

# Monthly admissions for heart failure (HF)— Environmental links

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## ABSTRACT

In recent years the role of HF in the outcomes, cost of treatment in cardiology is raising. Concomitantly a number of studies were published demonstrating connections of many cardiac events with Space Weather Activity-Solar, Geomagnetic, Cosmic Ray (Neutron) activity levels. The aim of this study was to study links of timing of hospital admissions for HF with season and space weather components. **Patients and Methods:** monthly admissions of male and female patients for HF in two hospitals of Rabin Medical Center for years 2000-2012 were the subject of the study. 76,601 patient were included, 42,293 men, 34,308 woman. The cosmophysical data from USA, Russia and Finland were used. **Results:** Monthly average number of admissions for HF:  $491.0 \pm 82.4$ ,  $271.1 \pm 46.75$  for men and  $219.9 \pm 39.8$  for woman. Gender admissions strongly correlated. Monthly admission for HF number differed by 2.2 - 2.5 times. Minimal admissions were in August, September; maximal—in January, February, December and March (according to numbers). It was a significant inverse correlation of monthly HF admissions with monthly solar activity and GMA indices and correlation with CRA (neutron) activity. **Conclusion:** Monthly admissions number for HF is fluctuated by season of the year, depending on gender and related to monthly solar and Cosmic Ray (Neutron) activity level. Gender differences in HF exacerbation may be a component explaining gender differences in longevity.

## KEYWORDS

Monthly; Admissions; Heart; Failure; Male; Female; Solar; Geomagnetic; Cosmic; Ray Neutron; Activity

## 1. INTRODUCTION

The aging human population, progress in the treatment of Acute Cardiac Event and drop in related mortality stimulate the increase of admissions number and cost of treatment of heart failure patients. It's also a rising group between death causes from heart diseases [1-10]. In recent years many studies were published demonstrating the links of a number of cardiovascular events (AMI, SCD, Cardiac Arrhythmia, Stroke) with environmental physical activity-solar (SA), Geomagnetic (GMA), Cosmic Ray (Neutron) (CRA) activity. The aim of this study was to check the timing of hospital admissions of heart failure (HF) patients and association of monthly distribution of admissions with season of the year and the mentioned space weather components.

**Patients and Methods:** The subject of the study was 76,601 admissions of 27,187 (14,457 male and 12,729 female) patients in two hospitals (Beilinson and Hasharon) of Rabin Medical Center in Petah Tiqwa, Israel, a tertiary medical facility, affiliated to Tel Aviv University. The admitted patients included 42,293 male and 34,308 female. The observation time was 13 years—2000-2012, 156 months. Monthly admissions for patients with HF, including codes 428 - 0.1 of the IDC9 were included in this study. Statistical evaluation included monthly both gender admissions and the number comparison, average monthly admission numbers, maximal and minimal admissions monthly and monthly admission number cor-

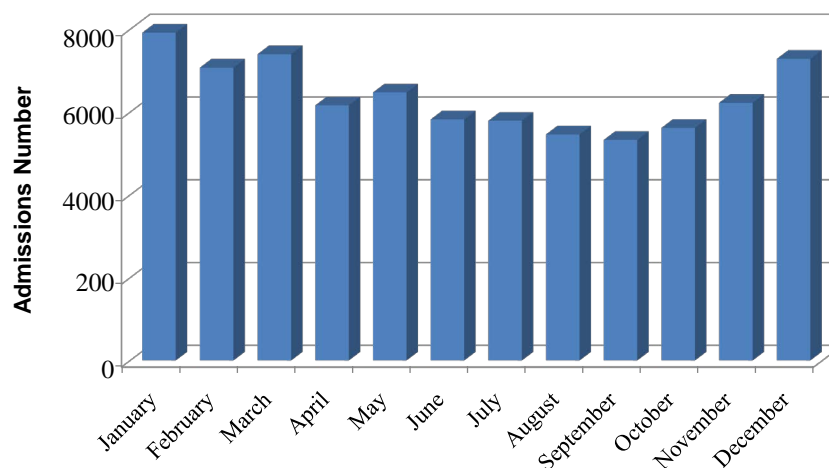
relation with SA, GMA, CRA (Neutron) activity monthly indices. The cosmophysical data were obtained from space science institutions in the USA, Russia and Finland [11-15].

For the obtained results Pearson correlation coefficients and their probabilities were calculated. Probabilities of 95% and higher were accepted as significant, these of 90% - 94.9%—as strong trend to statistical significance.

## 2. RESULTS

The number of admissions fluctuated by season, achieving the maximum in winter months—January, February, December, March, according to admission numbers, and minimal in late summer—August and September. The monthly admission range was 338 - 726 for all admissions; 180 - 410 for male and 171 - 326 for female patients monthly admissions. The average of HF patient's admissions at the observation time was 2.82 times/per patient; 2.91 for male and 2.70 for female patients.

**Figure 1** presents the monthly distribution of admissions for HF in Beilinson and Hasharon hospitals of Rabin Medical Center in years 2000-2012. The monthly average admission number was  $491.0 \pm 82.4$ ;  $271.1 \pm 46.75$  for male and  $219.9 \pm 39.8$  for female patients.



**Figure 1.** Monthly admissions number for heart failure (n = 76,601) Rabin Medical Center, 2000-2012.

**Table 1.** Heart failure patients admission number monthly and space weather activity indices pearson correlation coefficients (r) and their probabilities (p).

1. Index	Pts. No.	Correlat. Coeff. and Probab.	Sunspot No.	Smoothed Sunspot No.	Solar Flux 2800 MGH, 10.7 cm	Adjusted Solar Flux	Geomagnetic Activity			Cosmic Ray (Neutron) Activity Imp/min	
							Ap.	Am.	Cp.	Moscow	Oulu
2. All	76,601	R	-0.36	-0.33	-0.28	-0.30	-0.04	-0.003	-0.01	0.13	0.11
		P	<0.001	<0.001	<0.001	<0.001	<0.001	0.406	0.006	<0.001	<0.001
3. Male	42,293	R	-0.40	-0.40	-0.34	-0.32	-0.11	-0.081	-0.07	0.22	0.17
		P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4. Female	34,308	R	-0.28	-0.28	-0.20	-0.23	0.05	0.088	0.07	0.08	0.03
		P	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

progress in HF in the Framingham study was 8 per 1000 at age 50 - 59 for both gender, and 66 per 1000 for male and 79 for female at age 80 - 89 [5]. In a later European-Rotterdam study male patients prevailed, like in this study, and the percent of HF patients increased from 0.9% at age 55 - 64 to 17.4% in persons 85 years and older [6]. Both American and European authors predict that in the next 7 - 10 years the percent of HF will increase by 20% - 25% [3-6]. In the latest (2013) American guidelines HF is described as affecting 20% of Americans at age  $\geq 40$ . HF is seen in 20:1000 in the age group of 60 - 69 achieving 80:1000 at age  $\geq 85$  with 50% 5 years mortality after diagnosis [8-10].

The season differences of HF admissions follow the yearly rhythmicity in mortality. In our previous study it was shown that in two different countries with significant climate differences in the Northern hemisphere cardiovascular mortality is maximal in February [16]. The response of the cardiovascular system to lower temperatures, comorbidities, changes in diet, social problems are between the possible stimulators for HF exacerbation in winter months [2,3,5]. New studies confirm the positive impact of Flu vaccination on cardiovascular disease natural history [17].

Special attention was put on links between admission time (month) and associated space weather activity indices. It follows a number of publications describing such links between SA, GMA, CRA (Neutron) activity and such cardiovascular emergencies like SCD, AMI, life threatening cardiac arrhythmia's, blood coagulation, inflammation markers, immunoglobulin levels, hormone production with the level of the mentioned cosmophysical parameters [18-58].

Between the mentioned risk factors for HF [2] coronary heart disease, cardiac arrhythmia, arterial hypertension exacerbation are significantly connected with such space weather parameters like SA, GMA, CRA (Neutron) activity [30-58].

Such pathogenesis factors like myocardial contractility (related to coronary perfusion and ischemia), arrhythmia—atrial fibrillation, different sorts of tachycardia, or heart conduction defects can serve as aggravating heart failure factors, changing the patients status and demanding hospital treatment [2].

The data presented in **Table 1** confirm such connection between HF monthly admissions and studied physical indices.

Here it must be explained the interrelationship between the mentioned space physical activity factors: Cosmic ray origin is still a subject for active scientific discussion. The most energetic (mostly proton consisting) part of CRA are the highest known energies, reaching  $10^{20-22}$  electronvolt. The accepted physical laws are built for energies up to  $10^{19}$  electronvolt. If Cosmic Ray would

be from our galaxy it would demand to add a special coefficient (Plank parameter) to most energy related formulas. This was discussed repeatedly in the last years [59-61]. But at this stage it's accepted that Cosmic Ray comes to our galaxy from a "near", but different galaxy, or from there located Supernova [62-64]. This allows remaining with the accepted energetic processes formulation. The SA and GMA are natural shields of our Planet from the super energetic parts of Cosmic Ray [59-64]. In our previous publications it was shown that in the last 10 - 20 years SA was inverse correlated with CRA by  $r = -0.85$ ,  $p < 0.0001$  and positive related to GMA,  $r = 0.50$ ,  $p < 0.0001$ . GMA is also inverse related to CRA,  $r = -0.66$ ,  $p < 0.0001$ . This explains the negative correlation of SA with HF admissions seen in **Table 1**, and positive with CRA. CRA is measured by Neutron activity (imp/min) on the Earth surface. Why Neutron? The high energy Cosmic Rays are so energetic, that many atom electrons in the surrounding space are compressed into the nuclei of the atoms and converted to Neutrons. The number of these remains of atoms arriving to the Earth's surface is the measure of Cosmic Ray activity [59]. Despite the multiple etiology of HF exacerbation, were the medical side is only one of many "players" in the change in the natural history, we see that the changes in this part of the process follows the time distribution of such medical events like AMI, SCD, Stroke by their connection with physical parameters of the space weather [11,15,21,46,47]. In an additional study related to circannual death distribution it was shown that this process is rhythmic and the acrophase for total deaths number, cardiac origin and stroke related deaths are in February, with small time differences by gender and each of the mentioned etiologies [16,17,21]. The male prevalence in HF admissions can be a component of causes related to higher, female longevity in most countries [65].

The relatively low, but very significant correlation coefficients in **Table 1** are a consequence of number of factors: antagonistic action of the space activity factors—SA and GMA are inverse correlated to CRA and serve as a shield of our Planet from CRA. SA is at  $r = -0.85$  related to CRA; GMA at  $r = -0.66$  [11,46,47,57,58]. HF is provoked by many, often very different, factors that are different related with environment influences; GMA and CRA are more connected with daily than in monthly fluctuations in biological effects [11,15,21].

#### 4. CONCLUSIONS

Monthly admissions number for HF is fluctuated by season of the year, depending on gender and related to monthly solar, Geomagnetic and Cosmic Ray (Neutron) activity level.

Gender differences in HF exacerbation can be a component explaining longevity differences in male and female longevity in most industrialized countries.

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