Monthly Variation in Emergency Department Admission for Acute Onset Atrial Fibrillation

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ABSTRACT **Background:** The cold season seems to be a trigger for atrial fibrillation (AF). Some reports are controversial and demonstrate variability according to the climatic characteristics in different regions.

Objective: To analyze whether meteorological factors contribute to seasonal variation of exacerbation of AF diagnosed in patients referred to the emergency department (ED) of our hospital.

Methods: We retrospectively reviewed medical data of consecutive patients admitted to the ED with symptomatic acute onset AF from 1 January 2016 to 31 December 2018. We recorded the mean monthly outdoor temperature, barometric pressure, and relative humidity during the study period.

Results: During the study period, 1492 episodes of AF were recorded. New onset AF were 639 (42.8%) and paroxysmal atrial fibrillation (PAF) were 853 (57.2%) (P = 0.03). The number of overall admission of AF episodes was not distributed uniformly through the year. Incidence of AF episodes peaked during December and was lowest in June (P = 0.049). Of 696 episodes (46.6 %) the patients were hospitalized and for 796 (53.4%) the patients were discharged (0.01). The number of hospitalizations was not distributed uniformly through the year (P = 0.049). The highest number of hospitalizations happened in December and the lowest in May. Outdoor temperature and barometric pressure (but not relative humidity) may mediate a monthly fluctuation in AF episodes with highest number of ED visits in December and the lowest in June.

Conclusions: Meteorological conditions influence exacerbation of AF episodes and hospitalization. Outdoor temperature and barometric pressure may mediate a monthly fluctuation in AF.

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KEY WORDS: atrial fibrillation (AF), meteorological factors, seasonal variation

The incidence of various cardiovascular diseases has been found to exhibit seasonal variation with peaks in winter [1]. Like other cardiovascular pathologies, the winter season seems to be an evocative trigger for atrial fibrillation (AF), although some data from the literature are controversial and point out variability of the climatic characteristics in different regions [2-4].

An increased trend in AF hospitalization has been reported [5] and its seasonal variation has an important epidemiological and practical implications.

We analyzed whether meteorological factors contribute to seasonal variation of acute exacerbation of AF diagnosed in patients referred to the emergency department (ED) of our hospital.

PATIENTS AND METHODS

Emek Medical Center is a secondary hospital that serves a population of about 500,000 people and is situated in a rural region in north east Israel.

With acute onset of AF, we considered first onset AF and paroxysmal atrial fibrillation (PAF) episodes. Patients with more than one episode of AF during the study period are repeatedly entered in the study. Patients with permanent AF, open-heart surgery within 1 month, hyperthyroidism, acute coronary disease, pericarditis, or respiratory infection were excluded from the study.

We retrospectively reviewed the computerized and archived medical data of consecutive patients in the hospital database admitted to the ED with symptomatic acute onset AF from 1 January 2016 to 31 December 2018. We recorded the mean monthly outdoor temperature, barometric pressure, relative humidity and acute onset AF during the studied period.

Data were analyzed by month of the year and by northern meteorological season as follows: winter (December to February), spring (March to May), summer (June to August), and autumn (September to November).

The mean monthly air temperature, relative humidity, and barometric pressure were obtained from World Weather Online: Afula Monthly Climate Average [6]. The approval for the study was obtained from the ethics review committee of human research, Emek Medical Center, Afula (nr. 0083-18).

STATISTICAL ANALYSIS

A series of chi-square tests or Fisher's exact tests (when the assumptions of the parametric chi-square test were not met) were conducted to analyze the difference between patient's characteristics in both groups. A chi-square test for goodness of fit was used to identify non-uniform distribution across the year in the prevalence of AF episodes. The association among clinical covariates and risk of AF episodes was tested by multiple logistic regression analysis. Pearson's coefficient and Spearman's rank correlation were used to evaluate the relationship between the incidence of AF episodes and mean outdoor temperature, humidity, atmospheric pressure, and pollutant values. We computed the 2-tailed *P* values, where $P < 0.05$ was considered a statistically significant result. Statistical analysis was performed using R statistical software version 3.6.1.

RESULTS

The baseline patient characteristics are listed in Table 1.

During the study period 1492 episodes of AF were recorded in 1349 patients. Their monthly distribution is reported in Figure 1. The episodes of new onset AF were 639 (42.8%) and the episodes of PAF were 853 (57.2%), ($P = 0.03$).

Table 1. Patients baseline clinical characteristics

Column	Value
Age of patients during AF episode	
≤ 60 years	387 (26%)
60–75 years	607 (40.7%)
≥ 75 years	498 (33.3%)
Gender	
Male	761 (51.1%)
Co-morbidity	
Thyroid	156 (10.5%)
Chronic lung disease	181 (12.1%)
Obesity	309 (20.7%)
Diabetes mellitus	532 (35.7%)
Hypertension	942 (63.1%)
Ischemic heart disease	361 (24.2%)
State post CVA	144 (9.7%)
Valvular heart disease	121 (8.1%)
Congestive heart failure	177 (11.9)
Drug therapy	
Antiarrhythmic drugs (patients with PAF) (amiodarone, dronedarone, propafenone, flecainide, digoxin)	216 (25.3%)
ACE inhibitors	400 (26.8%)
Beta blockers	625 (41.9%)
Statins	346 (23.2%)

ACE = angiotensin converting enzyme, AF = atrial fibrillation, CVA = cerebrovascular accident, PAF = Paroxysmal atrial fibrillation

During the study period, there were 219 AF recurrences (14.7%); 89 patients (6%) had 1 recurrence, 33 patients (2.3%) had 2 recurrences, 17 patients (1.1%) had 3 recurrences, and 4 patients (0.9%) had together a total of 13 recurrences.

The number of overall admission of AF episodes was not distributed uniformly through the year. The incidence of AF episodes peaked in December and was lowest in June ($P = 0.049$). The distribution of PAF admissions was not spread uniformly throughout the year ($P = 0.04$), while the number of first onset AF was uniformly distributed throughout the year ($P = 0.24$).

Age, gender, underlying diseases, and antiarrhythmic drugs did not affect the monthly variation of AF number episodes ($P = 0.59$). During meteorological seasons no statistical significant variation of the whole AF episodes, PAF, and first onset AF admission was found ($P = 0.29$).

For 696 episodes (46.6 %) the patients were hospitalized and for 796 episodes (53.4%) the patients were discharged home (0.01). The number of hospitalizations was not distributed uniformly through the year ($P = 0.049$). The highest number of hospitalizations occurred in December and the lowest number in May.

ED admission for AF was not uniformly distributed throughout the day: 414 patients (27.7%) arrived in the morning (time: 6.00–12.00), 492 patients (33%) in the afternoon (time: 12.00–17.000), 254 patients (17%) in the evening (time: 17.00–21.00), and 332 patients (22.3%) in the late evening/night (time: 21.00–6.00).

Figure 1. Mean monthly distribution of AF episodes recorded in a 3-year period

1 = January, 2 = February, 3 = March, 4 = April, 5 = May, 6 = June, 7 = July, 8 = August, 9 = September, 10 = October, 11 = November, 12 = December

AF = atrial fibrillation

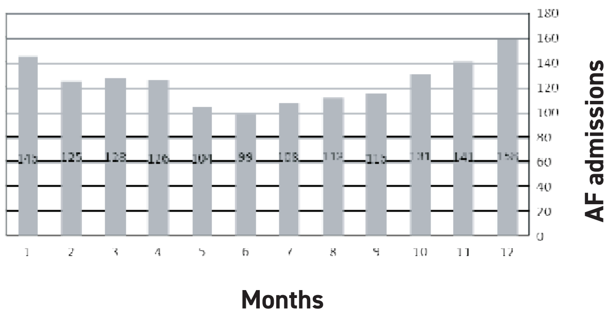


Table 2. Poisson regression model between predictors

Predictors	Incidence rate ratios	95% confidence interval	*P*
Temperature	1.01	0.99–1.03	0.436
Barometric pressure	1.03	1.01–1.06	0.014

Observations 36

Figure 2A. Correlation between mean monthly outdoor temperature and AF admission to the emergency department over 3 years (P = 0.03, rho = -0.623)

1 = January, 2 = February, 3 = March, 4 = April, 5 = May, 6 = June, 7 = July, 8 = August, 9 = September, 10 = October, 11 = November, 12 = December

AF = atrial fibrillation

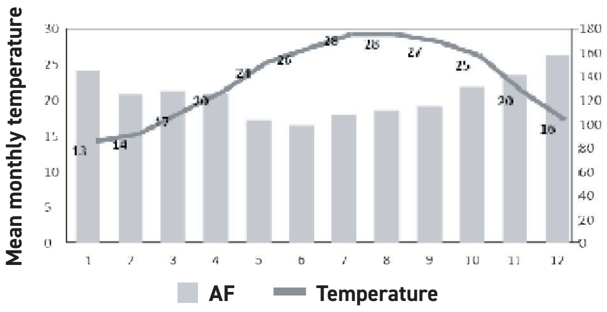


Figure 2B. Correlation between mean monthly barometric pressure and AF admission to the emergency department over 3 years (P = 0.002, rho = 0.79)

1 = January, 2 = February, 3 = March, 4 = April, 5 = May, 6 = June, 7 = July, 8 = August, 9 = September, 10 = October, 11 = November, 12 = December

AF = atrial fibrillation

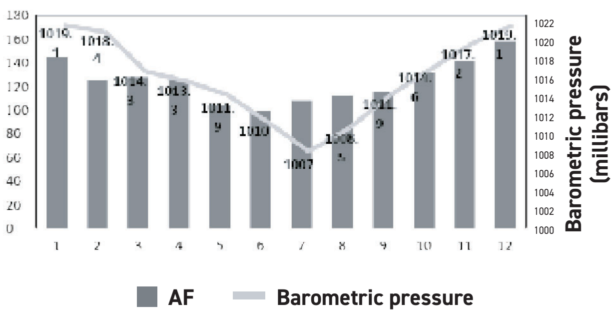
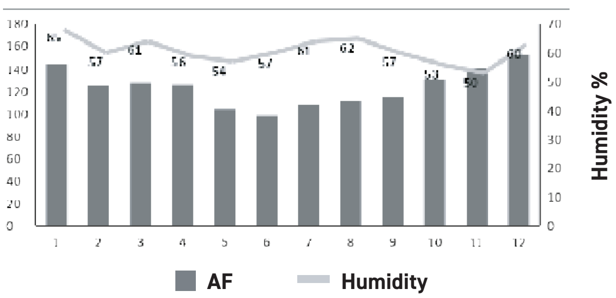


Figure 2C. Correlation between mean monthly relative humidity and AF admission to the emergency department over 3 years (P = 0.79, rho = 0.08)

1 = January, 2 = February, 3 = March, 4 = April, 5 = May, 6 = June, 7 = July, 8 = August, 9 = September, 10 = October, 11 = November, 12 = December

AF = atrial fibrillation



The monthly number of AF episodes was inversely correlated with the mean monthly outdoor temperature [Figure 2A] (P= 0.03, rho -0.623) and correlated with barometric pressure [Figure 2B] (P = 0.002, rho 0.79). No correlation was found with humidity [Figure 2C], (P= 0.79, rho 0.08).

In a multivariate analysis using the Poisson regression model [Table 2], only barometric pressure was an independent predictor of monthly variation of acute AF episodes (IRR 1.03, 95%CI 1.01–1.06, P= 0.014).

DISCUSSION

Our main finding was that in our region significant fluctuations of acute AF episodes were monthly, but not dependent on meteorological seasons, as reported by others [7-10]. We observed that AF episodes recurred more frequently during cold months (December and January) than during warm months (May, June, July, August, and September).

The different behavior of AF episode fluctuation is probably due to the different length of the seasons in Israel compared with that in other regions. In Israel the period of warm temperature (summer) is longer, and time of cold temperatures (winter) is shorter than that of the other regions that were studied.

We were unable to find studies that differentiated the distribution of PAF episodes from those of first onset AF during the year. A novel finding was that only PAF episodes have a monthly variation throughout the year, while first onset AF episodes were uniform.

An inverse relationship with outdoor temperature was seen as reported by other studies [8,10,11], but contrasting the results found by Watanabe et al. [9]. Cold temperature and barometric pressure were correlated with monthly AF paroxysms, but by multivariate analysis only barometric pressure was statistically significant. A correlation with AF episodes and barometric pressure was found also by Gluszak and colleagues [4], who found an absence of AF episodes during times of high pressure. However, we recorded more AF admissions in the ED during months with higher atmospheric pressure than during months with lower pressure.

We did not find any correlation with relative humidity as reported also by Comelli and co-authors [11], but Nguyen et al. [12] found that a low absolute humidity is associated with the onset of AF.

There is a weak seasonality for AF hospitalization consistent with other studies [2,8,13], with a peak in the cold months.

We did not show uniform distribution of acute AF episodes diagnosed in patients admitted to ED during the day. We underline that we reported the hours of patient's arrival to the ED, but we could not define the time of AF onset. Different circadian variation was found by Comelli et al. [11], who noticed that the peak of ED admission for AF paroxysms between the hours of 10:00 and 12:00, with the lowest point between 05:00 and 07:00 [11].

Ischemic stroke was reported more frequently in winter [14,15]. AF episodes are a well-established risk factor for stroke. We did not study this topic but a high incidence of stroke during winter in patients with AF that also peaks in this environment was demonstrated [16].

AF episodes were reported more frequently after lower temperatures in the prior 48 hours [12]. We are unable to confirm this finding because we elaborated on monthly and not daily data. The mechanism underlying the increase of AF episodes during cold months is not well clarified, but is probably multifactorial.

Respiratory diseases that show a seasonal variation like that of AF with a winter peak [17] have been reported to be a trigger of AF [18]. The underlining mechanism of the association with barometric pressure is speculative. Fluctuation of the barometric pressure in a cold front may emit electromagnetic waves that may affect metabolic processes and cellular membranes and induce AF [4].

Cold weather increases peripheral arterial resistance and systolic blood pressure, and consequently, left ventricular end diastolic pressure increases. This fact leads to an increase in left atrial pressure and distension of the atrium that initiates and perpetuates AF. Cold temperatures may facilitate AF development acting on the neuroendocrine system and increasing noradrenaline levels that facilitate AF onset. In winter, glucose intolerance has been reported and it may promote AF paroxysm [8]. Considering that peripheral thyroid hormones increase in adaptation to cold exposure, it has been suggested that the physiological seasonal modification in peripheral thyroid hormones could influence the seasonal variation of AF episodes [19].

LIMITATIONS

This study was retrospective and thus, some data for analysis such as the timing of AF onset, were not available. Other factors that we did not consider may have influenced AF onset episodes as physical exertion, alcohol consumption, mental and emotional stress, time spent outdoors, and air quality data.

We were not able to correlate each AF episode with the actual air temperature on the specific day.

Our patients referred to the ED may not be representative of the whole patient population with symptomatic AF episode onset in our area because some patients are not referred to the hospital.

CONCLUSIONS

Meteorological conditions influence symptomatic exacerbation of atrial fibrillation episodes and hospitalization. Outdoor temperature, barometric pressure (but not relative humidity) are thought to mediate a monthly fluctuation in atrial fibrillation episodes with the peak in December and the lowest point in June.

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Are you a politician asking what your country can do for you or a zealous one asking what you can do for your country?

Kahlil Gibran (1883–1931), Lebanese-American poet and artist