

Increased Exhaled Nitric Oxide in Wind and Brass Musicians

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Abstract

Playing a wind or brass (W/B) instrument is considered a strenuous activity for the respiratory system. Exhaled nitric oxide (FeNO) is a potential marker of airway inflammation, and the aim of this study was to compare levels of FeNO between W/B musicians to a group of people who did not play these instruments. Eighty-three (41 male) nonsmoking, nonasthmatic subjects, aged between 18 and 60 years, participated in the study. Forty-one played a W/B instrument, and 42 either played a non-wind/brass (NW/B) instrument or no instrument at all. Subjects completed a respiratory health questionnaire, height and weight measurements, skin prick tests (SPTs), and FeNO measurements. FeNO levels were increased in W/B musicians compared to NW/B subjects (23.6 ppb and 18.1 ppb, respectively). After adjusting for age, sex, height, and degree of atopy, this difference approached statistical significance ($P = .06$). Increased FeNO may indicate subclinical airway inflammation in W/B musicians.

Keywords

musicians, wind instruments, airway inflammation, exhaled nitric oxide

The playing of wind and/or brass (W/B) instruments has been described as a particularly strenuous activity for the respiratory system.¹ Whether such an activity is associated with some form of airway inflammation is a question that has remained unresolved since a study by Plamenac and Niculin² in 1969 reported evidence of bronchial cell atypia among W/B musicians. In that study, the authors examined sputum samples from 30 W/B musicians and observed pulmonary macrophages showing signs of irritation, a large quantity of leukocytes, and evidence of eosinophilia among other indicators of epithelial cell damage.² Fractional exhaled nitric oxide (FeNO) has been proposed as a marker of eosinophilic airway inflammation.³ This study aimed to compare W/B musicians' FeNO to a group of non-wind or brass (NW/B) musicians and nonmusicians. It was hypothesized that FeNO would be higher among W/B musicians.

Methods

Participants within the age range of 18 to 60 years who were nonsmokers and who reported no current asthma or other chronic respiratory conditions were recruited for the study. All subjects were at least 3 weeks clear of any respiratory infection at the time of testing. Participants were classified as W/B musicians if they played W/B instruments regularly (≥ 5 h/wk for ≥ 2 years). Musicians who played only NW/B instruments and subjects who did not play any musical instruments were classified as NW/B participants.

Subjects completed a respiratory health questionnaire,⁴ and height and weight were measured. Atopy was determined using

skin prick tests (SPTs). Atopy is an important factor affecting FeNO concentrations even in healthy adults⁵ and therefore needs to be considered when measuring FeNO. Subjects were assessed for 7 allergens including the following: cow's milk, egg white, rye grass, mixed grass, cat hair, dog hair, house dust mite (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*), alternaria, and aspergillus. Histamine, 10 mg/mL concentration, was used as a positive control. A positive response to an allergen was defined as a weal equal to or greater than the positive control. Participants were classified as either atopic (≥ 1 positive SPT response) or nonatopic (no positive SPT responses). Exhaled NO was measured on a fast response chemiluminescence analyzer (CLD88, Eco Medics, Duernten, Switzerland) using the single-breath online collection method according to international guidelines.⁵ Briefly, subjects were asked to inhale to total lung capacity and then exhale for as long as they could, maintaining an expiratory flow

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Table 1. Participant Demographics and Fractional Exhaled Nitric Oxide (FeNO) Between Non-Wind/Brass (NW/B) and Wind/Brass (W/B) Subjects

Variable	NW/B (n = 42)	W/B (n = 41)	Comparison
Age, ^a y	34.8 ± 11.5 (19-61)	30.3 ± 11.6 (18-60)	NS
Height, ^a cm	170.8 ± 7.8 (154-183)	171.1 ± 8.1 (155-186)	NS
Atopic ^b	21 (47%)	21 (49%)	NS
Sex (M) ^b	19 (42%)	22 (50%)	NS
FeNO, ^c ppb	18.9 ± 16.4 (5.4-86.1)	23.2 ± 16.3 (7.2-86.1)	β = 0.24 ppb ^d 95% CI, -0.01 to 0.49 P = .06 ^d

NS = not significant; CI = confidence interval.

^a Mean ± standard deviation (range).

^b n (%).

^c Unadjusted geometric mean ± standard deviation (range).

^d Multiple linear regression β and P values based on ln(FeNO) transformed data, adjusted for age, sex, height, and atopy.

of 50 mL/s. Subjects breathed against a resistance to ensure closure of the velum to minimize contamination from the nasal passages.⁶ The mean of 3 acceptable plateaux was recorded for each participant.

Exhaled NO data were natural-log transformed to approximate a normal distribution. Comparisons were made between W/B and NW/B participants for age, height, sex, and atopy using *t* tests and χ^2 analyses. Multiple linear regression was then used to compare groups for FeNO, adjusting for sex, age, height, and atopy. All of these factors have been associated with FeNO^{7,8} and therefore were included a priori in the model.

Further analysis was carried in the W/B group to investigate if there were differences in FeNO based on maximum intraoral pressures required for playing a particular instrument. The Student *t* test was used to compare FeNO in the W/B musicians who played instruments requiring high intraoral pressures (trumpet, French horn, trombone; highest pressure >100 mm Hg) to those who played instruments requiring lower pressures (tuba, flute, saxophone, oboe, bassoon, clarinet; highest pressure <100 mm Hg). The categorization of W/B musicians by intraoral pressures was based on the work of Bouhuys⁹.

Results

Eighty-three subjects (41 male) were recruited for the study. Forty-one (22 male) were W/B musicians, and 42 (19 male) were NW/B subjects. The W/B and NW/B participant groups were similar in terms of height, atopy, and sex (Table 1). On average, the W/B musicians were slightly but not significantly younger than the NW/B participants (Table 1). The geometric mean FeNO for W/B musicians was 23.2 parts per billion (ppb) for W/B musicians and 18.9 ppb for NW/B participants (Table 1). After adjusting for all other variables, the difference between the 2 groups approached statistical significance ($P = .06$).

Within the W/B group, there was no significant difference in FeNO between musicians who played instruments requiring high maximum intraoral pressures (n = 16) compared to those

who played low pressure instruments (n = 25). Mean FeNO was 20.8 ppb and 24.8 ppb, respectively ($P = .64$).

Discussion

Previous research by Plamenac and Niculin² has suggested that W/B playing may be associated with some form of airway inflammation, evidenced by bronchial cell atypia among these musicians. That was based on the analysis of sputum samples from 30 healthy wind musicians. However, there was no comparison group. We used FeNO as a potential marker of airway inflammation and observed marginally higher FeNO among W/B musicians compared to NW/B participants. As all subjects were healthy with no known respiratory disease, this may support the earlier findings² of subclinical inflammation in W/B musicians.

Exhaled NO has been proposed as a marker of eosinophilic airway inflammation.³ There are good data demonstrating a positive association between FeNO and eosinophils in sputum,¹⁰ bronchoalveolar lavage,¹¹ and bronchial biopsy inflammation.¹² However, the relationship between FeNO and airway eosinophils is not always consistent, and there is still discussion as to whether FeNO truly is a marker of eosinophilic inflammation.¹³ Interestingly, FeNO has often been reported to be increased in response to environmental¹⁴ and occupational¹⁵ exposures. The inflammatory responses with these environmental exposures are not all characterized by eosinophilia, and therefore, the mechanism(s) for raised FeNO may also be varied.

It is not known if the observed increase in FeNO reflects subclinical inflammation among W/B musicians or some other aspect of airway pathology. Musicians take deep and rapid inhalations followed by sustained expiration against resistance.¹⁶ It is conceivable that the physiology of W/B playing could have some detrimental impact on the airways. Although the subgroup numbers were small, there was no evidence that playing a W/B instrument that can create high intraoral pressures was associated with higher FeNO than lower pressure instruments. The physiology of playing W/B instruments is complex, and maximal intraoral pressures alone may not adequately determine the

potential strain on the lungs and airways. A larger group of W/B musicians using instruments with varying pressure/flow profiles would be required to investigate this further.

The increase in FeNO observed among W/B musicians in the current study was fairly small and was not associated with clinical outcomes. However, this is consistent with the previous findings of Plamenac and Niculin,² who also reported evidence of airway inflammation among healthy W/B musicians. Due to the cross-sectional nature of this study, it is not possible to ascertain whether the physical practice of W/B playing has a role in this increase in FeNO or whether the results reflect inherent differences between the participant groups due to other factors that could not be controlled in the study. Further research is needed to confirm this observed increase in FeNO among W/B musicians and to pinpoint possible mechanism(s) if it truly exists.

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Declaration of Conflicting Interests

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References

1. Bouhuys A. Lung volumes and breathing patterns in wind instrument players. *J Appl Physiol*. 1964;19:967-975.
2. Plamenac P, Niulin A. Atypia of the bronchial epithelium in wind instrument players. *Acta Cytol*. 1969;13:274-278.
3. Payne DNR. Nitric oxide in allergic airway inflammation. *Curr Opin Allergy Clin Immunol*. 2003;3:133-137.
4. Burney P, Luczynska C, Chinn S, Jarvis D. The European Community Respiratory Health Survey. *Eur Respir J*. 1994;7:954-960.
5. Horvarth I, Barnes PJ. Exhaled monoxides in asymptomatic atopic subjects. *Clin Exp Allergy*. 1999;29:1276-1280.
6. American Thoracic Society and European Thoracic Society. ATS/ERS recommendations for standardized procedures for the online and offline measurement of exhaled lower respiratory nitric oxide and nasal nitric oxide, 2005. *Am J Respir Crit Care Med*. 2005;171:912-930.
7. Taylor DR, Mandhane P, Greene J, et al. Factors affecting exhaled nitric oxide measurements: the effect of sex. *Respir Res*. 2007;8:82.
8. Olin A, Rosengren A, Thelle D, Lissner L, Bake B, Torén K. Height, age, and atopy are associated with fraction of exhaled nitric oxide in a large adult general population sample. *Chest*. 2006;130:1319-1325.
9. Bouhuys A. Pressure flow events during wind instrument playing. *Ann New York Acad Sci*. 1968-1969;155:264-275.
10. Berry MA, Shaw DE, Green RH, et al. The use of exhaled nitric oxide concentration to identify eosinophilic airway inflammation: an observational study in adults with asthma. *Clin Exp Allergy*. 2005;35:1175-1179.
11. Warke TJ, Fitch PS, Brown V, et al. Exhaled nitric oxide correlates with airway eosinophils in childhood asthma. *Thorax*. 2002;57:383-387.
12. Payne DN, Adcock IM, Wilson NM, et al. Relationship between exhaled nitric oxide and mucosal eosinophilic inflammation in children with difficult asthma, after treatment with oral prednisolone. *Am J Respir Crit Care Med*. 2001;164:1376-1381.
13. Franklin PJ, Stick SM. The value of FeNO measurement in asthma management: the motion against FeNO to help manage childhood asthma—reality bites. *Paediatr Respir Rev*. 2008;9:122-126.
14. Van Amsterdam JG, Nierkens S, Vos SG, Opperhuizen A, van Loveren H, Steerenberg PA. Exhaled nitric oxide: a novel biomarker of adverse respiratory health effects in epidemiological studies. *Arch Environ Health*. 2000;55:418-423.
15. Lemiere C. Induced sputum and exhaled nitric oxide as noninvasive markers of airway inflammation from work exposures. *Curr Opin Allergy Clin Immunol*. 2007;7:133-137.
16. Sataloff RT, Spiegel JR, Hawkshaw M. The effects of respiratory dysfunction on instrumentalists. *Med Prob Perform Art*. 1990;5:94-97.

Bios

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