The effect of large air pollution exposure on chronic rhinitis

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Dear Editor:

On August 4th, 2020, Beirut witnessed the largest non-nuclear explosion in modern history. The explosion resulted in the release of large amounts of gases and particulate matters (PM) including ammonia and nitrogen oxides (NO_x), as well as pure oxygen (O_2) [(1)]. NO_2 conversion into nitric and nitrous acids has been shown to damage the alveolar structure in distal airways [(2)].
The goal of this study is to investigate the early and late, subjective and objective, effects of the explosion and particulate matter exposure on the upper airway, specifically chronic rhinitis.
We performed a cross-sectional study of patients presenting to a center in Beirut, Lebanon between January 1st, 2019 and October 31st, 2023 with a diagnosis of rhinitis. Institutional Review Board approval was secured prior to data collection (BIO-2022-0320). Since the Beirut blast occurred in August 2020, we divided our timeline review arbitrarily into three equal time periods: pre-blast period (Jan 1st, 2019- July 31st, 2020), early post-blast group (September 1st, 2020- March 31st, 2022), and the late post blast group (April 1st, 2022 to October 31, 2023), with the earliest pre-blast date of review was the start on electronic medical records at our institution (January 2019). Allergy skin testing was conducted to check for reactions to common allergens. Patients with chronic rhinosinusitis (CRS) were excluded.
We included a total of 460 patients. Table 1 summarizes the findings among the three groups. Multivariate logistic regression showed that the odds of testing positive for allergic rhinitis are 0.5 in the early post-blast period compared to the pre-blast period (OR=0.50, 95% CI of 0.30 to 0.79), but these odds then increased to 2.3 times in the late post-blast period (OR=2.3, 95% CI of 1.47 to 3.46) (Table S1). Regarding the sinonasal symptomatology, multivariate logistic regression showed that the odds of having headache/facial pressure as a sinonasal symptom were 14.4 in the early post-blast period (OR=14.4 95% CI of 1.84 to 112.46), and 2.2 in the late post-blast period (OR=2.2, 95% CI of 1.01 to 4.73) (Table S1).
Our study shows a decrease in allergic rhinitis on the short term (first 19 months after the exposure) followed by an increase in its incidence on the long-term after the blast. Since this is a cross-sectional analysis, it is not possible to determine if the air pollution exposure is the cause of this change in the type of rhinitis.
Limited research on air pollution and upper airway diseases has found that both chronic rhinitis and CRS are associated with exposure to air pollutants [(3,4)]. Indeed, PM2.5 exposure have been found to be higher in patient with non-allergic rhinitis [(4)]. A recent case-control study has showed that long-term exposure to fine particulate matter air pollution increases the odds of developing non-allergic rhinitis [(4)]. On the other hand, long term exposure to PM2.5 has also been associated with allergic disease including allergic rhinitis and asthma [(5)].
Another important finding from our study is the increase in the headache and facial pressure after the blast. Headache disorders and exacerbations have been linked to weather and ambient air pollution changes [(6)]. However, the increase in headache symptoms after the blast could also be secondary to the stress related to the blast itself. Therefore, these results should be interpreted with caution, and further research is needed to fully understand this relationship.
There are several limitations to this study. First, its retrospective cross-sectional design precludes causality. Second, it lacks generalizability since it includes a single geographical area and single institution within Beirut. Third, the distance of the patients to the blast epicenter could not be determined which may affect the incidence of rhinitis.

Authorship contribution

CAZD: data collection, manuscript writing, data analysis, addressing revisions. IC: data collection, manuscript writing. JG: data collection. OAH: data collection. CAM: manuscript writing and editing, data analysis, addressing revisions. ZK: manuscript writing and editing, project overview, addressing revisions.

Table 1. Patients' characteristics, comorbidities, and sinonasal differences between the three groups: pre-blast, early post-blast, and late post-blast.

Variables Mean (SD)/N(%)	All (N=460)	Pre-blast (N=151)	Early post-blast (N=153)	Late post-blast (N=156)	p-value
Age	34.6 (14.6)	36.8 (15.3)	33.8 (13.4)	33.2 (15.0)	**0.002**
Female	254 (55.2%)	75 (49.7%)	91 (59.5%)	88 (56.4%)	0.213
Allergic rhinitis	266 (57.8%)	88 (58.3%)	68 (44.4%)	110 (70.5%)	**<0.001**
Perennial	230 (50%)	78 (51.7%)	59 (38.6%)	93 (59.6%)	**0.001**
Seasonal	132 (28.7%)	38 (25.2%)	36 (23.5%)	58 (37.2%)	**0.015**
Asthma	56 (12.2%)	19 (12.6%)	20 (13.1%)	17 (10.95)	0.828
OSA	21 (4.6%)	10 (6.6%)	6 (3.9%)	5 (3.2%)	0.321
Current Smoker	162 (35.2%)	56 (37.1%)	44 (28.8%)	62 (39.7%)	0.109
Migraine	28 (6.1%)	7 (4.6%)	6 (3.9%)	15 (9.6%)	0.074
Sinonasal symptoms					
Nasal obstruction	322 (70%)	104 (68.9%)	115 (75.2%)	103 (66%)	0.201
Sneezing	110 (23.9%)	51 (33.8%)	30 (19.6%)	29 (18.6%)	**0.002**
Cough	69 (15%)	18 (11.9%)	27 (17.7%)	24 (15.4%)	0.371
Post-nasal drip	53 (11.5%)	17 (11.3%)	17 (11.1%)	19 (12.3%)	0.950
Throat irritation	38 (8.3%)	9 (6%)	13 (8.5%)	16 (10.3%)	0.390
Headache/facial pressure	28 (6.1%)	1 (0.7%)	13 (8.5%)	14 (9%)	**0.003**

OSA: obstructive sleep apnea.

Conflict of interest

The author declares that he has no conflict of interest.

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This manuscript contains online supplementary material

SUPPLEMENTARY MATERIAL

Materials and Methods

This is a cross-sectional study of patients presenting to a rhinology tertiary care center in Beirut, Lebanon between January 1st, 2019 and October 31st, 2023 with a diagnosis of rhinitis. Institutional Review Board approval was secured prior to data collection (BIO-2022-0320). Since the Beirut blast occurred in August 2020, we divided our timeline review arbitrarily into three equal time periods: pre-blast period (Jan 1st, 2019- July 31st, 2020), early post-blast group (September 1st, 2020- March 31st, 2022), and the late post blast group (April 1st, 2022 to October 31, 2023), with the earliest pre-blast date of review was the start on electronic medical records at our institution (January 2019).
Any patient living in the Greater Beirut area and presenting for evaluation of rhinitis was included in this study. Patients residing outside the Greater Beirut area were excluded due to lack of direct exposure to air pollution generated by Beirut explosion. Demographic data and comorbidities included age, gender, history of smoking, and sinonasal symptoms at the time of the evaluation. Patients who did not undergo allergy skin testing were excluded. Patients with chronic rhinosinusitis (CRS) were also excluded.
Allergy testing was conducted to check for reactions to common allergens which included trees (ash, cypress, olive tree, eastern oak, privet, birch mix, pine mix), grasses (bermuda, timothy, ryegrass, 7 grass mix), weeds (chenopodium, russian thistle, ragweed and weed mix), mold mix, household inhalants (D. Farinae and D. pteronyssinus) and pet allergens (cockroach, cat and dog). The tests were done on the back or arm of participants (the allergens tested were provided from DIATER Laboratories). All patients received the same allergy testing.
Data analysis was done using Stata 18. Frequencies and means were calculated for nominal and continuous variables. Differences between 3 time-period groups on demographic and clinical variables were investigated in univariate analyses using ANOVA and chi-square tests. Univariate and multivariate logistic regression were performed to evaluate the early and late effects of the blast on the allergic rhinitis and headache symptom while adjusting for age, gender, and comorbidities. Sample size calculation was performed to detect a small effect size of 0.2 with a power of 80% and alpha of 0.05. That showed that a minimum sample of 321 is needed. Statistical significance is set at a p-value of 0.05.

Table S1. Univariate and multivariate analyses of the effect of the blast on the odds of allergic rhinitis and sinonasal symptoms.

Variable	Unadjusted			Adjusted*		
	OR	95% CI	p-value	OR	95% CI	p-value
Early post-blast						
Allergic rhinitis	0.57	0.36,0.90	0.016	0.50	0.30,0.79	0.004
Nasal obstruction	1.37	0.83,2.26	0.223	1.30	0.78,2.16	0.322
Sneezing	0.48	0.28,0.81	0.006	0.47	0.28,0.80	0.005
Cough	1.58	0.83,3.01	0.162	1.48	0.77,2.84	0.241
Post-nasal drip	0.99	0.48,2.01	0.968	1.04	0.51,2.15	0.909
Throat irritation	1.46	0.61,3.54	0.396	1.64	0.67,4.04	0.282
Headache/facial pressure	13.93	1.80,107.87	0.012	14.4	1.84,112.46	0.011
Late post-blast						
Allergic rhinitis	2.30	1.50-3.42	<0.001	2.30	1.47,3.46	<0.001
Nasal obstruction	0.75	0.50,1.14	0.183	0.69	0.45,1.05	0.084
Sneezing	0.63	0.39,1.01	0.056	0.61	0.38,0.99	0.044
Cough	1.05	0.61,1.79	0.869	1.06	0.62,1.83	0.828
Post-nasal drip	1.10	0.61,2.00	0.752	1.16	0.63,2.11	0.639
Throat irritation	1.46	0.75,2.88	0.268	1.67	0.83,3.35	0.150
Headache/facial pressure	2.00	0.95,4.40	0.068	2.20	1.01,4.73	0.048

* adjusted for age, gender, and migraine

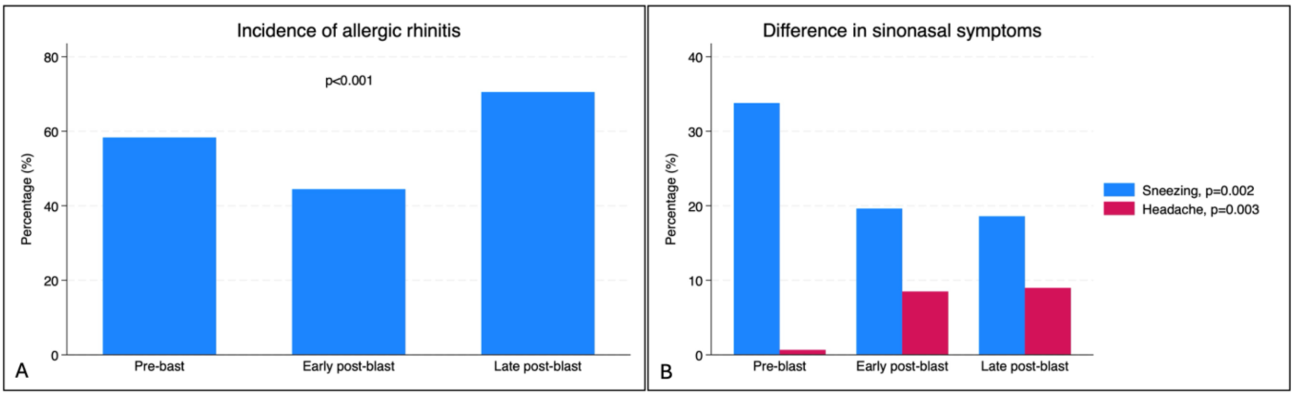

Figure S1. Bar graph showing the difference in incidence of allergic rhinitis (A) and sinonasal symptoms (B) in the pre, early, and late post-blast periods. Allergic rhinitis significantly dropped in the early post-blast period and then significantly increased to a level higher than the pre-blast period (A). For the sinonasal symptoms, sneezing dropped while headache/facial pressure increased after the blast.