

Temperature Effects on Chronic Lithium Toxicity in Arizona

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BACKGROUND

- Lithium is a common mood stabilizing medication used for mental health disorders such as bipolar and as adjunct in depression. This medication has a very narrow therapeutic window (0.6-1.2mEq).¹
- Due to the narrow therapeutic index, lithium toxicity while taking prescribed doses is not an uncommon event reported to the AZPDIC.
- Dehydration is a very common cause of acute kidney injury which may lead to decreased lithium excretion and increased toxicity.
- Chronic lithium poisoning is responsible for the highest risk of neurotoxicity.¹ If not treated at an emergency department in time, lithium toxicity can lead to Syndrome of Irreversible Lithium Effectuated Neurotoxicity (SILENT).
- Arizona can reach upwards of 119°F (48.3°C) in certain counties and due to the higher variations of temperatures, it may be possible that patients are more likely to experience dehydration.³
- Previous studies have shown mixed results in the relationship between increased rates of toxicity and temperature.^{6,7,8} These studies were mainly focused on toxicity in an ambulatory care setting.^{6,7}

OBJECTIVE

- To examine the relationship between environmental temperature and the frequency of patients reporting chronic lithium toxicity to emergency departments in Arizona.

METHODS

- This study is a retrospective, descriptive chart review including patient cases that were reported from January 1, 2017- December 31, 2021.
- Information collected was deidentified and only the following was given to the researchers:

- Presentation Date
- Zip code
- Age
- County
- Serum Lithium
- Sodium Level
- Serum Creatinine
- Prescribed Total Li Dose per Day
- Relevant Symptoms
- Treatments
- Outcome

Inclusion Criteria

- Patients were ages 18-89
- Serum lithium levels >1.2meq/L
- Denied suicidal ideation or accidental overdose
- Lithium was taken per prescribed dose
- Were seen at a hospital and Reported to the AZPDIC

Exclusion Criteria

- Patients ingesting any amount greater than the prescribed dose
- Subtherapeutic lithium levels
- Patients reporting therapeutic errors
- Cases that remained at home
- Lack of zip code
- Lack of admission date

- Ambient Temperature information was collected from weather.gov

- Data was analyzed using a Chi-square test with alpha-priori level of 0.05.

Patient Demographics

341 patients

↓ 225 excluded

116 patients included

County (N, %)

Cochise	(3, 2.59%)
Coconino	(9, 7.76%)
Mohave	(10, 8.62%)
Navajo	(4, 3.45%)
Pima	(77, 66.37%)
Pinal	(2, 1.72%)
Yavapai	(8, 6.90%)
Yuma	(3, 2.58%)

	Mean	SD
Age	51.1 yr	(14.40)
Serum Li level	2.25 mEq/L	(0.78)
Na	136 mEq/L	(4.23)
SCr	1.4mg/dL	(0.94)

Symptoms (%)

Altered Mental Status	(63.25%)
Tremor	(30.77%)
Dizziness	(17.09%)
Nausea/Vomiting/Diarrhea	(22.22%)

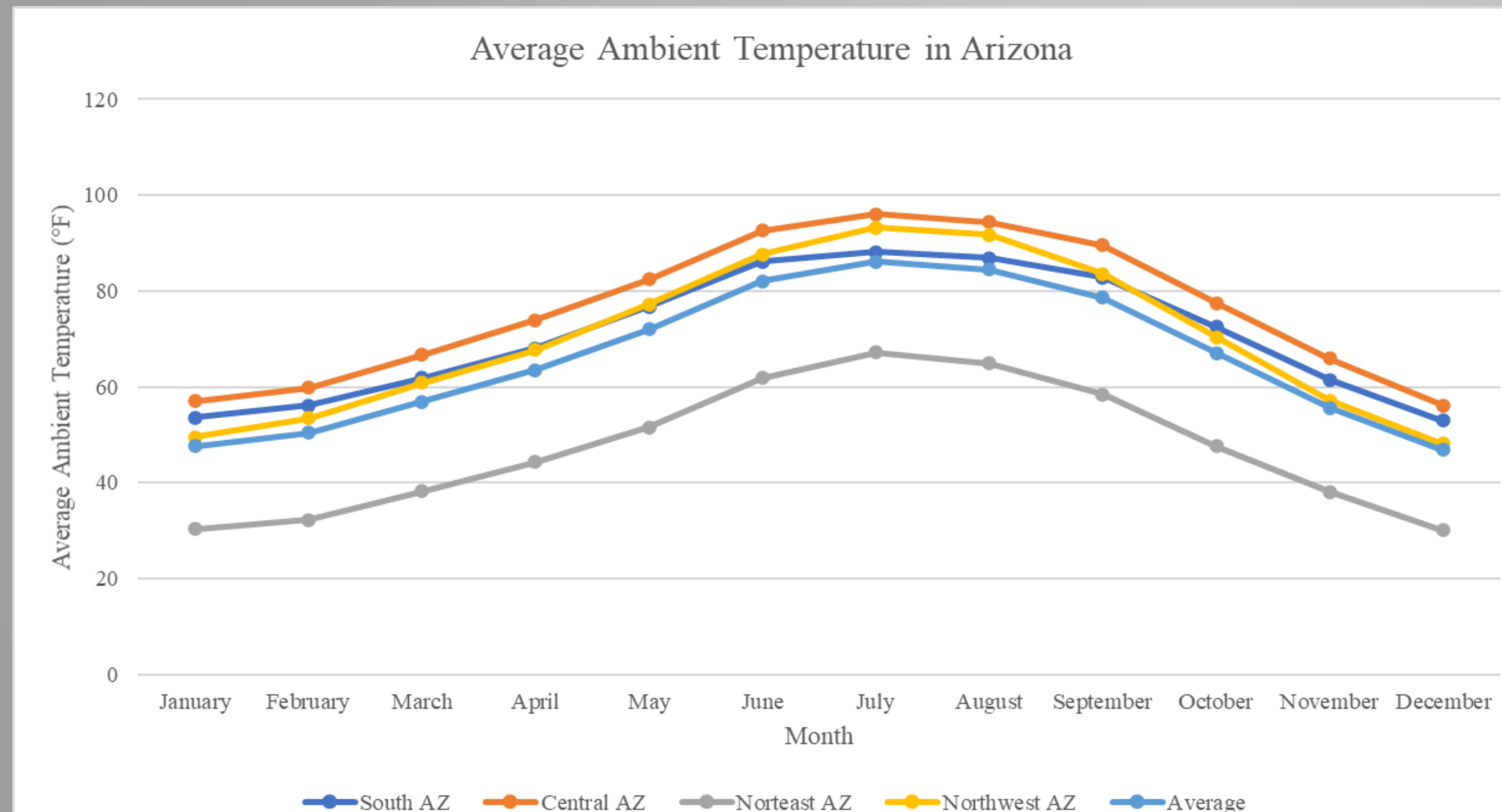


Fig.1 Average Ambient Temperature in Arizona via Weather.gov reports

RESULTS

Primary Outcomes

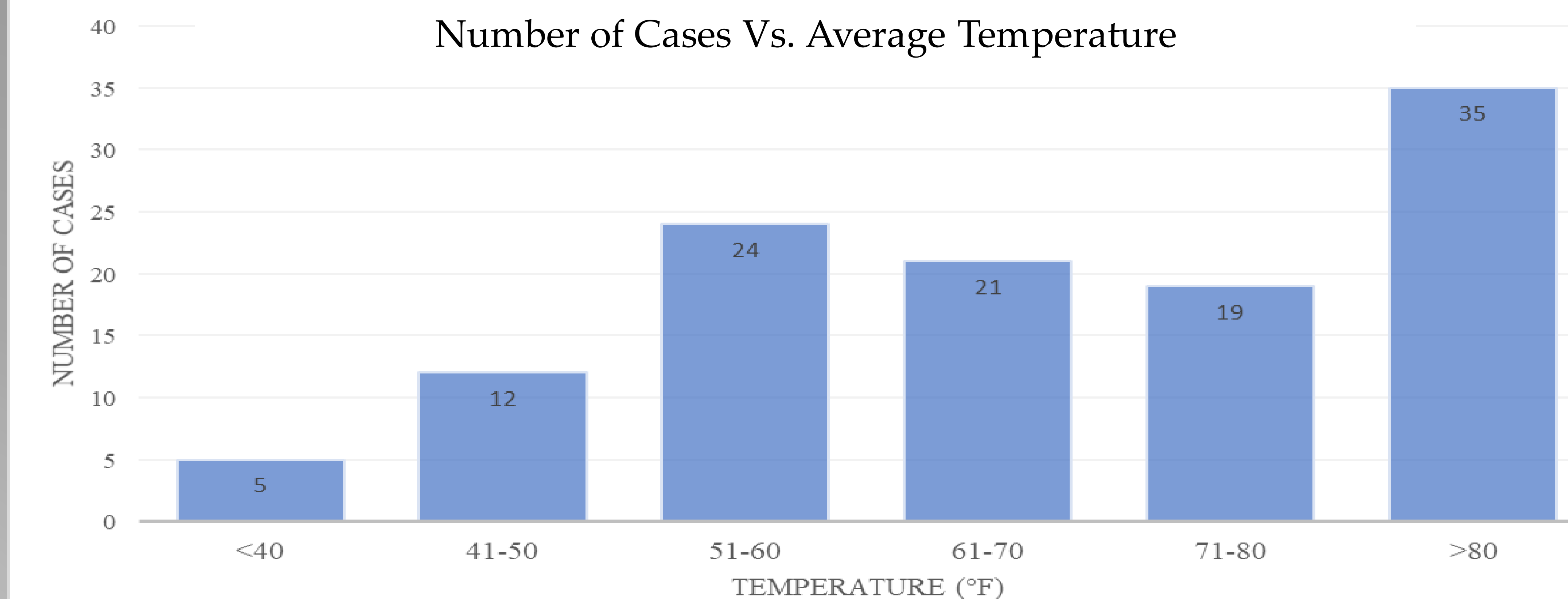


Fig. 2 Number of Cases Vs. Average Temperature. Chi-square analysis shows a value of p=0.002 with 95% CI

Average Cases by Month

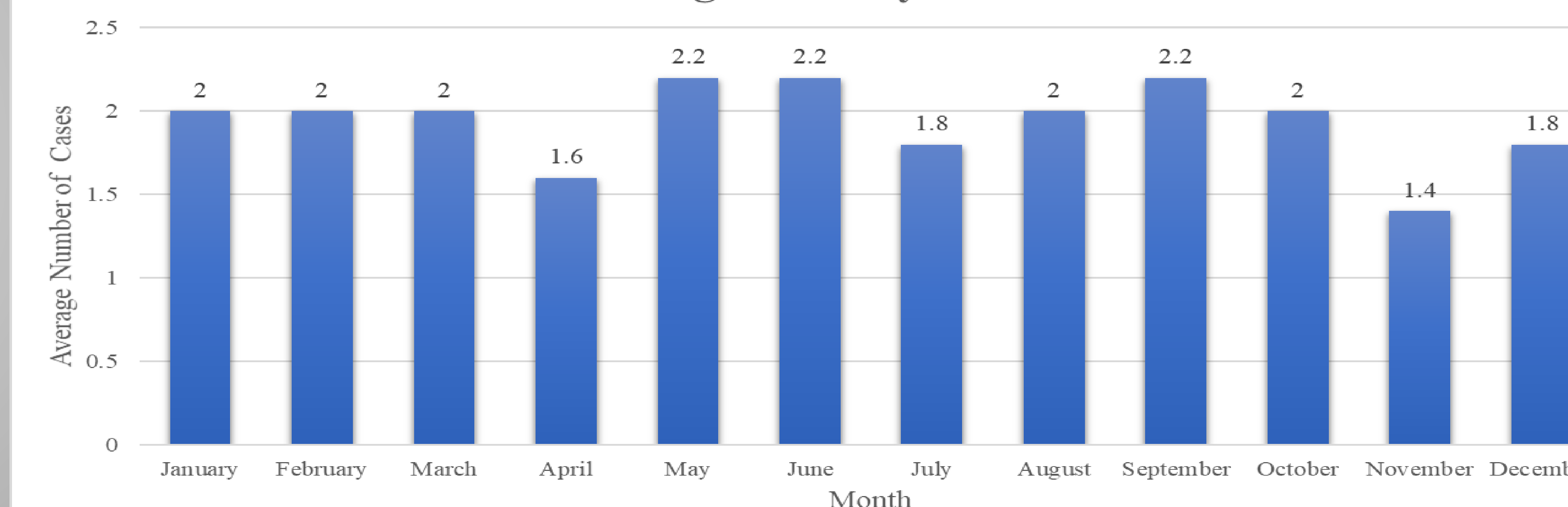


Fig. 2 Average Cases by Month. Chi-square analysis shows a value of p=0.25 with 95% CI

DISCUSSION

- The primary finding of this study is that temperature and cases of chronic lithium toxicity reported to the AZPDIC do appear to be associated with higher ambient temperature and frequency of cases reported. There does not appear to be an association between seasonal variation and cases of chronic lithium toxicity.

- Key patient demographics showed that the average patient age was 51.1 years (SD 14.4), initial supratherapeutic lithium levels with a mean of 2.25 mEq/L (SD 0.78), within normal ranges of sodium with an average of 136 mEq/L (4.23), and slightly elevated serum creatinine with a mean of 1.4mg/dL (SD 0.94).

- Ambient temperature in all of Arizona is not uniform throughout the state, with higher (6,909 feet) and lower (141 feet) elevations posing a difficulty in reporting higher average temperatures. Majority of cases were from Pima county (66.37%) ranging an elevation of 2,838 ft.

Symptom based reporting showed that 63.25% of cases reported altered mental status. This shows that acute toxicity is less likely found in our cases due to higher concentrations of lithium in the brain over time due to chronic lithium toxicity. Tremor was reported at 30.77% and a cumulative of gastrointestinal symptoms of nausea/vomiting/diarrhea were still reported in about 22.22% of cases.

These findings indicate that inhabitants of Arizona counties, excluding Maricopa county, may not have the proper strategies to prevent dehydration lithium toxicity.

- proper hydration and/or access to water
- shade access/ home status
- air-conditioning.

Chronic lithium patients are followed by a physician for adequate level checks, which indicates providers may not be adapting their lithium dosages closely to prevent patients from coming into the emergency room for toxicity and further education may be warranted.

The results of this study should be generalized cautiously to patients that arrive at an emergency department with chronic lithium toxicity in other states.

LIMITATIONS

- Retrospective chart review from the AZPDIC database; limited to what was documented for each case report.
- Unknown if other factors such as drug-drug interactions, recent dose changes, and access to hydration changes were a factor other than temperature.
- Cases were taken from all counties in Arizona, excluding Maricopa county.

CONCLUSION

- There appears to be a correlation between the ambient temperature of Arizona and increased cases of lithium toxicity.
- There does not appear to be a strong correlation with the time of the year and lithium cases.
- Further prospective research needs to be done on this topic to provide information to aid physicians and pharmacists.

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