

The Influence of Social Determinants of Health on Healthcare Access, Utilization, and Treatments in Atopic Dermatitis Patients Using All of Us and Machine Learning Methods



Abstract
#MSR88



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OVERVIEW & STUDY OBJECTIVE

- Background:** In the United States, atopic dermatitis (AD), affects 7.3% of the adult population, or 19 million adults. Despite its prevalence, due to ranges in severity, treatment is relatively challenging and time consuming with affordability being a concern especially in the most severe population. Recent studies have shown that social determinants of health (SDoH) affect healthcare access and healthcare utilization (HCU).^{1,2}
- The US National Institutes of Health’s *All of Us* (AoU) database:** Focuses on diversity and inclusion in its participants to give more representative data. At the time of analysis, *AoU* contained over 372,000 US patients and four types of records: surveys, electronic health records, whole genome sequencing, and Fitbit data. *AoU* oversamples certain populations, including those 65+ and Black respondents.
- Objectives:** Using the *AoU* database, we used machine learning methods to characterize how SDoH influence AD patient healthcare access and healthcare utilization.

METHODOLOGY

- Patients with and without AD (ICD-9: 691, ICD-10: L20.9) who filled out the All of Us HCAU and SDoH surveys were included in the analysis. (n=1390 with AD, n=93,651 without AD)
- Propensity matching on age, gender, sex at birth, race, and ethnicity was also conducted to address potential differences (n=1390).
- Phase I consisted of descriptive analysis of demographic differences between the two cohorts. There were n=80 SDoH* predictors and n=5 outcome variables, consisting of 1) Annual Doctor Visits, 2) Annual Medical Specialist Visits, 3) Delays in Getting Care, 4) Inability to Afford Care, and 5) Skipping/Delaying Medications Due to Cost. Pearson correlations were conducted between the predictors and latter three outcome variables to inform variables for Phase II. In addition, t-tests and Chi-square tests were conducted between responses to outcome variables between the AD and non-AD groups to determine whether differences between populations were statistically significant.
- In Phase II, balanced random forest classifiers were applied to assess how well SDoH domains could predict HCU responses with a 75/25 training validation split. GridSearch was applied to further optimize parameters. Training and test errors were then evaluated for overfitting.

SDoH* = 80 SDoH questions broken out into 5 domains, including: neighborhood quality and safety, supportive relationships, experience of discrimination, food and housing security, and stress.

RESULTS

Table 1: Population Demographics

Category	Non-AD (n=93,651)	Non-AD (n=1390)	AD (n=1390)
Age	59.5yrs	61.7yrs	61.7yrs
% Female	63.7%	68.4%	68.6%
% Male	35.0%	30.4%	30.1%
% Other	1.3%	1.2%	1.3%
% Hispanic/Latino	2.2%	1.6%	1.7%
% White	85.8%	83.4%	83.3%
% Black	7.8%	11.7%	11.8%
% Asian	3.0%	2.5%	2.3%
% Other	1.2%	0.8%	0.9%

Table 2: AD vs non-AD Significance Testing Results

Outcome	Test Type	p-value
Skipping/Delaying Medications Due to Cost	t-test	0.041
Inability to Afford Care		0.843
Delays in Getting Care		0.006
Doctor Visits	Chi-Square	< 0.01
Specialist Visits		< 0.01

Testing threshold used was $\alpha = 0.05$. Chi-square testing demonstrated that the distribution statistically differed between the AD and control group for both visit types.

Table 3: SDoH Domains with the Largest Impact on Model Performance

SDoH Domain	Skipping/Delaying Medications	Delays in Getting Care
Experience Discrimination	2 nd	3 rd
Food and Housing Security	4 th	4 th
Neighborhood Quality and Safety	3 rd	5 th
Stress	1 st	2 nd
Supportive Relationships	5 th	1 st

When analyzing which SDOH domains contributed the most to the models’ accuracy, stress, experience of discrimination, and neighborhood quality and safety were considered the top three domains in the Skipping/Delaying Medications outcome. Supportive relationships, stress, and experience of discrimination were considered the top three domains in the Delays in Getting Care category.

Figures 1-2: Distribution of Annual Visits by Population

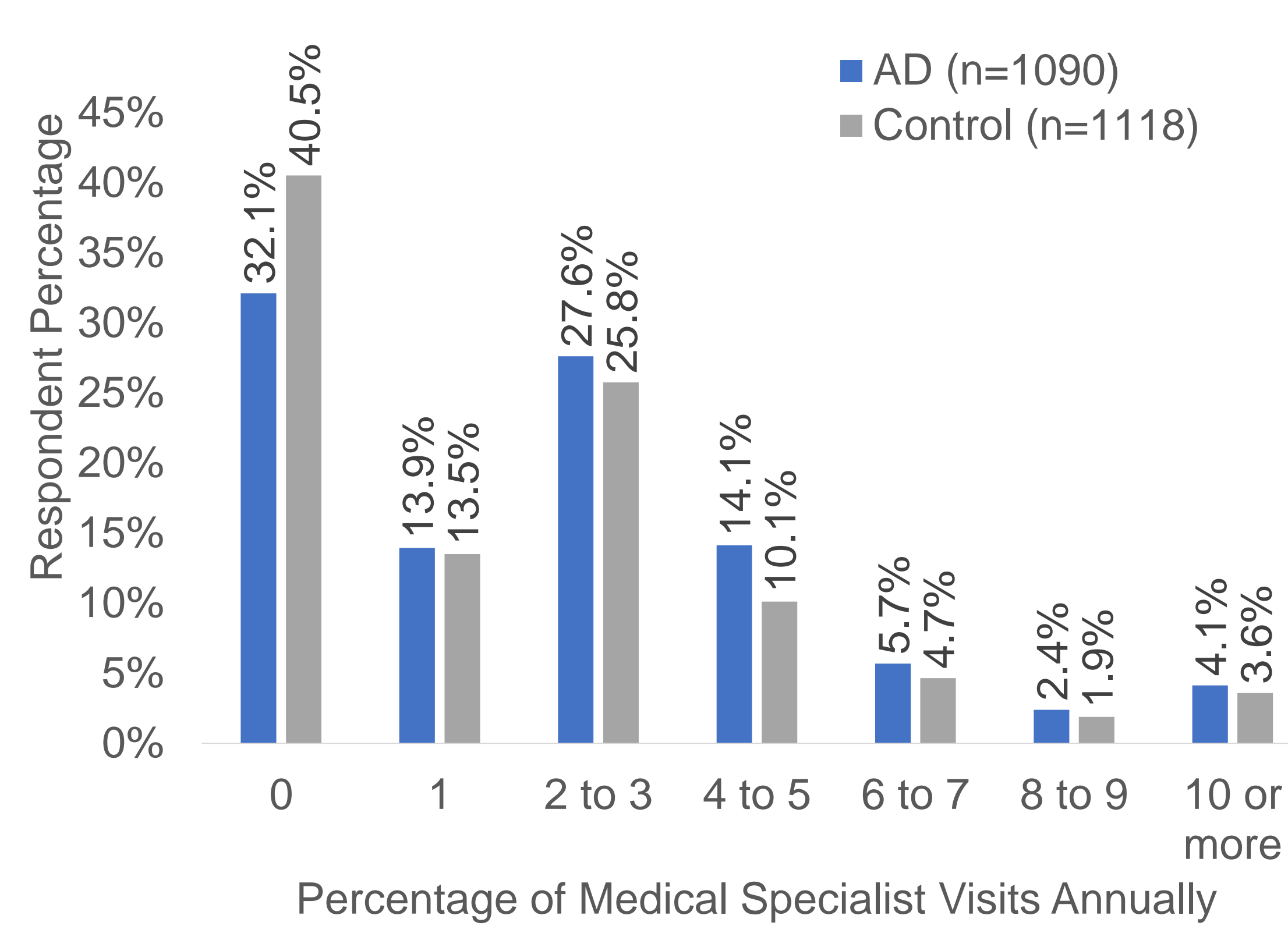
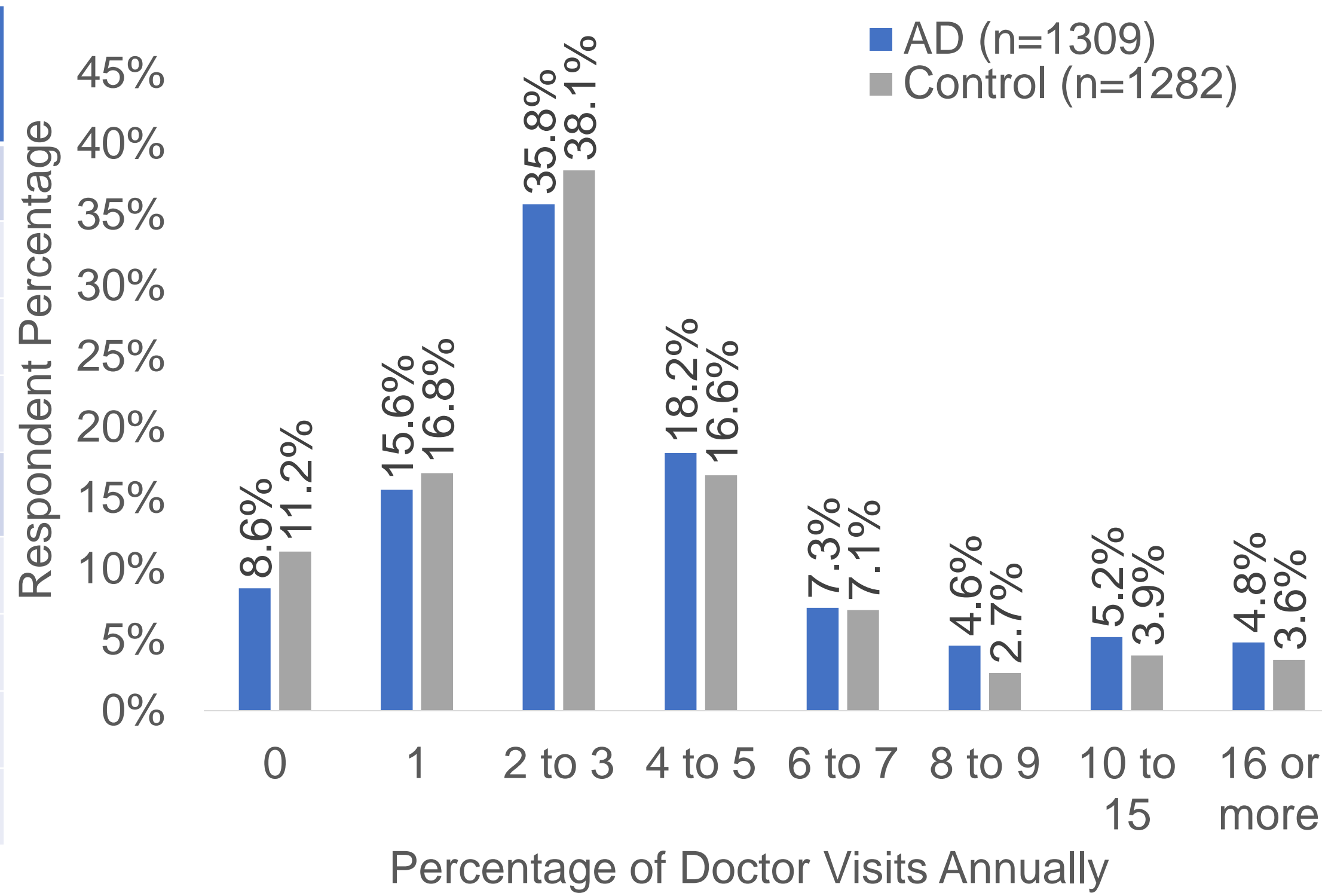


Table 4: Random Forest Model Results in AD Population of SDoH vs Skipping/Delaying Medications Due to Cost Domain

Outcome Question Code	Training Accuracy	GridSearch Accuracy
Skipped Med to Save Money	76.6%	73.5%
Took Less Med to Save Money	77.4%	72.9%
Delayed Filling Rx to Save Money	74.9%	71.8%
Alternative Therapies	68.5%	66.6%
Lower Cost Rx to Save Money	78.8%	55.0%
Worried About Paying	64.2%	50.7%
Bought Rx From Other Country	53.3%	48.1%

Table 5: Random Forest Model Results in AD Population of SDoH vs Delays in Getting Care Domain

Outcome Question Code	Training Accuracy	GridSearch Accuracy
Childcare	77.4%	80.6%
Elderly Care	72.3%	78.3%
Transportation	77.5%	78.0%
Rural Area	67.2%	74.8%
Nervous	75.2%	71.9%
Can’t Afford Copay	71.1%	71.9%
Time Off Work	68.9%	67.5%
Had To Pay Out of Pocket	75.6%	65.2%
Deductible Too High	69.2%	63.8%

DISCUSSION & CONCLUSIONS

- Conclusions and Impact:** Atopic dermatitis patients have statistically significant differences for more doctor and specialist visits, delays in receiving care and have affordability concerns for medications compared to the non-AD population. The models demonstrated that social determinants of health appear to be predictive for delays in medication filling and receiving care, although not so for inability to afford care.
- Limitations:** Due to imputation needed for predictor and outcome variables, the models experienced a modest degree of overfitting. The outcomes are survey questions and are primarily coded as binary responses, so the study is limited to detection of differences in outcomes, rather than a numerical magnitude. The independent impact of SDoH relative to AD towards patient outcomes does not have an established baseline in this study, which is to be addressed in future work.
- Next Steps:** Future steps involve confirming visit frequency by care setting as well as prescription switch behavior in EHR data to validate survey responses. Non-SDoH variables such as demographics, income level, and education will be added as predictors. The independent contribution of SDoH factors to HCU will also be compared relative to the impact of an AD diagnosis.

1. National Academies of Sciences, Engineering, and Medicine. Factors that affect health-care utilization. In Health-care utilization as a proxy in disability determination 2018 Mar 1. National Academies Press (US).
2. Ardekani A, Fereidooni R, Heydari ST, Ghahramani S, Shahabi S, Bagheri Lankarani K. The association of patient-reported social determinants of health and hospitalization rate: A scoping review. Health Science Reports. 2023 Feb;6(2):e1124.