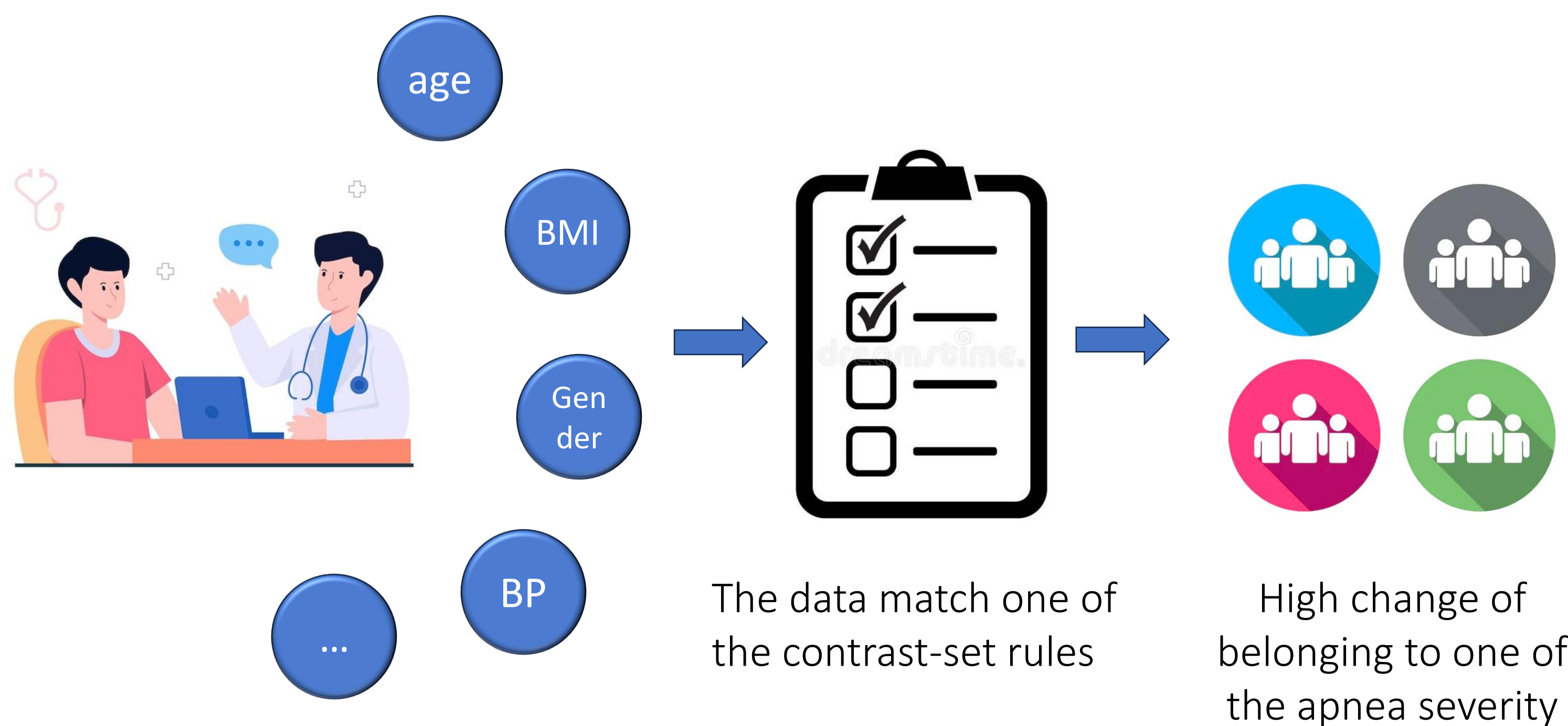


Exploring Sleep Apnea Risk Factors with Contrast Set Mining: Findings from the Sleep Heart Health Study

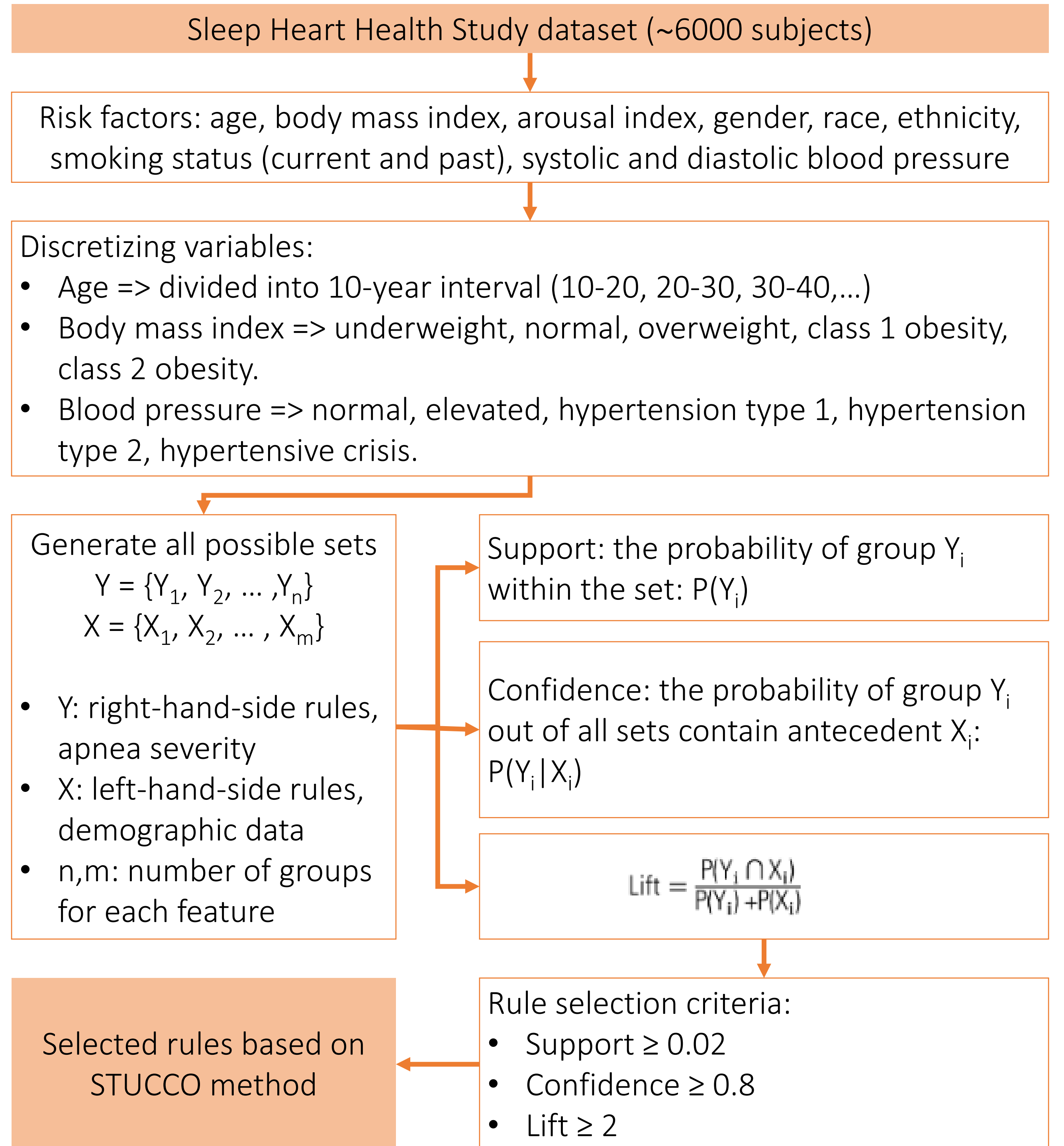
1 Introduction

This paper presents an approach for contrast set mining technique that might be meaningful in identifying sleep apnea patients. Contrast set mining can be defined as finding population subgroups that are statistically interesting (as large as possible and have the most unusual distributional characteristics) with respect to the property of interest

Sleep apnea detection is a key focus in sleep health research due to its high and rising prevalence. Past studies have largely examined prevalence and epidemiology, with limited exploration of feature combinations for detection. Machine learning has advanced this area by enabling fast, accurate predictions using multiple demographic factors, yet model interpretability remains challenging. Traditional methods, like feature ranking, identify individual feature importance but don't capture how features interact when combined. This study uses contrast set mining to reveal how demographic features work together in detecting sleep apnea, backed by statistical evidence.



2 Method



3 Result

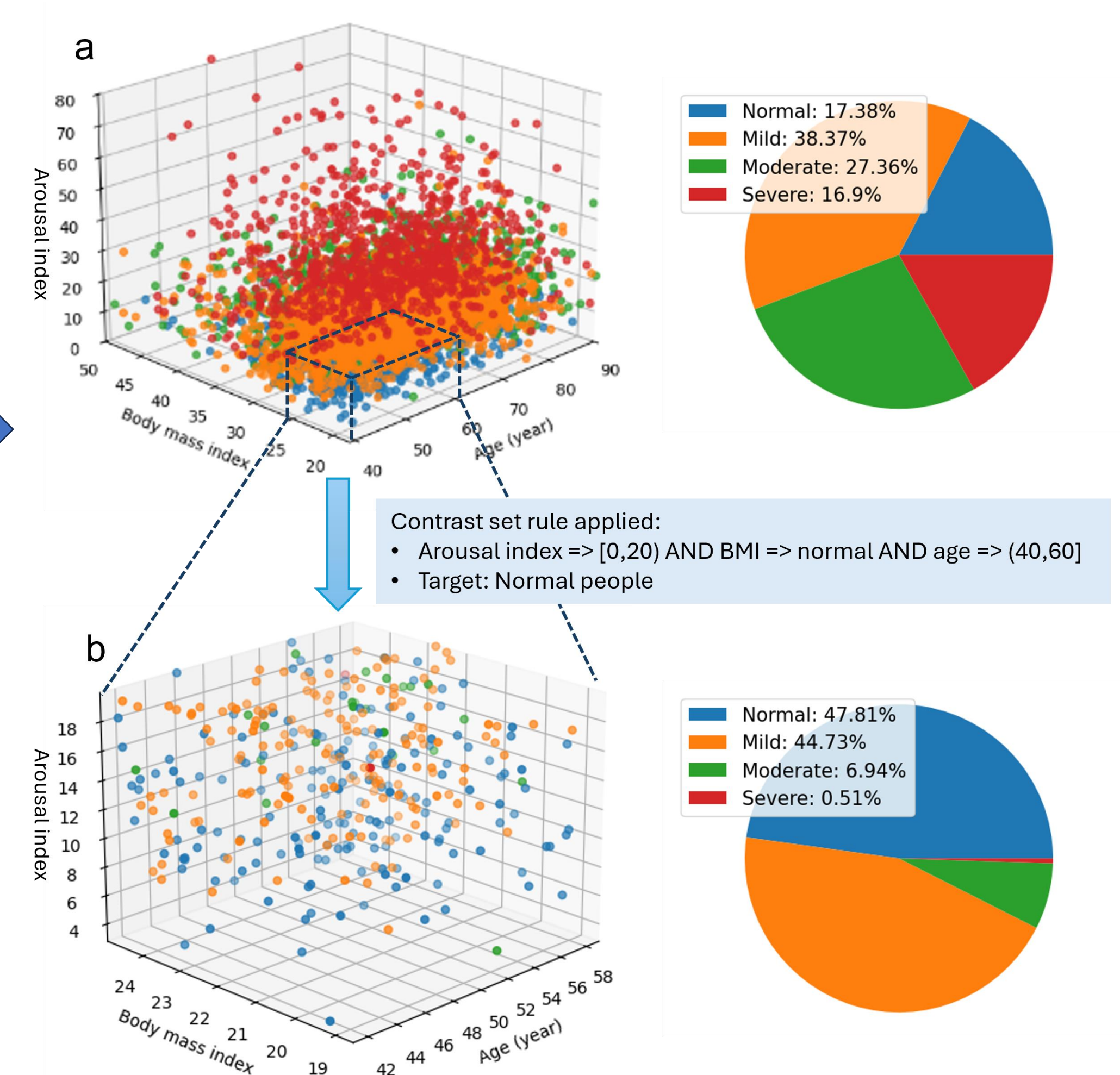
In contrast set mining, an increase in the number of rule components typically results in more rules. However, complex rules with numerous elements are harder to interpret, so this study limits rule length to four components or fewer. Most rules focus on distinguishing severe and normal sleep apnea against other groups.

Table 1: Contrast set rules associated with normal people (Apnea-hypopnea index < 5e/h).

Contrast set rules			Sleep apnea severity	Lift	Support (%)	Confidence (%)
Arousal index=> [0, 20]	BMI=>normal	Age=>(40, 60]	Normal	3.05	14.13	90.29
Arousal index=> [0, 20]	BMI=>normal	BP_categories=>Normal	Normal	2.88	11.74	88.33
Arousal index=> [0, 20]	BMI=>normal	Ever_smoker=>no	Normal	2.51	12.64	88.89
Arousal index=> [0, 20]	BMI=>normal	Gender=>female	Normal	2.36	17.00	95.40
Arousal index=> [0, 20]	BMI=>normal		Normal	2.27	14.15	89.74
Arousal index=> [0, 20]	Age=>(40, 60]	BP_categories=>Normal	Normal	2.21	14.29	90.30
Arousal index=> [0, 20]	Age=>(40, 60]	BMI=>overweight	Normal	2.09	11.65	88.05
Gender=>female	BMI=>normal	Ever_smoker=>no	Normal	2.13	13.29	79.29
BMI=>normal	Ever_smoker=>yes	Gender=>female	Normal	2.13	13.29	79.29

Table 2: Contrast set rules associated with severe apnea patients (Apnea-hypopnea index > 30e/h).

Contrast set rules				Sleep apnea severity	Lift	Support (%)	Confidence (%)
Current_smoker=>no	Gender =>male	BMI => class 2 obesity	Age=> (60, 70]	Severe apnea	2.94	16.51	77.78
Current_smoker=>no	Gender =>male	BMI => class 2 obesity		Severe apnea	2.23	19.25	80.72
Current_smoker=>no	Gender =>male	BMI => class 1 obesity	Age=> (70, 80]	Severe apnea	2.24	16.28	82.35



3 Conclusion

The contrast sets reveal that when the arousal index is below 20 events/h and BMI is within the normal range, it is typically associated with a healthy population. Adding the age factor (within 40-60 years) increases confidence to over 90%, with support of 14.1% and a lift of 3.05. Combining arousal index, BMI, and blood pressure slightly reduces these indicators, suggesting age has more influence than blood pressure. Additionally, the female gender contributes significantly to the normal population, with higher support and confidence but a lower lift due to the larger size of the female group compared to the 40-60 age group.

In the severe sleep apnea group, factors such as male gender, age over 60, and a BMI above 30 (indicative of obesity) were key determinants. Most rules associating male sex or class 2 obesity with severe apnea demonstrated confidence levels exceeding 75% which consistent with previous studies

Visit our lab website at:
<https://www.ubicomp-lab.org>

References

- Bay, S.D.; Pazzani, M.J. Detecting change in categorical data: Mining contrast sets. In Proceedings of the Proceedings of the fifth ACM SIGKDD international conference on Knowledge discovery and data mining, 1999; pp. 302-306.
- Bearpark, H.; Elliott, L.; Grunstein, R.; Cullen, S.; Schneider, H.; Althaus, W.; Sullivan, C. Snoring and sleep apnea. A population study in Australian men. American journal of respiratory and critical care medicine 1995, 151, 1459-1465.
- Strohl, K.P.; Redline, S. Recognition of obstructive sleep apnea. American journal of respiratory and critical care medicine 1996, 154, 279-289.