

Abstract

Hypothermia-related deaths are preventable and commonly occur in vulnerable populations. Several studies have been done on hypothermia related-deaths in major cities. However, the State of Maryland, and Baltimore City has had very little research done. The database of the State of Maryland Office of Chief Medical Examiner (OCME) in Baltimore City was searched for all fatalities related to hypothermia between 2018-2022. Factors including sex, race, age, alcohol and drug intoxication, natural diseases, homelessness, autopsy findings, scene locations, and temperature were analyzed.

Introduction

Hypothermia is defined as a body temperature below or equal to 35°C (95°F) and occurs when the body loses more heat than it generates.^{1,2,3} This is a preventable cause of death that can be seen during the winter months when the temperature drops below at most 75°F (23.9°C) and leads to several yearly fatalities in the United States⁴. Hypothermia is challenging to determine as the cause of death due to the lack of definitive signs and must be done by excluding all other possibilities.^{1,2,3,5} Approximately 1,300 deaths from hypothermia are reported annually in the United States⁴. Most of these deaths affect vulnerable populations: the homeless, the elderly, infants, and those who have been abused⁴. Male is known to be a risk factor for death due to hypothermia⁴. Comorbidities include cardiovascular, pulmonary, and psychiatric disorders⁴. The manner of death in the majority is "accident," which means most of them are "preventable⁶."

Objectives and Methods

Our research aims to focus on hypothermia as a cause of death with contributing factors such as past medical history, alcohol and/or drug use, and socio-economic status. Interpret and provide public education and assist with public safety during times of increased risk.

This study aims to address the following:

- Understand the causes and conditions for hypothermia to occur.
- Evaluate demographics (age, race, socioeconomic class, gender, etc.) that are at high risk for hypothermia-related deaths.
- Analyze the role that alcohol and drugs have on hypothermia-related deaths by use of toxicology reports.
- Analyze the role that underlying health issues have on the risk of hypothermia-related deaths.
- Analyze the autopsy findings that lead to the cause of death being ruled as hypothermia.
- Analyze how scene temperature and location lead to a hypothermia-related death.

A retrospective study of hypothermia-related deaths was conducted at the statewide medical examiner system in Maryland. The database of the Maryland Office of Chief Medical Examiner was searched for all fatalities related to hypothermia between 2018-2022. A total of 130 hypothermia-related deaths that went to autopsy were identified and evaluated in this study.

Results

The rate of hypothermia-related deaths in Maryland was an average of 0.77 per 100,000 population per year. Of the 130 cases, 83% (N=108) cases were classified as accidents, 5% (N=6) were suicide, and 12% (N=16) could not be determined. Of the 6 cases classified as suicides, 5 were drowning cases complicated by hypothermia, and one was a drug overdose complicated by hypothermia. There was a difference in race with white being the most predominate at 49% (N=64) followed by African American at 41% (N=53).

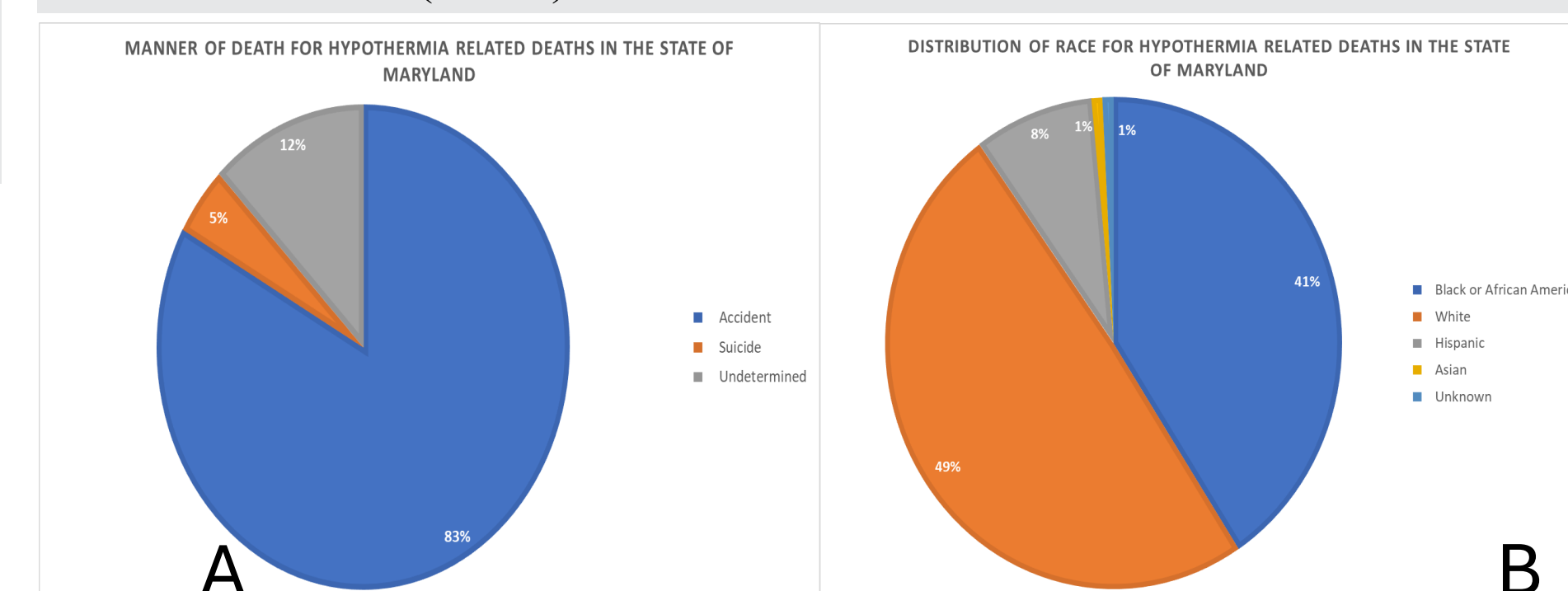


Figure A: The distribution of manner of death determined from 130 autopsy hypothermia related deaths in the State of Maryland between 2018 – 2022.
Figure B: The distribution of race for the same 130 cases.

Males (N=101) were more likely to die of hypothermia than females (N=29) (OR 3.7, 95%CI 2.42 - 5.54). The ages ranged from 8 to 96 years old with the majority of victims' ages between 40 – 64 (N= 68, 52%). 28% (N=36) of victims were 65 years and older.

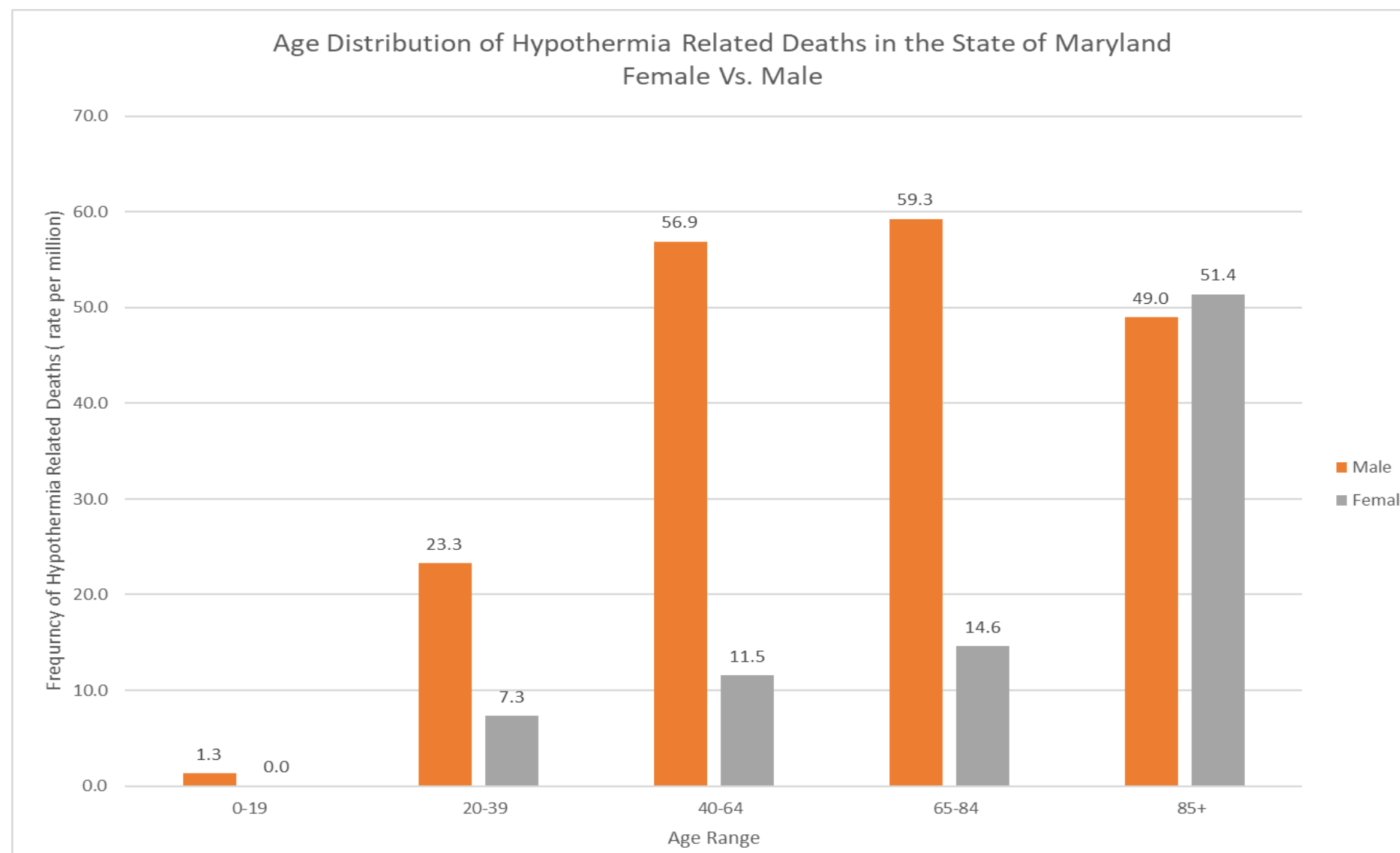


Figure 1: The age distribution and difference between male and female sex of hypothermia related deaths in the State of Maryland between 2018 – 2022.

Of the 130 deaths, 33% (N=43) were homeless and 70% of (N=97) were found outdoors. Maryland consists of 23 counties and Baltimore City with a population of 6.046 million. Of the 43 homeless victims, 17 were found in Baltimore City and 26 were found in the 23 counties combined.

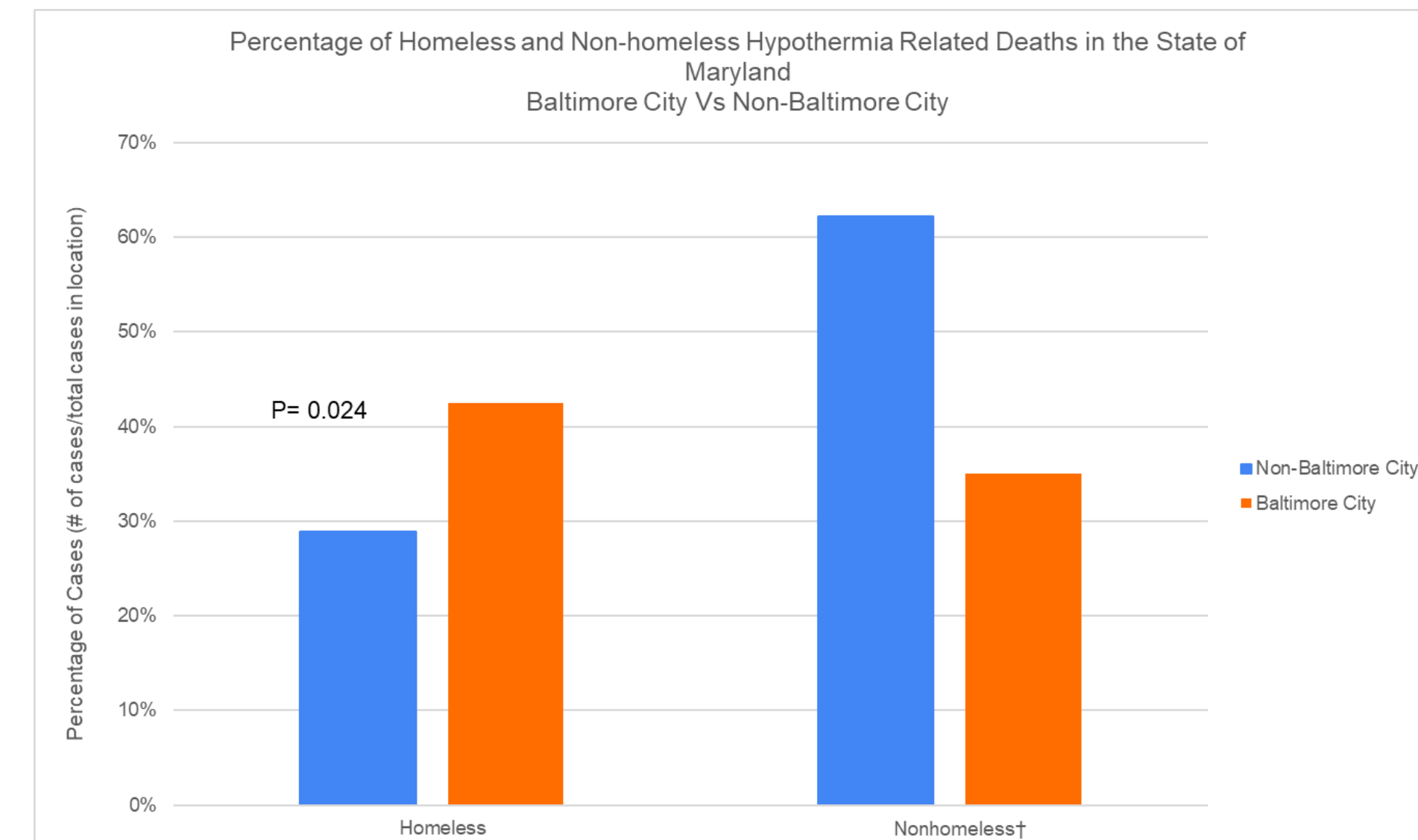


Figure 2: The difference between homeless hypothermia related deaths in Baltimore City and the counties in the State of Maryland.

Postmortem toxicological analysis revealed that 34% (N=44) were positive for alcohol. Seventeen cases had a blood alcohol concentration > 0.20%. Thirteen (10%) cases were positive for cocaine.

Table 1: The number of hypothermia-related autopsy cases that had a positive cocaine toxicology test.

Cocaine	State of Maryland		Baltimore City, MD		Counties (non-Baltimore City), MD		P value [†]
	n	%	n	%	n	%	
Total	130	-	40	100%	90	100%	-
Positive	13	10%	7	18%	6	7%	0.057

[†] P values were obtained using Fisher's exact test.

Table 2: The number of positive and negative toxicology tests for ethanol from 130 hypothermia-related autopsy cases

Ethanol	State of Maryland		Baltimore City, MD		Counties (non-Baltimore City), MD		P value [†]
	n	%	n	%	n	%	
Total	130	-	40	100%	90	100%	-
Positive	44	34%	11	28%	33	37%	0.296
Negative	84	65%	29	73%	55	61%	-
Not tested	2	2%	0	0%	2	2%	-
Average EtOH Concentration*	0.18%		0.15%		0.18%		-

[†] P values were obtained using chi squared test.

*With multiple blood draws, highest ethanol concentration was used.

Autopsy showed that 35% (N=46) had Wischniewski spots and 5% had pancreatitis. The environmental temperature was much lower in the cases with Wischniewski spots than the cases without Wischniewski spots (Temperature 34.4±9.9F vs 37.3±13.1F, p=0.043).

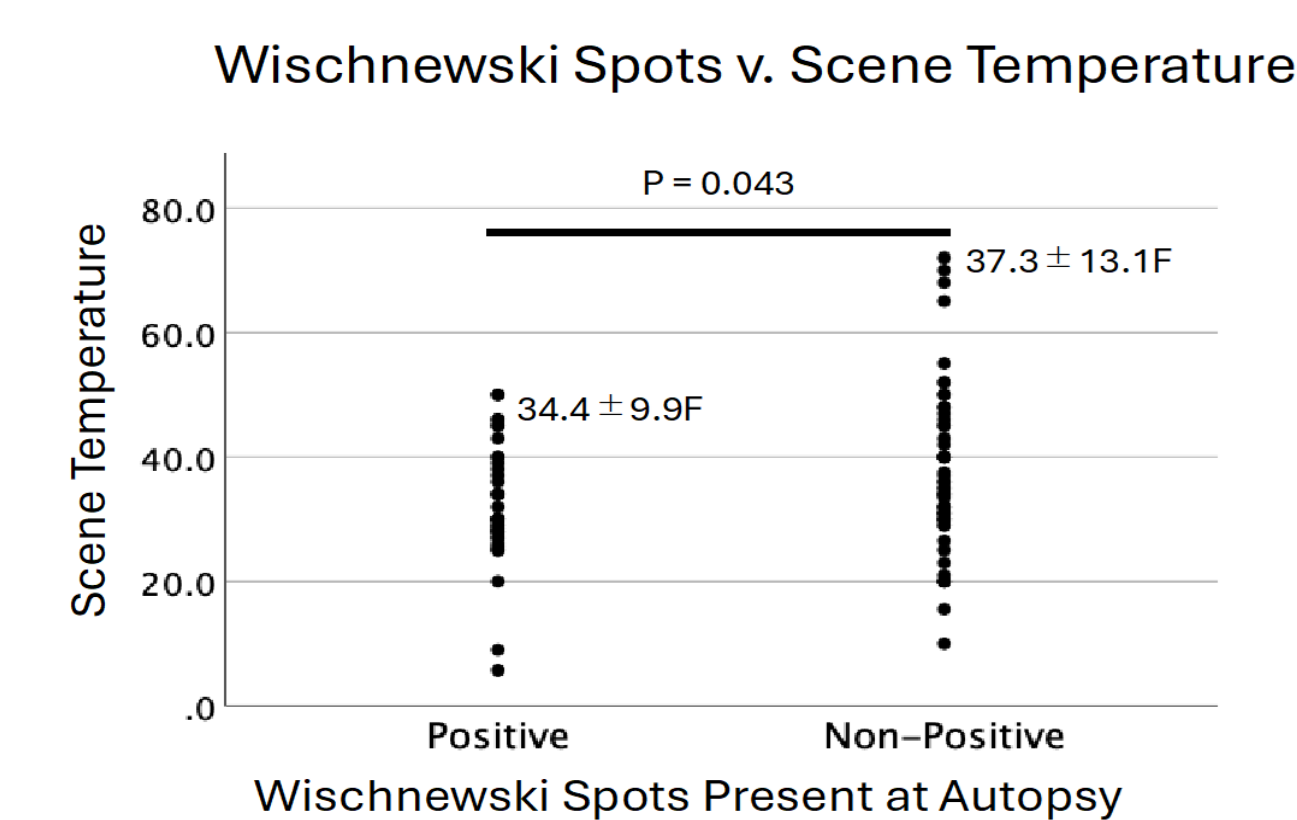


Figure 3: The prevalence of Wischniewski spots in comparison to the scene temperature.

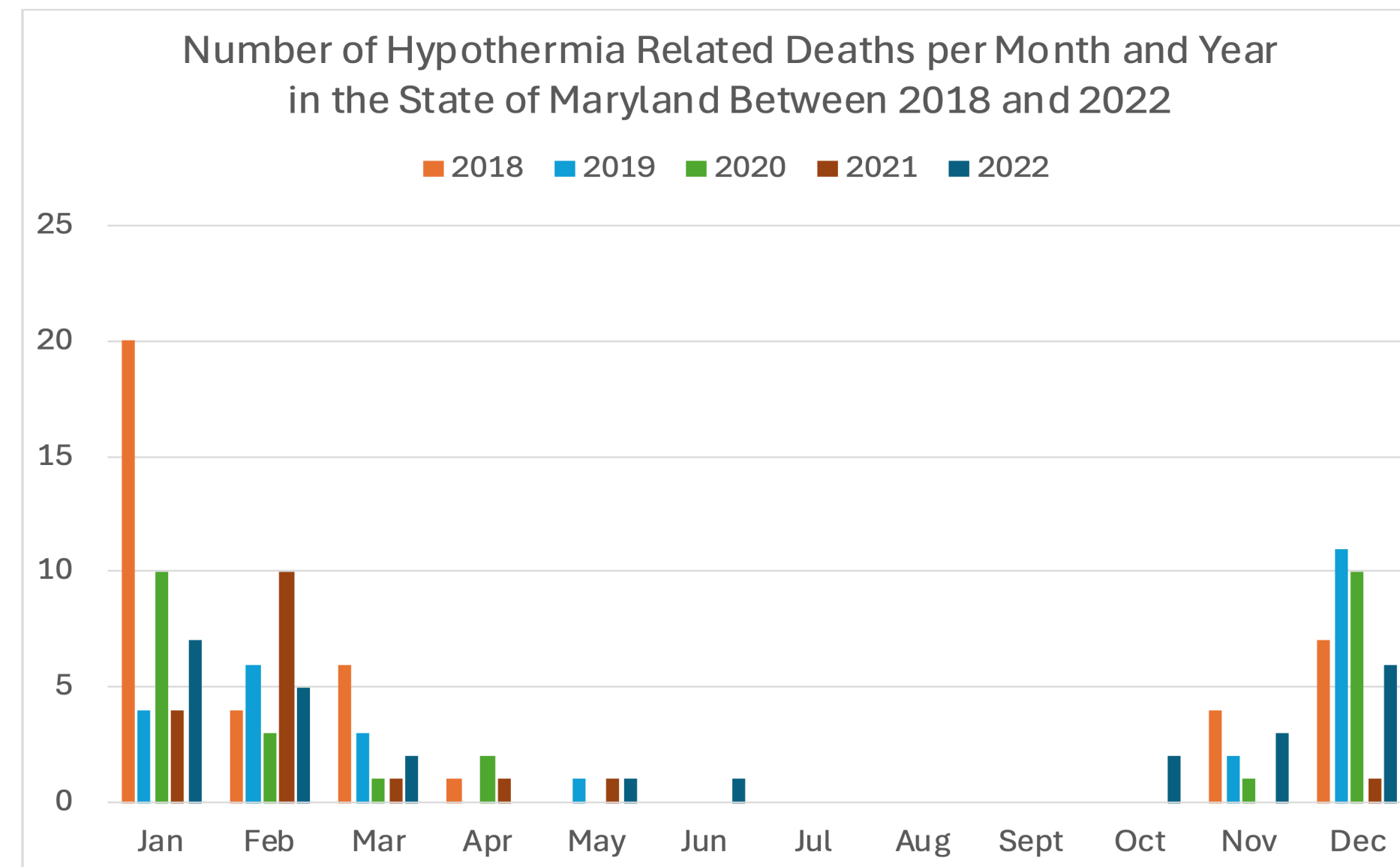


Figure 4: The Distribution of Hypothermia-Related deaths throughout the twelve months of the year.

Results Cont.

Cardiovascular disease was the leading underlying cause of death (N=78), followed by Pulmonary disease (N=15), history of Dementia (N=12), and Diabetes Mellitus (N=11). Other significant medical conditions included Schizophrenia in 5% (N=6) and bipolar disorder in 6% (N=8) of cases.

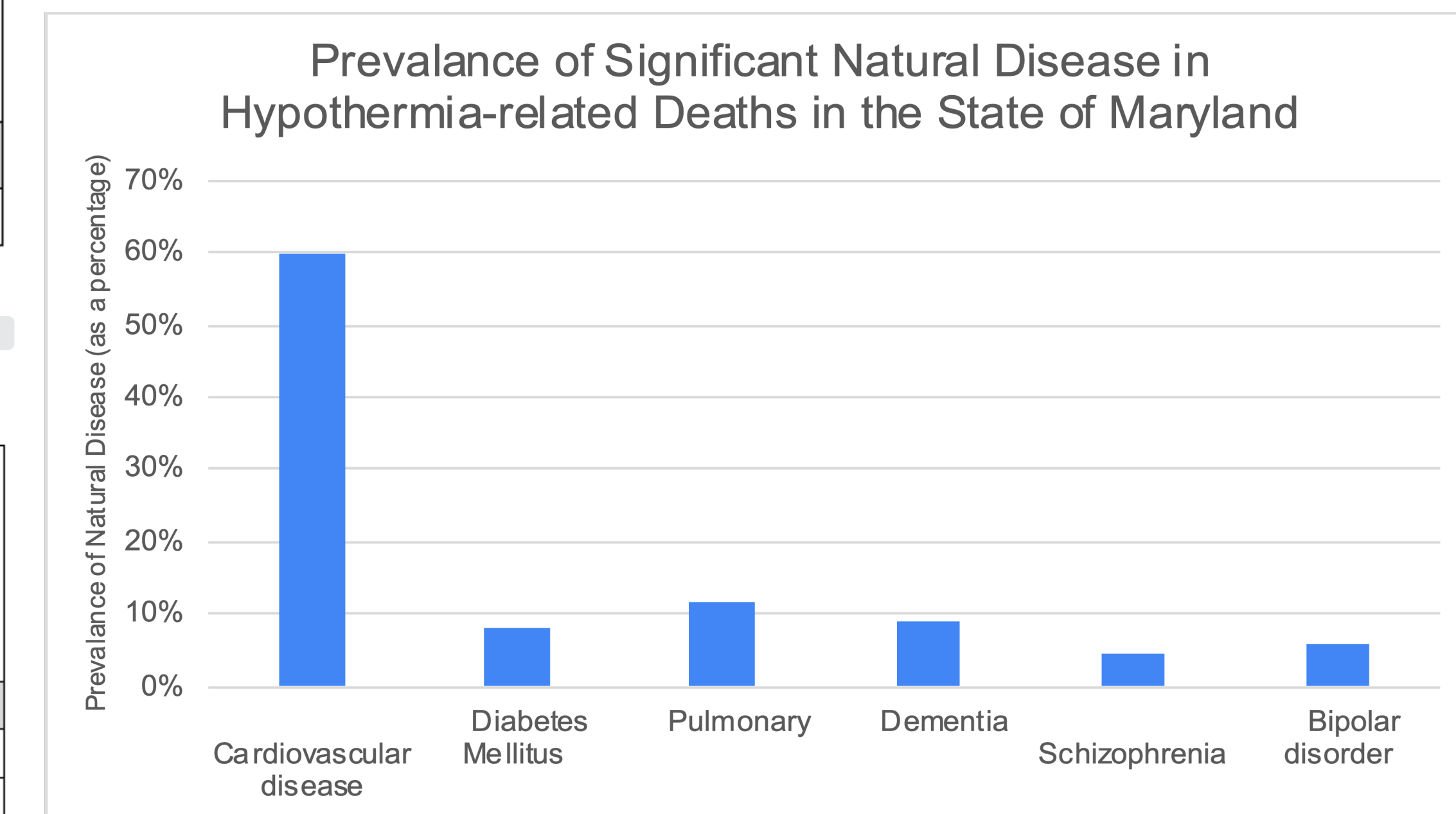


Figure 4: The prevalence of natural diseases found in hypothermia related deaths in the State of Maryland from 2018-2022.

Discussion/Conclusion

Hypothermia-related deaths are preventable and commonly occur in vulnerable populations. The State of Maryland currently has a system in place called Cold Blue to combat hypothermia related death in extreme cold weather. They suggest actions for those who are of highest risk (infants, those who suffer from mental illnesses, are hungry or dehydrated, consumed alcohol, or those with inadequate clothing) when the extreme cold occurs⁷. Our data can be used by the local public health agencies to target those higher-risk populations, such as the homeless and elderly, and provide appropriate interventions to prevent such death.

References

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