PREVENTIVE MEDICINE - LABORATORY **ORIGINAL PAPERS**

PREDICTORS OF ADMISSION/NON-ADMISSION INTO THE HOSPITAL, HEALTH EFFECTS, AND METEOROLOGICAL FACTORS RELATED TO A VIOLENT STORM IN TIMISOARA, ROMANIA

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PREDICTORS OF ADMISSION/NON-ADMISSION INTO THE HOSPITAL, HEALTH EFFECTS, AND METEOROLOGICAL FACTORS RELATED TO A VIOLENT STORM IN TIMISOARA, ROMANIA (Abstract): The aim of the performed study is to investigate predictors of admission/non-admission into the hospital, health effects and meteorological factors related to a violent storm that happened on the 17^{th} of September 2017, in Timisoara, Romania. **Materials and methods:** Case-study with a 6-day retrospective investigation (15^{th}-20^{th} September) of admissions/non-admissions, all health effects and storm-trauma health effects, and meteorological factors on a sample of 1,156 patients (54.93% males, 45.07% females) who came to the ERU, sample that included a "storm-trauma" sample of 71 patients (60.60% males, 39.40% females). **Results:** Three subgroups of the entire sample were considered: before storm-no effects (15^{th}-16^{th}), during and after the storm-immediate effects (17^{th}-18^{th} and after the storm-delayed effects (19^{th}-20^{th} of September). Traumatic health effects (16.7% of trauma, 13.3%-due to the storm) and meteorological factors values (air temperature-31.6^{0}C, air pressure-732 mmHg, gust wind speed-106.92 Km/h-violent storm) were recorded on the 17^{th} of September. **Discussion:** Main predictors for admission into the hospital were covariate: mean air temperature (OR=1.924, P<0.001), relative humidity and age increase, and categorical: cardiac diseases (OR=0.436, P<0.001), fractures (OR=0.375, P<0.001), and urban/rural environment. A primary categorical predictor for non-admission into the hospital was contusions. A subgroup of population exposed to the storm (17^{th}-18^{th} of September) recorded significant differences in term of being admitted into the hospital in comparison with the other two subgroups. **Conclusions:** there is a relation between admissions/non-admissions into the hospital and personal characteristics (age, rural/urban), health effects (cardiac diseases, fractures, contusions), and meteorological factors (air temperature, humidity, pressure) in the context of the violent-storm. **Keywords:** ADMISSION, HOSPITAL, HEALTH EFFECTS, METEOROLOGICAL FACTORS, STORM.

INTRODUCTION

On the 17^{th} of September 2017 at 3.40 p.m. a violent storm happened in the Western region of Romania. Under the conditions of a particularly strong thermal contrast (the quick decrease of the air temperature from 31-32°C to 16°C) the base of the formed clouds was very close to the ground (500-600 meters), while their peak reached 10,000-13,000 meters and caused the production of these particularly violent phenomena. An orange code was issued at 3.38 p.m. (1), but since it was a Sunday, people were outdoors and relaxing. Severe health effects and environmental damages followed the storm: 8 people died and 67 were wounded (2). It was a mid-latitude storm, with around 100 Km^2 surface area (Western region of the country- large disaster) and small number of deaths (8- small disaster) (3, 4). Several trees and several buildings were damaged. People were also injured as a result of trying to repair the damage done to buildings and trees. The Emergency Receiving Unit (ERU) of the County Emergency Clinical Hospital performed the reception, consultation and referral of patients to hospitals' departments. Current research that has been carried out on the impact of climate change at global and regional level reviewed vulnerabilities of the natural world and human societies to adapt to climate change and extreme weather events (5). Older persons and their families employed predictive and adaptive strategies to avoid and minimize extreme weather impacts (6). Vital lessons could be learned from extreme weather events and a management strategy for wind disasters is important for planning in advance a well prepared and prompt response to potential damages involving health (7). Certain studies on extreme weather events in the area have described a historic afternoon pattern of tornadoes in the Eastern region of the country (8) and an inappropriate behavior of the population during and immediately following a disaster (9). A lack of knowledge is observed regarding health effects of extreme weather events in the Western region of the country. A framework consisting of rapid needs assessments, health surveillance, tracking, registries and epidemiological investigations, including risk factors and health outcome studies and evaluation of interventions need to be applied throughout a disaster management cycle. Epidemiological methods (case-studies) have to be routinely integrated into disaster response and fully communicated to response leaders (10). The aim of this study is to investigate predictors of admission/non-admission into the hospital, the health effects, and the meteorological factors that are related to a violent storm.

MATERIALS AND METHODS

The study was performed on a "retrospective 6-day investigation" sample of 1,156 patients (54.93% males and 45.07% females, aged 8-93 years) with an included "storm-trauma" sample of 71 patients (60.6% males and 39.4% females, aged 9-91 years), patients who were received at the Emergency Receiving Unit (ERU) of the County Emergency Clinical Hospital, in the context of a violent storm that happened on the 17th of September 2017. The "retrospective 6-day investigation" sample consisted of patients who were received at the ERU over the course of 6 days (15th-20th September, 2017) considering all health effects. The "storm-trauma" sample consisted of patients received at the ERU from the 17th of September at 4 p.m. to the 18th of September at 8 p.m., considering traumatic health effects due to the storm. The daily distribution of patients received at the ERU can be seen in tables I and II.

The method consisted of a case-study with a retrospective 6-day investigation (15th -20th of September) using:

Primary medical evidence: patients who went or were taken to the ERU; patients who were/not were admitted into the hospital; all health effects and storm related trauma health effects;

The meteorological factors: temperature-ºC, relative humidity-%, precipitations-liters/m^2, pressure-mmHg, wind speed-Km/h, sunshine-hours) established at the Regional Meteorological Center.

The storm happened on the 17th of September and lasted 20 minutes (from 3:40 to 4:00 p.m.), all the population in the area were exposed to the specific meteorological factors. In order to separate the population exposed to the storm from the population not exposed the author considered: 15th-16th of September corresponding to before storm- no effects; 17th-18th of September - during and immediate effects of the storm; 19th -20th of September - after the storm- delayed effects.

Statistical analysis (frequency, Kruskal Wallis, Mann-Whitney with Bonferroni correction, Chi square, ANOVA one way and binary logistic regression) was performed with the aid of *SPSS 20* software (11). Storm trauma effects were analyzed considering the frequency due to the small size of the sample. Statistical comparison between 2-day distribution series of patients was performed by the aid of Kruskal Wallis, Mann-Whitney with Bonferroni correction and *Chi square* analysis for categorical variables (gender, rural/urban, diagnostics, admission/non-admission into the hospital) and ANOVA one way for covariate variables (age, meteorological factors).

Personal predictors (gender, age and urban/rural environment), time predictors (date and hour of patients' reception at the ERU), established diagnostics and meteorological factors (temperature, humidity, precipitations, wind speed, pressure and sunshine) as possible predictors were analyzed for the entire sample relative to admission/non-admission of patients into the hospital sections or the other medical units from the ERU, using binary logistic regression. This type of regression uses the dependent variable consisting of only two nominal categories (admission/non-admission into the hospital), and any score (covariate: age, temperature, humidity, wind velocity and pressure values) or nominal (categorical: gender, rural/urban environment, daily and hourly presentation to the ERU, diagnostics) variables can be used as the predictors. The reference category is the non-admissions into the hospital for categorical variables. A similar analysis was performed for admitted patients with the main associated diagnostics (presence/absence of diagnostic) as dependent variable related to personal characteristics, time, and meteorological possible predictors.

The author asked for and received from the County Hospital Leadership the agreement to access primary evidence while keeping this evidence confidential and respecting the personal data protection law. The medical data were already collected for medical and statistical purpose, with the requested and received individual consent of the patients. The initial outcome of all health effects data registration was for medical and statistical purpose, and the initial outcome of the traumatic health effects due to the storm data collection was to report to local and national authorities. The agreement (no. 8/22.03.2019) of the University of Medicine and Pharmacy's Ethical Commission was requested and obtained (for this statistical clinical study).

RESULTS

Daily and hourly presentation of patients to the ERU

Daily presentations of patients to the ERU recorded the highest frequencies on the 17th (17.39%), 18th (18.94%) and 19th (17.48% of patients) of September, 2017 (tab. I). The highest frequency of patients received at the ERU due to storm related trauma was recorded on the 17th of September, 2017 (76.06% of patients) (tab. II).

Hourly evolution of the all causes related trauma and of the storm related trauma emergencies observed during the 17th and 18th of September, 2017 reveals the greatest numbers of patients with traumatic health effects due to the storm on the 17th of September between 4 p.m. and 9 p.m. (48 patients) and on the 18th of September between 12 a.m. and 8 p.m. (17 patients) in the context of all trauma health effects (fig. 1).

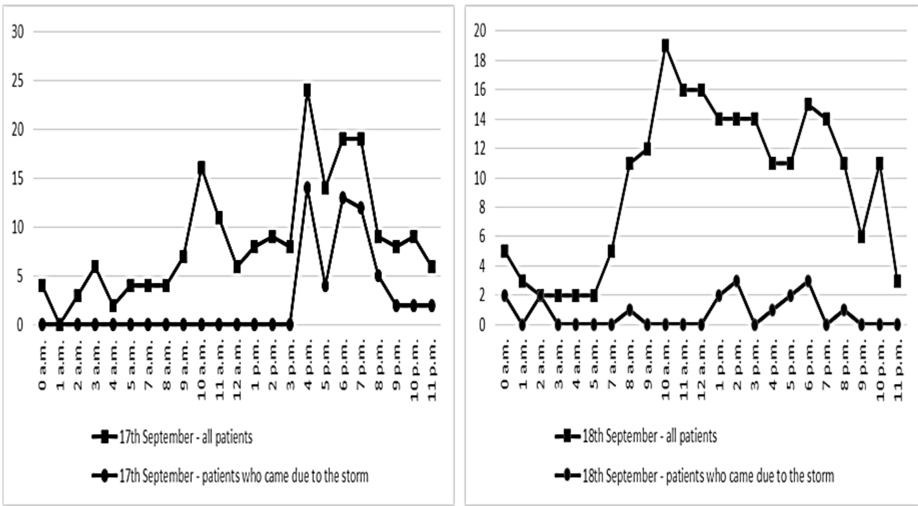

Fig.1. Hourly-evolution of all patients and patients who came at the ERU due to the storm (17th-18th September)

Personal features (gender, age, and rural/urban environment)

Patients who went or were taken to the ERU during the retrospective 6-day investigation for all health effects were more frequently males (54.9%) than females (45.1%) with a peak on the 18th of September for males (57.5%) (tab. I). Patients who went or were taken to the ERU due to the storm related trauma were more frequently males (60.6%) than females (30.4%) with peaks on the 17th of September for both genders: males-32 patients and females-22 patients (tab. II).

Age groups distribution of patients who went or were taken to the ERU with all health effects from the 15th to 20th of September 2017 recorded the greatest frequencies at ages 60-70 (16.9%), 20-30 (15.2%) years (tab. I). For patients who arrived at the ERU with storm related trauma on the 17th and 18th of September the highest frequencies were recorded for ages 50-60 (26.8%) and 20-40 (38%) years (tab. II).

Between the 15th and 20th of September, the patients from urban area came or were taken to the ERU more frequently than patients from rural area (tab. I). During the 17th-18th of September period, the frequency of patients who came from rural area increased (from 43.8% to 52.1%, respectively) and the frequency of patients who came from urban area decreased (from 56.2% to 47.9%, respectively). On the 18th of September the frequency of patients from rural areas (52.1%) was higher than patients from urban areas (47.9%) (tab. II). Patients who were directly affected (with trauma) by the storm came to the ERU more frequently from rural (38, 53.5%) than from urban (33, 46.5%) areas (tab. II).

There was no statistically significant difference (Kruskal-Wallis, Mann-Whitney with Bonferroni correction) in the personal characteristics of patients who came or were taken to the ERU before, during and after the storm 2-day samples.

Health effects

All diagnostics distribution in the patient population received at the ERU during the retrospective 6-day investigation (15th-20th September) can be seen in first table. An increase of frequencies was recorded for neurologic (199; 13.7%), digestive (162; 11.2%) diseases, contusions (159; 11%), urinary diseases (112; 7.7%), fractures (100; 6.9%) and cardiac diseases (94; 6.5%). There was no statistically significant difference (Kruskal-Wallis, Mann-Whitney with Bonferroni correction) in the diagnostics of patients who came or were taken to the ERU before, during and after storm.

Traumatic health effects

The greatest numbers of trauma diagnostics were recorded on the 18th (166 diagnostics, 28.7%) and 17th (97 diagnostics, 16.7%) of September 2017 (tab. I). During these 2 days 45.8% of all trauma were observed, 19.3% (112 diagnostics) of them due to the storm, according to the patients' statements (tab. II).

Traumatic health effects due to the storm

Traumatic health effects due to the storm could be seen in comparison with all trauma diagnostics on the 17th (amputations-1/1, contusive wounds-21/21, cut wounds-5/5, CCT-cranial-cerebral trauma-17/17 and fractures-15/15) and 18th of September (contusions-7/47, CCT-4/13, fractures-9/26, and sprains-5/13) (fig. 2).

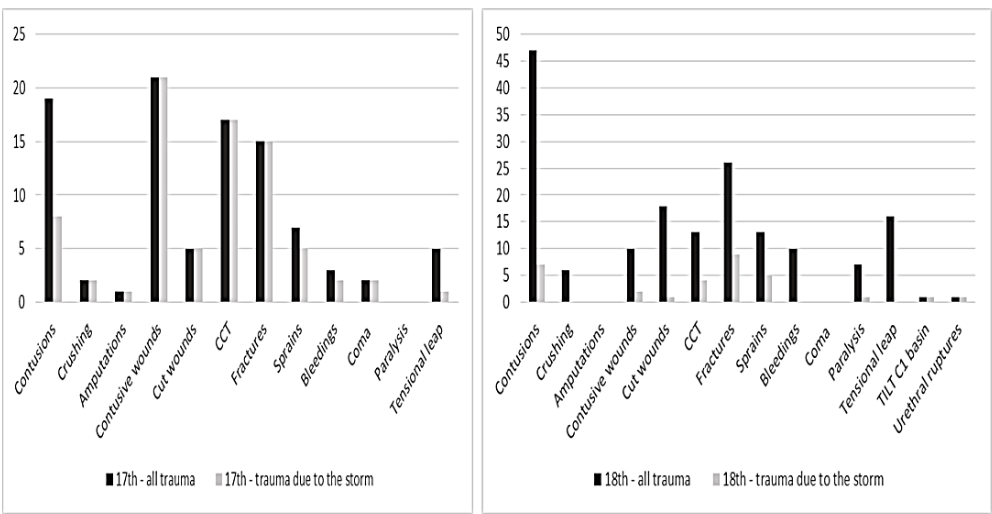

Fig. 2. All traumatic health effects and traumatic health effects due to the storm, seen comparatively (17th-18th September)

Admissions/non-admissions into the hospital

Over the period from the 15th to the 20th of September, the patients who were received, consulted and treated at the ERU were sent home (829; 71.7%), or they were admitted to the hospital sections (327; 28.2%) as follows: surgery (71; 6.1%), neurosurgery (36; 3.1%), neurology (43; 3.7%), orthopedics, traumatology and politraumatology (32; 2.8%), gastroenterology (20; 1.7%), cardiology (17; 1.5%), infectious diseases (15; 1.3%) (fig. 3).

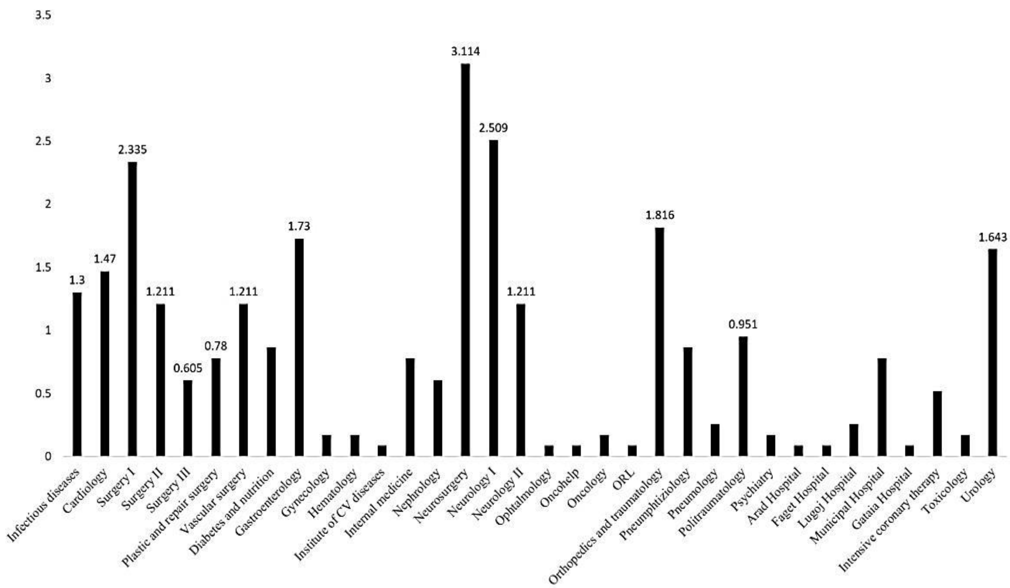

Fig. 3. Patients' distribution (%) according to hospital sections to which they were sent from the ERU

Daily admission/non-admission into the hospital can be seen in tables I and II. Admission of patients into the hospital was the highest in term of frequency in the 17th and 18th of September for all diagnostics (22.3% and 24.8%, respectively) and for trauma due to the storm diagnostics (23.9% and 15.5%, respectively).

A statistically significant difference (Chi Square=25.97, P<0.001) of admitted patients between time series (15th-16th, 17th-18th and 19th-20th of September) was found as follows: between 15th-16th and 17th-18th (Mann-Whitney: z=-4.87, P<0.001) and between 17th-18th and 19th-20th (Mann-Whitney: z=-3.306, P=0.001). No difference (Mann-Whitney: z=-1.674, P=0.094) of admitted patients was recorded between 15th-16th and 19th-20th of September.

Patients affected directly by the storm were more frequently admitted (28 patients, 39.4%) into the hospital than patients from the 6-day investigation sample (327; 28.2%). Most frequently admitted into the hospital due to the storm were male patients (26.7%), age group 50-60 years (11.2%), from the rural environment (25.4%), with fractures (12.7%), on the 17th of September (23.9%), when the violent storm happened.

TABLE I.

Descriptive statistics of 6 days investigation sample, all variables

Variables		**6 days investigation sample n[1] (%)**						
		15.09	**16.09**	**17.09**	**18.09**	**19.09**	**20.09**	**Total**
Daily presentation to the ERU		166(14.4)	186(16.1)	201(17.4)	219(18.9)	202(17.5)	182(15.7)	**1156 (100%)**
Gender	Male	94(56.6)	100(53.8)	106(52.8)	**126(57.5)**	114(56.4)	97(53.2)	**635(54.9)**
	Female	72(43.4)	86(46.3)	**95(47.2)**	93(42.5)	88(43.6)	87(47.8)	**521(45.1)**
Age	0-10 y.o.	1(0.6)	0	2(1)	1(0.5)	0	0	4(0.3)
	10-20 y.o.	3(1.8)	1 (0.5)	8(4)	11(5)	11(5.45)	3(1.65)	37(3.2)
	20-30 y.o.	23(13.9)	35(18.8)	31(15.4)	27(12.3)	31(15.35)	29(15.9)	**176(15.2)**
	30-40 y.o.	21(12.7)	33(17.7)	30(14.9)	30(13.7)	26(12.9)	23(12.6)	163(14.1)
	40-50 y.o.	22(13.3)	27(14.5)	23(11.4)	37(16.9)	32(15.8)	23(12.6)	164(14.2)
	50-60 y.o.	22(13.3)	15(8.1)	32(15.9)	26(11.9)	20(9.9)	30(16.5)	145(12.6)
	60-70 y.o.	36(21.7)	33(17.7)	34(16.9)	28(12.8)	35(17.3)	30(16.5)	**196(16.9)**
	70-80 y.o.	17(10.2)	24(12.9)	22(10.9)	31(14.2)	28(13.9)	22(12.1)	144(12.5)
	80-90 y.o.	8(4.8)	12(6.5)	12(6)	12(5.5)	9(4.5)	12(6.6)	65(5.6)
	> 90 y.o.	1(0.6)	0	1(0.5)	0	3(1.5)	2(1.1)	7(0.6)
	Missing[2]	12(7.2)	6(3.2)	6(3)	16(7.3)	7(3.5)	8(4.4)	55(4.8)
Environment	Rural	68(41.0)	78(41.9)	**88(43.8)**	**114(52.1)**	80(39.6)	84(46.2)	**512(44.3)**
	Urban	98(59.0)	108(58.1)	113(56.2)	**105(47.9)**	122(60.4)	98(53.8)	**644(55.7)**
Diagnostics	Neurologic	27(12.4)	35(16)	27(12.2)	50(13.9)	27(11.7)	33(16.3)	**199(13.7)**
	Digestive	26(12)	27(12.4)	24(10.8)	24(6.6)	34(14.7)	27(13.3)	**162(11.2)**
	Contusions[3]	19(8.7)	21(9.6)	19(8.6)	47(13)	29(12.6))	24(11.9)	**159((11)**
	Urinary	21(9.7)	14(6.4)	19(8.6)	23(6.4)	15(6.5)	20(9.9)	**112(7.7)**
	Fractures[3]	13(6)	18(8.3)	15(6.8)	26(7.2)	16(7)	12(5.9)	**100(6.9)**
	Cardiac	23(10.6)	12(5.5)	11((5)	20(5.5)	19(8.2)	9(4.5)	**94(6.5)**
	CCT[3]	8(3.7)	14(6.4)	17(7.7)	13(3.6)	9(3.9)	6(3)	67(4.6)
	Contusive wounds[3]	10(4.6)	5(2.3)	21(9.5)	10(2.8)	14(6)	3(1.5)	63(4.3)
	Tensional leap[3]	14(6.4)	8(3.7)	5(2.3)	16(4.4)	4(1.7))	8(4)	55(3.8)
	Respiratory	1(0.5)	13(6)	9(4.1)	13(3.6)	9(3.9)	7(3.4)	52(3.6)
	Cut wounds[3]	6(2.8)	5(2.3)	5(2.3)	18(5)	10(4.3)	5(2.5)	49(3.4)
	Sprains[3]	6(2.8)	8(3.7)	7(3.1)	13(3.6)	6(2.6)	5(2.5)	45(3.1)
	Others ([3])	43(1) (19.8)	38(4) (17.4)	42(8) (19)	88(23) (24.4)	39(1) (16.9)	43(4) (21.3)	293(41) (20.2)
	Total[3]	77(13.3)	83(14.3)	97(16.7)	166(28.7)	89(15.4)	67(11.6)	579(100)
Total diagnostics		217(15)	218(15)	**221(15.2)**	**361(24.9)**	**231(15.9)**	202(14)	**1450(100)**
Admission/ non-admission into the hospital		36(11)/ 130(15.7)	37(11.3)/ 149(18)	**73(22.3)/ 128(15.4)**	**81(24.8)/ 138(16.6)**	53(16.2)/ 149(18)	47(14.4)/ 135(16.3)	**327(100)**/ 829(100)

[1]n - number of patients; [2]Patients did not declare age; [3]Trauma diagnostics.

TABLE II.

Descriptive statistics: 17th-18th September (investigation and trauma storm) variables

Variables		17-18.09.2017			17-18.09.2017		
		Investigation sample n[1] (%)			Storm trauma sample n[1] (%)		
		17.09	18.09	Total	17.09	18.09	Total
Daily presentation to the ERU		**201(17.4)[5]**	**219(18.9)[5]**	**420(36.3)[5]**	**54(76)**	**17(24)**	**71(100)**
Gender	Male	106(52.8)	126(57.5)	232	32(59.3)	11(64.7)	43(60.6)
	Female	95(47.2)	93(42.5)	188	22(40.7)	6(25.3)	28(39.4)
Age	0-10 y.o.	2(1)	1(0.5)	3(0.7)	1(1.8)	0	1(1.4)
	10-20 y.o.	8(4)	11(5)	19(4.5)	1(1.8)	0	1(0.1.4)
	20-30 y.o.	31(15.4)	27(12.3)	58(13.8)	10(17.9)	3(17.6)	13(18.3)
	30-40 y.o.	30(14.9)	30(13.7)	60(14.3)	12(21.4)	2(11.8)	14(19.7)
	40-50 y.o.	23(11.4)	37(16.9)	60(14.3)	4(7.1)	3(17.6)	7(9.8)
	50-60 y.o.	32(15.9)	26(11.9)	58(13.8)	14(25)	5(29.4)	19(26.8)
	60-70 y.o.	34(16.9)	28(12.8)	62(14.8)	4(7.1)	2(11.8)	6(8.4)
	70-80 y.o.	22(10.9)	31(14.2)	53(12.6)	2(3.6)	1(5.9)	5(7)
	80-90 y.o.	12(6)	12(5.5)	24(5.7)	4(7.1)	0	4(5.6)
	> 90 y.o.	1(0.5)	0	1(0.2)	1(1.8)	0	1(1.4)
	Missing[2]	6(3)	16(7.3)	22(5.2)	3(5.4)[4]	1(5.9)[4]	4(5.6)[4]
Environment	Rural	88(43.8)	114(52.1)	202	26(48.1)	12(70.6)	38(53.5)
	Urban	113(56.2)	105(47.9)	218	28(51.9)	5(29.4)	33(46.5)
Diagnostics	Neurologic	27(12.2)	50(13.9)	77(13.2)	0	0	0
	Digestive	24(10.8)	24(6.6)	48(8.2)	0	0	0
	Contusions[3]	19(8.6)	47(13)	66(11.4)	8(10.4)	7(20)	15(13.4)
	Urinary	19(8.6)	23(6.4)	42(7.2)	0	0	0
	Fractures[3]	15(6.8)	26(7.2)	41(7)	15(19.5)	9(25.7)	24(21.4)
	Cardiac	11((5)	20(5.5)	31(5.3)	0	0	0
	CCT[3]	17(7.7)	13(3.6)	30(5.2)	17(22.1)	4(11.4)	21(18.7)
	Contusive wounds[3]	21(9.5)	10(2.8)	31(5.3)	21(27.3)	3(8.6)	24(21.4)
	Tensional leap[3]	5(2.3)	16(4.4)	21(3.6)	0	2(5.7)	2(1.7)
	Respiratory	9(4.1)	13(3.6)	22(3.8)	0	0	0
	Cut wounds[3]	5(2.3)	18(5)	23(4)	5(6.5)	1(2.8)	6(5.3)
	Sprains[3]	7(3.1)	13(3.6)	20(3.5)	5(6.4)	5(14.3)	10(8.9)
	Others ([3]) (%)	42(8) (19)	88(23) (24.4)	130(32) (22.3)	6(7.8)	4(11.4)	10(8.9)
	Total [3]	97(16.7)[5]	166(28.7)[5]	263(45.4)[5]	77(13.3)[6]	35(6)[6]	112(19.3)[6]
	Total diagnostics	221(15.2)[5]	361(24.9)[5]	582(40.1)[5]	77(68.8)	35(31.2)	112(100)
Admission/ non-admission into the hospital		73(22.3)/ 128(15.4)[5]	81(24.8)/ 138(16.6)[5]	154(47.1) 266(32)[5]	17(23.9) 36(50.7)	11(15.5) 7(9.9)	28(39.4) 43(60.6)

[1]n - number of patients; [2]Patients did not declare age; [3]Trauma diagnostics;
[4]Not considered into trauma sample; [5] % from 6 days investigation sample; [6] % from total trauma diagnostics.

Meteorological factors

The highest values of the air temperature (mean-21.2ºC, maximum-31.6ºC and minimum-16.1°C) and of the wind speed (mean-7.2 Km/h, maximum-19.08 Km/h, and at gust-106.92 Km/h) were recorded on the 17th of September. Large variation of air temperature (difference between maximum-31.6°C and minimum-16.1°C) during the same day could be noticed. Low values of air pressure (mean-735.5 mmHg, maximum-737 mmHg and minimum-732.1 mmHg) were recorded on the 17th of September (tab. III) in association with precipitations (6 liters/m^2) and only 3.4 hours of sunshine. Gust wind speed indicated a violent storm on the Beaufort scale (level 11) on the 17th of September (fig. 4).

Table III.
Descriptive statistics: meteorological factors

Variables		6 days investigation meteorological factors						
		15.09	**16.09**	**17.09**	**18.09**	**19.09**	**20.09**	**Total**
Temperature (^{0}C)	mean	18.1	19.6	21.2	16.5	17.6	14.4	17.9
	maximum	23.6	30.8	**31.6**	23.5	25.0	21.3	25.9
	minimum	14.4	12.0	**16.1**	11.0	10.4	11.6	12.6
Relative humidity (%)	mean	53.5	60.0	66.0	77.5	68.0	93.8	69.8
Air pressure (mmHg)	mean	738.8	736.7	735.5	739.4	735.1	735.1	736.8
	maximum	740.9	739.0	**737.0**	740.5	739.3	735.5	738.7
	minimum	735.0	735.6	**732.1**	732.1	732.8	734.2	733.6
Wind velocity (Km/h)	mean	6.84	5.76	7.2	3.6	5.4	5.4	5.7
	maximum	20,52	17.28	19.08	9.72	13.32	12.96	15.5
	at gust	51.12	33.12	**106.92**	22.68	27.72	33.12	45.8

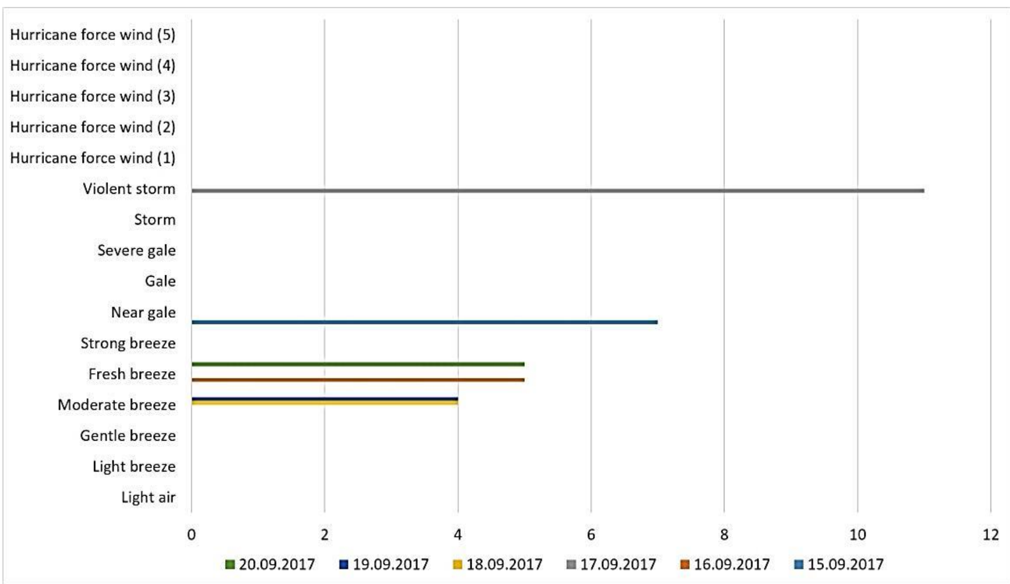

Fig. 4. Wind speed at gust over the investigated 6-day period on the Beaufort scale

There was a statistically significant difference (ANOVA) between air temperature recorded on 19th-20th of September and the other 2 time series 15th-16th ($P<0.001$) and 17th-18th September ($P<0.001$) as follows: mean air temperature ($F=317.402$, $P<0.000$), maximum air temperature ($F=201.204$, $P<0.000$) and minimum air temperature ($F=240.641$, $P<0.001$).

Mean air pressure recorded a statistically significant difference between the three time-series (ANOVA: $F=467.596$, $P<0.001$) with post hoc: 19th-20th and 15th-16th of September ($P<0.001$); and 19th-20th and 17th-18th of September ($P<0.001$). Air pressure maximum presented a statistically significant difference (ANOVA: $F=203.901$, $P<0.001$) between each of the three time-series.

Wind speed mean ($F=79.355$, $P<0.001$) and wind speed maximum ($F=277.885$, $P<0.001$) presented significant statistical differences between 15th-16th of September, and 17th-18th and 19th-20th series (*post hoc*, $P<0.001$).

Predictors of admission/non-admission into the hospital

Most relevant predictors of admission/non-admission into the hospital were established for the entire 6-day investigation sample of patients who came to the ERU.

Personal predictors (urban/rural environment, age)

An interesting result was obtained for the urban/rural environment categorical predictor related to admission/non-admission into the hospital. Reference for admission/non-admission was the last category (non-admission) for categorical variables. Patients who came from urban areas were more frequently non-admitted ($B=0.563$- good influence of predictor, $P=0.001$, $Exp(B)= 1.755$=Odd Ratio (OR) - an increase of non-admission of patients from urban area). The change in-2 Log Likelihood= 16.778= Chi square (χ^2) was significant ($P=0.001$) and supported the prediction (tab. IV). As a complementary result, patients who came to the ERU from the rural areas were more frequently admitted to the hospital than the patients who came from urban areas.

Age resulted as a covariate predictor significant for admission/non-admission into the hospital ($B=0.033$, $OR=1.033$ (95% CI: 1.026-1.041), $\chi^2=85.677$, $P<0.001$) (tab. IV). An increase of admission into the hospital is predicted by an increase of patients' age. The model is 70.7% accurate.

Time predictors (date, hour)

Date and hour at which the patients were at the ERU were not found as predictors or influencing factors on admission/non-admission into the hospital.

Established diagnostics as predictors

Main diagnostics that resulted as categorical predictors for admission/non-admission of patients into the hospital were: cardiac diseases ($B=-0.831$, $OR=0.436$, 95% CI: 0.279-0.681, $\chi^2=12.997$, $P <0.001$), fractures ($B=-0.982$, $OR=0.375$, 95% CI: 0.239-0.589, $\chi^2=17.612$, $P <0.001$), and digestive diseases ($B=-0.589$, $OR=0.555$, 95% CI: 0.387-0.794, $\chi^2=10.171$, $P=0.001$) (tab. IV). Negative values for B and $Exp(B)=OR<1$ indicate a decrease of non-admission (reference-last category=non-admission) into the hospital and a complementary increase of admission of patients into the hospital.

Other diagnostics that resulted as categorical predictors for admission/non-admission of patients into the hospital were: contusions ($B=0.740$, $OR=2.096$, 95% CI: 1.333-3.298, $\chi^2=11.419$, $P=0.001$), sprains (B=1.337, OR= 3.807, 95% CI: 1.337-10.838, P=0.012, χ^2=8.773), cut wounds (B=1.211, OR= 3.357, 95% CI: 1.306-8.625, P=0.012, χ^2=8.449) and psychiatric diseases-panic attacks (B=1.518, OR=4.564, 95% CI: 1.376-15.137, P=0.013, χ^2=9.101). Positive values for B and OR>1 indicate an increase of non-admission (reference-last category-non-admission) into the hospital (tab. IV). The model was 70.3% accurate.

Meteorological factors as predictors

Meteorological factors found as covariate predictors for admitted/not admitted patients who went or were taken to the ERU were: average air temperature (B=0.654, OR=1.924, 95% CI: 1.403-2.638, χ^2=17.408, P<0.001), maximum air temperature (B=-0.228, OR=0.796, 95% CI: 0.698-0.909, χ^2= 12.217, P<0.001) and relative humidity (B=0.065, OR=1.067, 95% CI: 1.035-1.101, χ^2=17.165, P<0.001) (tab. IV). Positive values of B and Exp(B)>1, 95% CI values>1 indicate an increase of hospital admission when the covariate predictors (mean air temperature between 16^0C-20^0C and relative humidity between 50%-80%) increase. Negative values of B and Exp(B)<1 indicate an increase of admissions into the hospital when the covariate predictor (maximum air temperature between 26°C-20°C) decreases. The model was 71% accurate (tab. IV).

TABLE IV.
Predictors of admission/non-admission into the hospital (n=327/n=829)

Personal predictors		B	Adjusted OR (95% CI)	*P*-value	Chi square	*P*-value
Step 1[a]	Age	0.033	1.033 (1.026-1.041)	0.000	85.677	0.000
	Gender (1)	-0.251	0.778 (0.592-1.022)	0.071	3.280	0.070
	Urban/Rural (1)	0.563	1.755 (1.339-2.301)	0.000	16.778	0.000
	Constant	-2.734	0.065	0.000		
Diagnostics		b	Adjusted OR (95% CI)	*P*-value	Chi square	*P*-value
Step 1[b]	Cardiac (1)	-0.831	0.436(0.279-0.681)	0.000	12.997	0.000
	Digestive (1)	-0.589	0.555(0.387-0.794)	0.001	10.171	0.001
	Contusions (1)	0.740	2.096(1.333-3.298)	0.001	11.419	0.001
	Contusive wounds (1)	0.796	2.217(1.023-4.806)	0.044	4.766	0.029
	Cut wounds (1)	1.211	3.357(1.306-8.625)	0.012	8.449	0.004
	Fractures (1)	-0.982	0.375(0.239-0.589)	0.000	17.612	0.000
	Sprains (1)	1.337	3.807(1.337-10.838)	0.012	8.773	0.003
	Psychiatric (1)	1.518	4.564(1.376-15.137)	0.013	9.101	0.003
	Constant	-4.144	0.016	0.000		
Meteorological factors		b	Adjusted OR (95% CI)	*P*-value	Chi square	*P*-value
Step 3[c]	Temperature air mean	0.654	1.924 (1.403-2.638)	0.000	17.408	0.000
	Temperature air maximum	-0.228	0.796 (0.698-0.909)	0.001	12.217	0.000
	Relative humidity	0.065	1.067 (1.035-1.101)	0.000	17.165	0.000
	Precipitation	-0.074	0.929 (0.874-0.987)	0.017	5.662	0.017
	Constant	-11.084	0.000	0.000		

a. Variable(s) entered on step 1: age, gender, and urban/rural environment. b. Variable(s) entered on step 1: cardiac, digestive diseases, contusions, and contusive wounds, cut wounds, fractures, sprains, psychiatric.

Predictors for main diseases of the patients admitted into the hospital

An interesting result was obtained for predictors of cardiac diseases and fractures.

Predictors of cardiac diseases

For cardiac diseases the main predictors were the age (B=0.038, OR=1.038, P<0.001, χ^2=42.516), and air pressure maximum (B=0.195, OR=1.215, P=0.002, χ^2=10.326, P=0.001). An increase of age and air pressure maximum (between 739 mmHg-741 mmHg) determines an increase in the number of patients with cardiac diseases. The model was 91.8% accurate. Both limits of air pressure maximum are situated under 760 mmHg (normal value at the sea level).

Predictors of fractures

For fractures the main predictors was the air pressure maximum (B=0.160, OR=1.173, and P=0.01, χ^2=7.213, P=0.007). An increase of air pressure maximum (between 739 mmHg-741 mmHg) relates to an increase of the frequency in which fractures occurred.

It is interesting that maximum pressure values between 739 and 741mmHg were recorded on the 18th of September. This means one day after the storm happened, when resulted an increase in the rate of these 2 diseases. The models were 74% accurate.

DISCUSSION

In the study performed the health effects in patients who went or were taken to the ERU due to common causes and due to a violent storm were retrospectively investigated. Use of the emergency health information offered to the author the possibility to analyze all health effects and health effects due to the violent storm, time evolution of patients received at the ERU, personal characteristics and admissions/non-admissions into hospital. The entire process that was analyzed happened in the context of population exposure to specific meteorological factors before, during and after the storm. The retrospective approach of extreme weather phenomena related to health effects recorded at emergency department is frequently mentioned in research literature in order to investigate the impact on population in real situations (12) and to assess the risk as an implementation strategy to reduce the negative impact on the population exposed (13).

Age distribution of the patients who were received most frequently at the ERU during the performed case-study indicates two age groups: old people (60-70 years) and young adults (20-30 years). Research in the field describes length of time spent in the emergency department for patients over 70 years (14) and an association between wind disasters and emergency department visits by age and causes (injuries, cardiac diseases for people over 65 years and renal diseases for people between 18-64 years) (15).

During the retrospective 6-day investigation the gender distribution of patients who were taken to the ERU was higher for males than for females, and the difference between the two genders distribution increased when the main reason for their needing medical attention at the ERU was injury due to the storm. The role of gender in emergency research and practice was mentioned in certain studies that consider trauma diseases (16) or cardiovascular diseases (17).

Patients who arrived at the ERU during

the retrospective 6-day investigation came more frequently from urban than rural areas. During the 17th and 18th of September, the days when the patients affected directly by the storm came to the ERU along with the other patients, those affected by the storm came more frequently from rural than from urban areas. The primary care system capacity in rural areas could be inadequate for responding to storm (18). Research literature regarding rural emergency management of public health crisis identifies as solutions: permanent institutions; improving interventions at the pre-disaster, disaster and post-disaster stages; investments and a reserve system of resources (19). On the other hand, the attitude and the response capacity of primary care medical staff in a rural area proved to be poor in another study (20).

Many patients who were affected by the storm went or were taken to the ERU between 4 p.m. and 9 p.m. on the 17th of September and between 12 a.m. and 8 p.m. on the 18th of September. The greatest percentage in terms of frequency of patients who arrived at the ERU was recorded there from the 17th to the 19th of September. An important aspect is that this violent storm happened on Sunday, during the weekend. In the performed study, the days of the week and the hours did not impact significantly the activity of ERU. In other research studies, on the other hand, the day of the week was shown to be an important factor (especially during the weekend) that could impact the Emergency Department efficiency: more time caring for emergency patients, less median specialist intensity or higher mortality at admission (21).

Health effects diagnosed in patients who came to the ERU were most frequently neurologic diseases, digestive diseases, contusions, urinary diseases, fractures and cardiac diseases. The number of admitted conditions (15) resulted in another research was similar to the study performed (17, if all trauma conditions are considered trauma), although they seem to be of a different order in terms of magnitude (22). Fractures and cardiac diseases most frequently resulted in hospital admissions. The research literature mentions acute myocardial infarction as one of the main causes of mortality in emergency department for non-traumatic diseases (23).

When traumatic health effects were analyzed over the entire 6-day period, resulted that the greatest frequency of trauma happened during the two day-period of the 17th to the 18th of September. Moreover, certain traumatic diseases were frequent and directly connected with the storm during these 2 days, such as: contusive wounds, CCT, fractures, sprains, contusions and cut wounds. Another study of trauma showed that women mainly experienced fractures and contusions/abrasions, whereas men experienced open wounds (24). Traumatic brain injuries found in the performed study were also investigated in research literature with the purpose of improving the efficiency of the emergency departments' management of patients with mild traumatic brain injuries (25).

An important aspect pursued in this case-study with the retrospective 6-day investigation was the admission and non-admission to the hospital (sending the patients home). A great proportion of patients (2/3 - 3/4) of the total number were received, consulted, treated at the ERU and sent home (26). The hospital sections that most frequently received patients who were admitted to the ERU were: surgery, neurosurgery, neurology, orthopedics and traumatology and politraumatology, cardiology and infectious diseases. Current research demonstrated that a proposed mobile emergency medical center (MEMC) facilitated transportation of patients with 2 lines ambulances which transported patients in critical condition: between MEMC and disaster, and from the MEMC to the requested hospitals for further treatment (27). In another study polytrauma was seen in the majority of patients and the affected hospital had the uphill task of treating hospitalized patients as well as disaster victims (28). A significant difference was found in the performed study when admissions into the hospital during and immediately after the storm (17^{th}-18^{th} of September) were compared to admissions before the storm (15^{th}-16^{th}), and to admissions after the storm (19^{th}-20^{th} of September). Concerns about weather-related injury were noticed in another study (29).

Meteorological factors investigated during the retrospective 6-day investigation (15th-20th September) indicated the maximum, minimum and the greatest difference between maximum and minimum temperature in the same day, 17^{th} September 2017. Low pressure values were associated with precipitation on the 17^{th} and 20^{th} of September. Gust wind speed surpassed 100 Km/h and indicated a violent storm on the 17th of September. Wind disaster, one of the hazards included in classification of meteorological disasters, was investigated in China (30).

When time series (15^{th}-16^{th}, 17^{th}-18^{th} and 19^{th}-20^{th} of September) of meteorological factors were considered, there was a significant difference between 19th-20th of September and the other 2 series for air temperature and air pressure and a significant difference between the 15^{th}-16^{th} of September and the other 2 series for wind speed. In other research studies outdoor air temperature and related meteorological parameters were associated with stroke attack (30) or with behavioral change with temperature increase (32). Different kinds of incidents in Europe with extreme weather events demonstrated effects of meteorological factors and climate change on public health (33).

Although, no statistically significant differences were found between time series of patients (15^{th}-16^{th} - not exposed, 17^{th}-18^{th} - exposed with immediate effects; and 19^{th} -20^{th} of September - exposed with delayed effects) regarding personal characteristics (gender, age, rural/urban) and pathology, there were significant differences in term of being admitted into the hospital.

Main predictors of admission/non-admission into the hospital of patients from the ERU were:

•Age increase, cardiac diseases, digestive diseases, fractures, mean air temperature and relative humidity increase, which predict admission in hospital.

•Urban environment, contusions, contusive wounds, cut wounds, and maximum air temperature increase, which predict non-admission into the hospital.

Another study (28) demonstrated that there was an interrelation of risk factors or a risk factors cascade triggered by individual or a cluster of risk factors. Therefore, extraordinary events (such as violent storms) or a crisis ordinarily have the so-called cascade effect. An example of this may be windstorm, resulting in a power outage and affecting hospitals, where it is essential for acute care clients to have a regular intake of electrical energy to ensure their life functions (33). By reducing human vulnerability to disasters, we can lessen--and at times even prevent their impact (34). Communities resilient to the health risks of climate change anticipate risks; reduce vulnerability to those risks; prepare for and respond quickly and effectively to threats; and recover faster, with increased capacity to prepare for and respond to the next threat (35). Preparing for anticipated effects of disasters can help reduce the public health and economic burden (36). Technical and operational synergies are identified to link disaster risk research and communities' adaptation in health (37).

In the performed study main predictors of the main diseases (cardiac and fractures) which led to admissions into the hospital were: age increase for cardiac diseases and air pressure maximum increase for cardiac diseases and for fractures. In research literature the increased incidence rate of ischemic stroke was consistent with the daily lowest and highest air pressure, highest air temperature and presence of hurricanes or storm (38). When confronting changing weather conditions, thinking in ecological terms about the determinants of health, disease and death in human population was considered critically important in another study (39).

The retrospective 6-day investigation offered us valuable information on the efficiency of the ERU, the pathology they usually encounter and the pathology they face in an extreme weather event. A limit of this study is that it is an observational one.

CONCLUSIONS

A relevant prediction of admission/non-admission into the hospital was found for the entire investigation sample. Main predictors of admissions into the hospital related to the storm are: rural environment, increase in age, cardiac diseases, digestive diseases, fractures, average air temperature and relative humidity increase. Main predictors of sending patients home are: urban environment, decrease in age, contusions, cut wounds, sprains, psychiatric diseases (panic attacks) and maximum air temperature increase. Main predictors for diseases with which patients were admitted to the hospital are age increase (cardiac diseases) and air pressure maximum increase 739-741 mmHg (cardiac diseases and fractures). There is a significant difference between admissions into the hospital during 17^{th}-18^{th} of September and the other two time series. Traumatic health effects were the most frequently recorded at the ERU during the 18^{th} and 17^{th} of September (mainly due to the storm). The greatest variation of air temperature, the gust wind (violent storm on the Beaufort scale) and the lowest values of air pressure were recorded during the storm, on the 17^{th} of September. There is a relation between admission or non-admissions of people into the hospital and personal predictors, health effects, and meteorological factors in the context of the violent storm.

ACKNOWLEDGMENTS

The author wishes to offer her recognition for the great support offered in medical data base building by Prof. Dr. Marius Craina, manager of the County Emergency Clinical Hospital "Pius Brinzeu" Timisoara, Dr. Mihai Grecu, Chief Medical Officer UPU SMURD (ERU), Prof. Dr. Horia Cristian, Coordinator of the Center of Traumatology "Austria House" Timisoara, Prof. Dr. Jenel M. Patrascu, Chief of the Clinical Orthopedic and Traumatology Section II and Prof. Dr. Radu Prejbeanu, Chief of the Clinical Orthopedic and Traumatology Section I, Timisoara, Assist. Univ. Dr. Ivan Mihaela-Viviana - Head of the Department of Cardiology, Prof. univ. Dr. Rodica Avram, Department of Cardiology, Prof. Dr. Jianu Dragos Catalin - Chief of the Department of Neurology I and Prof. Dr. Adriana Mihaela Simu, Chief of the Department of Neurology II, and Associate Professor Dr. Dehelean Liana, Chief of the Department of Psychiatry II, Timisoara. Great recognition I wish to offer to Mrs. Silvia Barbu, Meteorologist and Director of the Regional Meteorological Center Banat-Crisana, Romania who offered me constant support with knowledge and data base for meteorological data base building. Many thanks to Claudia Mirela Dinca, and to all the medical recorders who have supported the needed completion of the medical data base.

STATEMENT OF ETHICS

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The Ethical Agreement No. 8/22.03.2019 was requested and obtained from the "Victor Babes" University of Medicine and Pharmacy Timisoara's Ethical Commission, for this statistical clinical study.

CONFLICTS OF INTEREST AND FUNDING

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be considered as a potential conflict of interest.

The author declares that there is no conflict of interest regarding the publication of this paper. There was no institutional funding for this study.

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