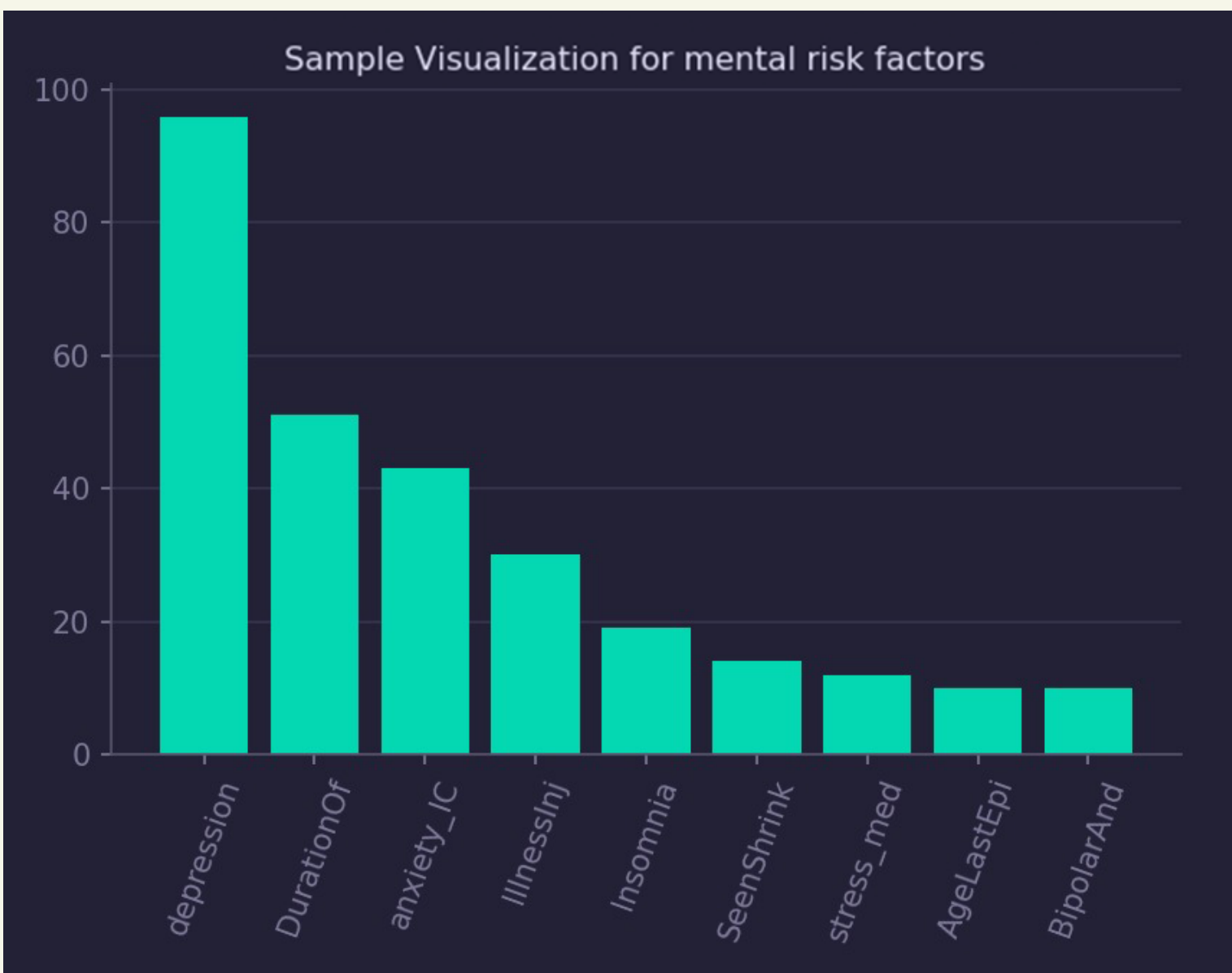
- We chose to use a Locally SParse Interpretable Neural Network (LSPIN) to examine the associations of the selected risk factors with AD.
- This model suits low sample size datasets of Tabular Biomedical data[2].
- The model is comprised of two Neural networks (NN). A gate-NN which chooses the relevant features per sample, and a prediction-NN which makes the decision based on the gated vector.
- The Interpretability of the model is represented by using the gate vectors to infer which features were relevant for the prediction process and therefore the deciding risk factors.

## RESULTS



The presented figure provides an overview of the distribution of chosen risk factors across different categories

- As depicted in the figure, mental health factors were the most selected feature category with life style features closely behind.
- These findings shed light on the relative prominence of each risk factor category and underscore the importance of considering multiple domains in understanding the etiology of the studied condition.



The figure presents the distribution of chosen risk factors specifically related to mental risk factors

- the results indicate that among the mental risk factors, depression was the most frequently chosen factor, accounting for an overwhelming 96% of the selections, and the most chosen feature overall.
- These findings highlight the substantial emphasis placed on depression as a significant contributor to the studied condition, while also underscoring the comparatively lower attention given to age at last depressive episode.

## CONCLUSION

- We were able to reach a 75% accuracy rating on the test data, and so we believe our interpreted risk factors can truly be used as predictive and preventative features.
- The clear advantage of addressing simple risk-factors for AD on pharmacological treatment has been recently quantified in >3500 people[3]. and so using this model allows identification of the most important risk factors for AD in the individual patient and specific combination may significantly improve outcome.
- The results could inform individuals about the most important risk factors for AD development according to their own demographic, clinical and genetic data and provide them with suggestions for early interventions that could delay or prevent the onset of the disease.
- Further analysis of the data could uncover groups of features that were chosen together by the model and might give a glimpse into some underlying connection between them, as well as what the subjects in these various groups have in common.

[1] Sáiz-Vázquez O, Gracia-García P, Ubillos-Landa S, Puente-Martínez A, Casado-Yusta S, Olaya B, Santabárbara J. Depression as a Risk Factor for Alzheimer's Disease: A Systematic Review of Longitudinal Meta-Analyses. J Clin Med. 2021 Apr 21

[2] J. Yang, O. Lindenbaum, Y. Kluger. Locally Sparse Neural Networks for Tabular Biomedical Data.

[3] . Roberts, R. O., Cha, R. H., Mielke, M. M., Geda, Y. E., Boeve, B. F., Machulda, M. M., Knopman, D. S., & Petersen, R. C. (2015). Risk and protective factors for cognitive impairment in persons aged 85 years and older. Neurology7