

Blood-Based Biomarkers in Psychiatric Disorders: Assessing Their Potential For Clinical Use

Bria Williams¹, Celeste Hicks², Tarun Goswami³

Wright State University; Department of Biomedical, Industrial and Human Factors Engineering



Background

Major depressive disorder (MDD) and post traumatic stress disorder (PTSD) are both complex mental health disorders with pathophysiologic processes still being explored. Unlike some medical conditions where laboratory tests or imaging results can provide clear evidence of disease, PTSD and MDD are only diagnosed clinically, using a detailed history of illness and criteria outlined in the DSM-5. Currently, there are no biomarkers used in the assessment of progression or the diagnostic process of these disorders. However, studies have identified certain biomarkers that have been associated with each condition and suggest that they may be dysregulated in individuals with these disorders.

Objectives

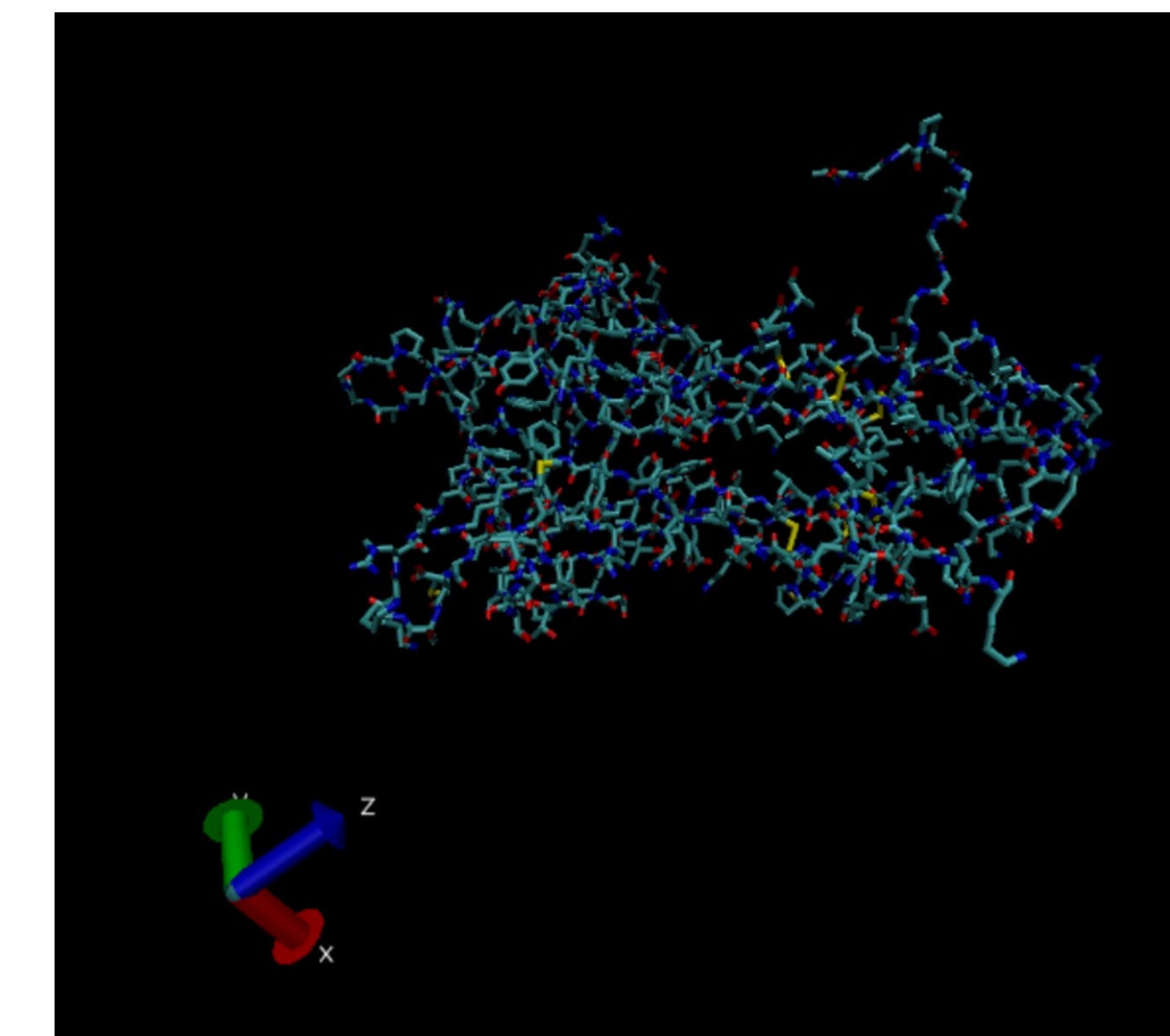
The purpose of this study is to highlight the biomarkers identified from literature and assess their thermodynamic stability to find the most promising biomarkers for potential clinical use.

Methodology

Biomarkers found to have an association with PTSD and MDD were identified from literature and modeled and simulated using the molecular dynamics software VMD and NAMD. The behavior of each protein was simulated in a water box at 310 K for 10 picoseconds. Bond, electrostatic, kinetic, total and potential energies of each protein was collected. MATLAB was then used to determine the approximate time to reach equilibrium for each energy as well as the average value of each.

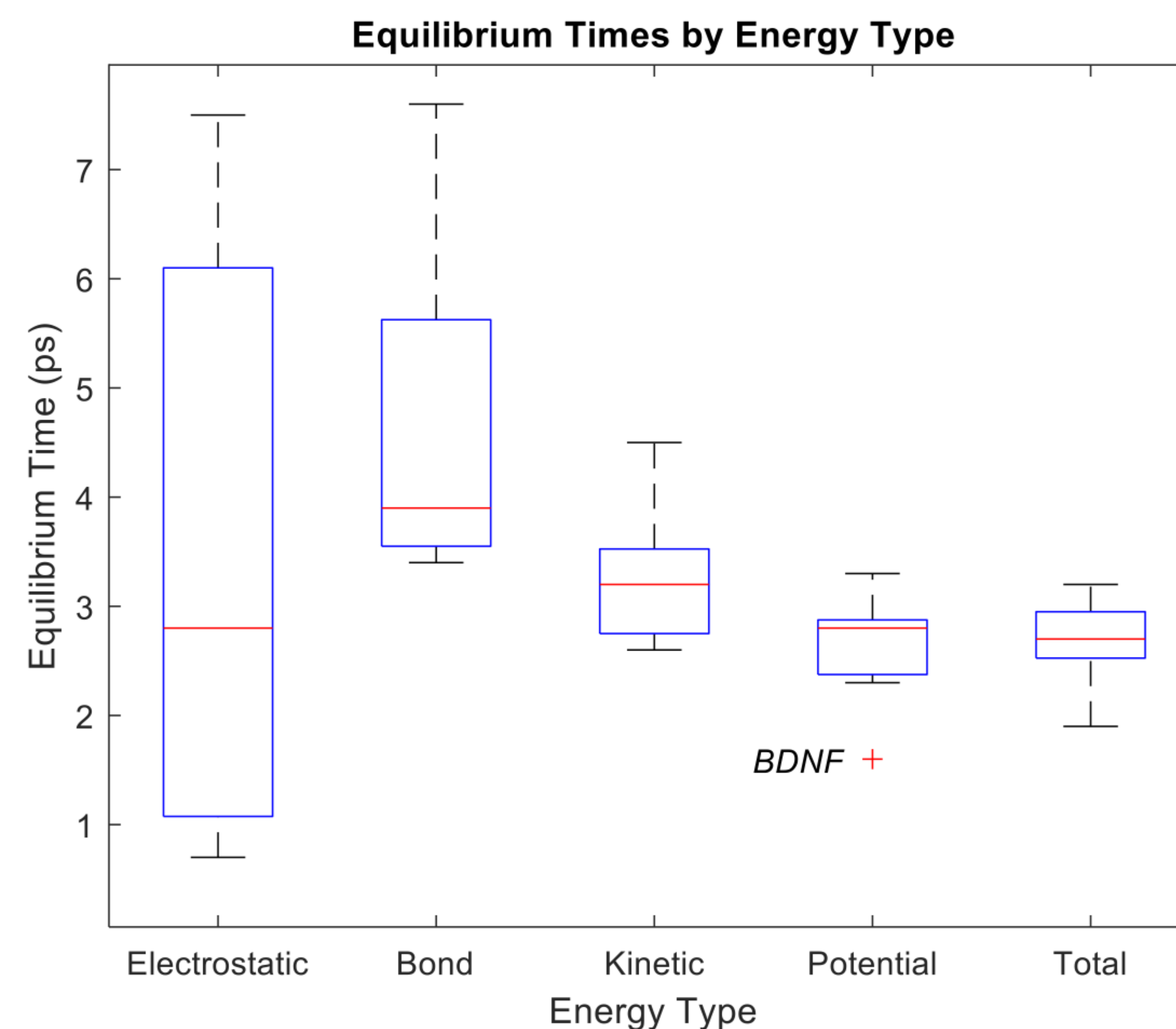
Results

Biomarker	Associated condition
BDNF	MDD, PTSD
NFL	MDD, PTSD
Cystatin-C	MDD
CRP	MDD, PTSD
NPY	MDD, PTSD
GFAP	MDD, PTSD
VEGF	MDD



Molecular Model of BDNF Created in VMD

		Electrostatic	Bond	Kinetic	Potential	Total
BDNF	Time (ps)	7.5	3.5	2.6	1.6	1.9
	Avg. Value (kcal/mol)	-108873.431	11502.1549	24346.1375	-77496.1935	-53193.9106



Discussion/Conclusions

- All biomarkers reached approximate equilibrium within the given timespan of 10 picoseconds
- BDNF was the only biomarker to reach equilibrium much faster for any one of the energy types, suggesting that it may be more thermodynamically stable than the other simulated proteins
- These findings support the potential of BDNF to serve as a measurable tool, as stability in aqueous conditions constitutes a critical characteristic among biomarkers

Future Directions

Additional properties should be investigated to further support the utility of BDNF and the other proteins as blood biomarkers

References

- Dell'Osso L; Carmassi C; Del Debbio A; Catena Dell'Osso M; Bianchi C; da Pozzo E; Origlia N; Domenici L; Massimetti G; Marazziti D; Piccini A; (n.d.). *Brain-derived neurotrophic factor plasma levels in patients suffering from post-traumatic stress disorder*. Progress in neuro-psychopharmacology & biological psychiatry. <https://pubmed.ncbi.nlm.nih.gov/19409951/>
- NS; C. B. R. (n.d.). *Brain-derived neurotrophic factor (BDNF) and inflammatory markers: Perspectives for the management of Depression*. Progress in neuro-psychopharmacology & biological psychiatry. <https://pubmed.ncbi.nlm.nih.gov/33096156/>
- Studer, G., Rempfer, C., Waterhouse, A. M., Gumienny, R., Haas, J., & Schwede, T. (2020, March 1). *QMEANDISCO-distance constraints applied on model quality estimation*. Bioinformatics (Oxford, England). <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7075525/>