

## STAMPEDE I, II, and III: Dyspnea in Returning Troops Studied

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Michael Morris, MD, FCCP, San Antonio Military Medical Center, Fort Sam Houston, San Antonio, Texas, USA, discussed results from three arms of the Study of Active Duty Military for Pulmonary Disease Related to Environmental Deployment Exposures [STAMPEDE I, II, and III]. The studies examined the effect of increased exposure to airborne particulates in the development of acute and chronic lung diseases in soldiers. STAMPEDE I sought to identify acute effects of dyspnea caused by deployment-related particulate exposure in soldiers within 6 months of redeployment. STAMPEDE II, expected to complete in mid-2015, is focused on soldiers from Fort Hood, evaluating them prior to and after their deployment, primarily to Afghanistan. STAMPEDE III is an ongoing, in-depth evaluation of dyspnea in returning soldiers.

Military operations in countries including Kuwait, Iraq, and Afghanistan involve exposure to natural particulate materials (eg, sand storms) as well as military-generated particulates. The exposures have been retrospectively linked to a number of respiratory difficulties [King MS et al. *N Engl J Med.* 2011; Szema MA et al. *Allergy Asthma Proc.* 2010; Smith B et al. *Am J Epidemiol.* 2009; Shorr AF et al. *JAMA.* 2004]. Details concerning a cause-and-effect relationship, the nature of the lung injury (acute versus chronic), and specific exposures of concern have remained unclear.

STAMPEDE I [Morris MJ et al. *Am J Respir Crit Care Med.* 2014] looked at 50 active-duty soldiers (80% men, mean age  $31.9 \pm 8.4$  years, mean body mass index  $28.6 \pm 4.3$  kg/m<sup>2</sup>, 26% previous smokers, 16% active smokers). Identified sources of particulate exposure in STAMPEDE I included dust/sand, burn pits, vehicle exhaust, and smoke/fumes. Pulmonary function testing revealed reduced forced expiratory volume at 1 second (FEV<sub>1</sub>), forced vital capacity (FVC), and diffusing capacity for carbon monoxide in 29 soldiers diagnosed with pulmonary abnormalities (Table 1).

Macrophage count was significantly depressed ( $P=.004$ ) in 26 of the diagnosed soldiers ( $77.2\% \pm 15.9\%$ ) compared with 13 undiagnosed soldiers ( $85.6\% \pm 3.5\%$ ). Asthma and nonspecific airway hyperresponsiveness were the most common diagnoses. Pulmonary difficulties were associated with higher rates of sleep disorders (57%) and psychiatric disorders (68%).

In STAMPEDE II, predeployment evaluations included spirometry, impulse oscillatory system total airway resistance (R5) and large airway resistance (R20), respiratory function, and chest radiography. The 1693 soldiers were predominantly Caucasian (58.1%) and African-American (20.6%), most were men ( $n=1409$ ), and most (64%) had never smoked. Comparisons of those who were or were not deployed revealed no appreciable differences in pulmonary function test parameters of FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC, R5, and R20.

STAMPEDE III has enrolled 106 patients to date (87% men, age  $37.5 \pm 9.2$  years, body mass index  $28.6 \pm 4.0$  kg/m<sup>2</sup>, 52% never smokers, 34% smoking during deployment). This study included a comprehensive battery of tests, which revealed abnormal results in many patients (Table 2). Over 20% of pulmonary abnormalities were not diagnosed. The most common diagnosis was asthma.

Collectively, the STAMPEDE studies indicate the hazards of conflict-related exposure to particulates for both acute and chronic lung diseases in soldiers.

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Table 1. Pulmonary Function Test Results From STAMPEDE I

	All (n = 50)	Diagnosed (n = 29)	Undiagnosed (n = 21)	P Value	Smoking History (n = 21)	No Smoking History (n = 29)	P Value
FEV <sub>1</sub> <sup>a</sup>	87.7 ± 12.7	82.2 ± 11.1	94.8 ± 11.7	.001	85.7 ± 10.7	88.8 ± 14.2	.20
FVC <sup>a</sup>	91.0 ± 13.4	87.0 ± 12.8	96.0 ± 12.8	.03	90.2 ± 11.4	91.2 ± 14.9	.39
FEV <sub>1</sub> /FVC	79.6 ± 5.8	78.5 ± 6.3	81.0 ± 4.9	.17	78.1 ± 5.9	80.6 ± 5.6	.07
TLC <sup>a</sup>	90.8 ± 13.1	90.4 ± 14.5	92.0 ± 11.0	.83	95.3 ± 10.7	87.8 ± 14.0	.02
RV <sup>a</sup>	82.1 ± 31.9	86.0 ± 37.1	75.8 ± 20.4	.20	93.0 ± 39.1	73.3 ± 21.6	.02
DLCO <sup>a</sup>	89.7 ± 15.2	85.1 ± 15.6	96.1 ± 11.1	.007	90.5 ± 17.9	88.1 ± 12.2	.30

DLCO, diffusing capacity for carbon monoxide; FEV<sub>1</sub>, forced expiratory volume at 1 second; FVC, forced vital capacity; RV, residual volume; TLC, total lung capacity.

<sup>a</sup>Percentage predicted.

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Table 2. Abnormal Results in STAMPEDE III

Test	Patients With Abnormal Results, %
FEV <sub>1</sub> /FVC	33
Forced expiratory flow, midexpiratory phase	34
Total lung capacity	5
DLCO	17
Postbronchodilator test FEV <sub>1</sub>	28
Residual volume	22
Methacholine challenge test	26
Laryngoscopy	13
Echocardiography	18
High-resolution computed tomography	16
Exhaled nitric oxide	17
Radioallergosorbent test	41

DLCO, diffusing capacity for carbon monoxide; FEV<sub>1</sub>, forced expiratory volume at 1 second; FVC, forced vital capacity.