ScienceDirect

American Journal of Preventive Medicine

Volume 65, Issue 5, November 2023, Pages 827-834

Research Article

Social Drivers of Mental Health: A U.S. Study Using Machine Learning

Shichao Du PhD [1], Jie Yao MSc [2], Gordon C. Shen PhD [3], Betty Lin PhD [4], Tomoko Udo PhD [2 5], Julia Hastings PhD [5], Fei Wang PhD [6 7], Fusheng Wang PhD [8 9], Zhe Zhang PhD [10], Xinyue Ye PhD [11], Kai Zhang PhD [12]

Show more

https://doi.org/10.1016/j.amepre.2023.05.022

Get rights and content

Introduction

Social drivers of mental health can be compared on an aggregated level. This study employed a machine learning approach to identify and rank social drivers of mental health across census tracts in the U.S.

Methods

Data for 38,379 census tracts in the U.S. were collected from multiple sources in 2021. Two measures of mental health problems—self-reported depression and self-assessed poor mental health—among adults and three domains of social drivers (behavioral, environmental, and social) were analyzed on the basis of the unit of census tracts using the Extreme Gradient Boosting machine learning approach in 2022. The leading social drivers were found in each domain in the main sample and in the subsamples divided on the basis of poverty and racial segregation.

Results

The three domains combined explained more than 90% of the variance of both mental illness indicators. Self-reported depression and self-assessed poor mental health differed in major social drivers. The two outcome indicators had one overlapping correlate from the behavioral domain: smoking. Other than smoking, climate zone and racial composition were the leading correlates

from the environmental and social domains, respectively. Census tract characteristics moderated the impacts of social drivers on mental health problems; the major social drivers differed by census tract poverty and racial segregation.

Conclusions

Population mental health is highly contextualized. Better interventions can be developed on the basis of census tract–level analyses of social drivers that characterize the upstream causes of mental health problems.

Section snippets

INTRODUCTION

Mental illness is common in the U.S.[1,2] In 2020, the prevalence of any mental illness was 21.0%, and the prevalence of serious mental illness was 5.6% among U.S. adults.[3] Unfortunately, the current healthcare system does not have the capacity to meet treatment demand fully, as evidenced by the number of designated mental health professional shortage areas and system fragmentation outside of them.4, 5, 6 A whole-of-society approach, not just healthcare reform, is needed to reduce the national …

Study Sample

Data were collected and analyzed on the analytic unit of census tract. Census tracts are small, relatively permanent statistical subdivisions of a county designed for administrative data collection. The compiled census tract data used in this study were primarily from three sources: 2016–2019 data from the Centers for Disease Control and Prevention's PLACES (formerly 500 Cities), 2015–2019 data from the U.S. Census Bureau's American Community Survey, and 2019 data from the Environmental …

RESULTS

Figure 1 presents the results of the first analysis. The length of each social driver indicated its gain in (or contribution to) predicting the outcomes. The value of the contribution (or the length of the bar) does not have substantial meaning. Rather, the relative magnitude of the contribution indicates its importance in predicting the outcomes. Only social drivers with significant contributions to predicting the outcome were listed on each figure (although the magnitude of some contributions …

DISCUSSION

This study used a state-of-the-art ML approach to rank social drivers of mental health within three domains (i.e., behavioral, environmental, and social) to predict adult mental health prevalences at the census tract level in the U.S. The three domains explained more than 90% of the

variance of either self-reported depression or self-assessed poor mental health. Across domains, smoking was the factor that explained most of both mental health indicators' variance in the sample. Other than …

CONCLUSIONS

Selected social drivers from the behavioral, environmental, and social domains are associated with self-reported depression and self-assessed poor mental health in U.S. census tracts. Collective responses to them are political.[36] President Biden expressly stated in the Unity Agenda that the mental health crisis in America is not a medical one but a societal one. Political advocacy for structural interventions made at the societal level would bridge mental health disparities that are prevalent …

CRediT authorship contribution statement

Shichao Du: Data curation, Methodology, Writing – original draft. **Jie Yao:** Formal analysis, Software. **Gordon C. Shen:** Methodology, Writing – review & editing. **Betty Lin:** Writing – review & editing. **Tomoko Udo:** Writing – review & editing. **Julia Hastings:** Writing – review & editing. **Fei Wang:** Writing – review & editing. **Fusheng Wang:** Writing – review & editing. **Zhe Zhang:** Writing – review & editing. **Xinyue Ye:** Writing – review & editing. **Kai Zhang:** Conceptualization, Methodology, Supervision, …

ACKNOWLEDGMENTS

KZ was partially funded by the National Institute on Aging of the National Institutes of Health under Award Number R01AG081244 and the American Heart Association grant (19TPA34830085).

No financial disclosures were reported by the authors of this paper. …

Special issue articles Recommended articles

REFERENCES (36)

KR Merikangas *et al.*
Lifetime prevalence of mental disorders in U.S. adolescents: results from the National comorbidity Survey Replication–Adolescent Supplement (NCS-A)
J Am Acad Child Adolesc Psychiatry (2010)

S Kino *et al.*
A scoping review on the use of machine learning in research on social determinants of health: trends and research prospects
SSM Popul Health (2021)

L Hu *et al.*
Ranking sociodemographic, health behavior, prevention, and environmental factors in predicting neighborhood cardiovascular health: a Bayesian machine learning approach
Prev Med (2020)

M Wang *et al.*
Human health risk identification of petrochemical sites based on extreme gradient boosting
Ecotoxicol Environ Saf (2022)

CA Makridis *et al.*
Leveraging machine learning to characterize the role of socio-economic determinants on physical health and well-being among veterans
Comput Biol Med (2021)

GY Dinwiddie *et al.*
Residential segregation, geographic proximity and type of services used: evidence for racial/ethnic disparities in mental health
Soc Sci Med (2013)

C Lund *et al.*
Social determinants of mental disorders and the Sustainable Development Goals: a systematic review of reviews
Lancet Psychiatry (2018)

K Rose-Clarke *et al.*
Rethinking research on the social determinants of global mental health
Lancet Psychiatry (2020)

R Mojtabai *et al.*
National trends in mental health care for US adolescents
JAMA Psychiatry (2020)

Substance Abuse and Mental Health Services Administration. Key substance use and mental health indicators in the United...

View more references

Cited by (3)

Developing an individualized treatment rule for Veterans with major depressive disorder using electronic health records ↗
2024, Molecular Psychiatry

Optimizing Mental Health Status Prediction Models Using Machine Learning Algorithms ↗

2024, Proceedings - 2024 3rd International Conference on Data Analytics, Computing and Artificial Intelligence, ICDACAI 2024

Student Management Perspectives on the Moderating Effects of Biological Clock Interventions on Mental Health ↗

2024, Applied Mathematics and Nonlinear Sciences

View full text