Published in final edited form as:
Arch Phys Med Rehabil. 2005 August ; 86(8): 1631–1635.

Dyspnea During Daily Activities in Chronic Spinal Cord Injury

Noel F. Grandas, MD, **Nitin B. Jain, MBBS, MSPH**, **Joan B. Denckla, MPH**, **Robert Brown, MD**, **Carlos G. Tun, MD**, **Mary Ellen Gallagher, MS**, and **Eric Garshick, MD, MOH**
From the Physical Medicine and Rehabilitation Service (Grandas, Tun) and Pulmonary and Critical Care Medicine Section (Garshick), VA Boston Healthcare System, West Roxbury, MA; Channing Laboratory, Brigham and Women's Hospital, Boston, MA (Jain, Garshick); Pulmonary and Critical Care Medicine Unit, Massachusetts General Hospital, Boston, MA (Brown, Gallagher); Harvard Medical School, Boston, MA (Grandas, Jain, Denckla, Brown, Tun, Garshick); and Medical Research Service, VA Boston Healthcare System, Boston, MA (Jain).

Abstract

Objective—To assess factors associated with breathlessness in chronic spinal cord injury (SCI) during daily activities.

Design—Cross-sectional survey.

Settings—Veterans Affairs SCI service and the community.

Participants—Four hundred forty-one participants 1 or more years post-SCI, and without acute illness, were recruited between 1994 and 2003 and were categorized according to their ability to walk unassisted, walk with an aid, or to move about by either hand-propelled wheelchair or motorized wheelchair (MWC).

Interventions—Assessment of injury extent, respiratory symptoms, cigarette smoking, comorbid medical conditions, and spirometry.

Main Outcome Measures—Breathlessness during talking, eating, or dressing.

Results—Breathlessness was more common in MWC users (20/85 users, 24%) than in nonusers (20/356, 6%). The main activity associated with breathlessness in 15 MWC users was talking (18%). In MWC users, the risk of breathlessness was related to lifetime cigarette smoking (odds ratio [OR] =1.02; 95% confidence interval [CI], 1.00–1.03 per pack year), and reports of chronic cough (OR=7.8; 95% CI, 2.0–32.7), and wheeze (OR=3.5; 95% CI, 1.04–13.6). SCI level, percentage of predicted forced vital capacity and forced expiratory volume in 1 second, and maximal inspiratory pressures were not related to breathlessness.

Reprint requests to Eric Garshick, MD, MOH, Pulmonary and Critical Care Medicine Section, VA Boston Healthcare System, 1400 VFW Pkwy, West Roxbury, MA 02132, e-mail: *eric.garshick@med.va.gov*..

Supported by the National Institute of Child Health and Human Development, National Institutes of Health (grant no. RO1 HD42141); Health Services R&D; Massachusetts Veterans Epidemiology Research and Information Center, Department of Veterans Affairs; Cooperative Studies Program; and Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital.

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the author(s) or upon any organization with which the author(s) is/are associated.

Suppliers
a. DSII; Warren E. Collins Inc, 220 Wood Rd, Braintree, MA 02184.
b. Validyne, 8626 Wilbur Ave, Northridge, CA 91324.
c. Hewlett Packard, 3000 Hanover St, Palo Alto, CA 94304.
d. Dataq Instruments Inc, 241 Springside Dr, Akron, OH 44333.
e. Proc Logistic in PC-SAS version 8.2; SAS Institute Inc, 100 SAS Campus Dr, Cary, NC 27513.

Conclusions—Breathlessness during selected daily activities (most commonly talking) was greatest in SCI participants who were most impaired with regard to mobility and was associated with reports of coughing, wheezing, and cigarette smoking.

Keywords

Dyspnea; Rehabilitation; Smoking; Speech; Spinal cord injuries

DYSPNEA, DEFINED AS a subjective report of breathlessness or shortness of breath, is common in people with chronic spinal cord injury (SCI) and is greatest in persons with tetraplegia.[1,2] One report[2] noted a 47% overall prevalence of breathlessness while at rest and a 42% rate during activity in 30 participants with high tetraplegia. The article did not define the term "rest" so it is not known whether it included dyspnea while speaking or eating. Also, the specific activity or activities associated with breathlessness were not noted, except for a 12% prevalence of dyspnea while subjects were dressing. Previously, we studied participants with neurologically motor complete SCI who used hand-propelled wheelchairs more than 50% of the time.[1] Thirty-one percent of the subjects with cervical injury reported dyspnea while moving quickly on a level surface or going up a slight hill.[1] The relation between dyspnea and specific activities of daily living (ADLs) in people with SCI is poorly defined. To address this deficiency, we compared the prevalence of dyspnea during selected ADLs in SCI participants, based on their level of mobility.

Since 1994 we have been assessing respiratory function in an SCI cohort recruited 1 or more years postinjury. At study entry, participants completed a detailed health questionnaire and underwent pulmonary function testing and a neurologic exam. We hypothesized that participants who commonly used motorized wheelchairs (MWCs), and who would therefore be the most impaired, would have the greatest prevalence of dyspnea during ADLs. We also determined which comorbid factors were associated with dyspnea in MWC users during these activities.

METHODS

Sample

Between October 19, 1994, and June 16, 2003, 479 participants with chronic SCI, defined as 1 or more years post-SCI, were recruited to assess longitudinal changes in pulmonary function and risk factors for respiratory illnesses. Participants had to be at least 22 years old (before July 2002, the criterion was 20y), without an acute illness or other neurologic diseases when tested, and able to breathe spontaneously without tracheostomy. The age criterion was increased from 20 to 22 years when National Institutes of Health funding was obtained as a result of differences in the age cutoff for inclusion of adults in research. Recruitment was from a pool of 1807 potential participants that included 1194 participants who were previously treated by the SCI Service at Veterans Affairs (VA) Boston Healthcare System, 546 participants from the National Spinal Cord Injury Association from Massachusetts, New Hampshire, Vermont, Maine, and Rhode Island, and 67 participants who responded to an advertisement. There were 271 participants who could not be contacted due to outdated addresses, 43 who declined testing because they lived too far from the VA medical center, 232 who were not interested, 73 who were ineligible because they had other neurologic conditions or did not have SCI, and 279 people who were deceased, resulting in 909 potential participants.

Of the 479 participants tested, those with a history of polio, multiple sclerosis, or stroke (n=25), with lung resection (n=4), without a detectable SCI level (n=8), with a tracheostomy (n=1), and with missing information on SCI level (n=1) were excluded from the analysis. The final dataset included 441 participants (328 veterans, 113 nonveterans), including 1 subject who was

tested 11 months after SCI. The entry criterion of 1 or more years post-SCI was selected to include subjects who survived acute injury and associated complications. However, since there was no a priori basis to exclude the person tested at 11 months, he was retained in the cohort.

The institutional review boards at VA Boston Healthcare System, Brigham and Women's Hospital, and Harvard Medical School approved the study, and informed consent was obtained from each participant.

Health Questionnaire

We used a respiratory health questionnaire based on the American Thoracic Society – Division of Lung Diseases (ATS DLD-78) adult respiratory questionnaire[3] to obtain a participant's history of pulmonary symptoms, cigarette smoking, comorbid medical conditions, previous chest illness, and pneumonia. To assess mobility, participants were asked "How do you usually get around (usually means more than half the time)?" Responses were recorded as motorized wheelchair, hand-propelled wheelchair, walk with aid (crutch, cane, or similar aid), or walk without assistance. Participants were then asked to respond "yes" or "no" to the following questions based on the ATS DLD-78 questionnaire for the able-bodied: "Are you usually too breathless to leave the house, or breathless while dressing or undressing?" "Are you usually breathless while talking for more than a few minutes?" "Are you usually breathless while eating?" If the answer to 1 or more of the questions was "yes," the participant was classified as having dyspnea.

Chronic cough was defined as coughing on most days for 3 consecutive months; having chronic phlegm was defined similarly. Any wheeze was defined as wheezing with a cold, or occasionally in the absence of a cold, or wheezing on most days or nights. Persistent wheeze was wheeze reported on most days or nights, or with a cold and occasionally apart from colds. Participants who had smoked 20 or more packs of cigarettes or had used 12 ounces of tobacco or more in a lifetime, or who had smoked 1 or more cigarettes a day for at least 1 year, were categorized as smokers. Participants who reported cigarette use within 1 month of testing were categorized as current smokers. Pack years were determined by calculating cumulative lifetime smoking preinjury and postinjury.

Neurologic Exam

Motor level and completeness of injury were based on American Spinal Injury Association (ASIA) guidelines.[4] Level of injury was further categorized into cervical motor complete and cervical grade C; and other (thoracic, lumbar, lower) motor complete and grade C, and all ASIA grade D.

Level and severity of injury were determined by a physician (CGT) in 398 participants (90.5%), by a trained research assistant in 38 participants (8.9%), from medical record review in 4 participants (0.7%), and in 1 participant by examination during later follow-up.

Spirometry

Spirometry was based on ATS standards[5] modified for use in SCI, as previously described.[5,6] Testing was done using a 10-L water-seal spirometer.[a] Maximum inspiratory pressures (MIP) and expiratory pressures (MEP) were measured 3 times with either a Validyne[b] pressure transducer connected to a Hewlett Packard strip chart recorder,[c] or a Dataq computerized data acquisition system[d] with a microchip pressure transducer. Maximal values were reported.[7]

Statistical Analysis

We used *t* tests to compare means, and we compared ratios using chi-square tests, using the Fisher exact test when appropriate. Data were expressed as mean values ± standard deviation

(SD). Logistic regression[e] was used to assess the association between dyspnea and potential clinical predictors, with exact methods used for categoric variables.

RESULTS

Dyspnea was more common among MWC users (20/85, 23.5%). The prevalence of dyspnea in MWC nonusers ranged from 3.4% to 14.3%, depending on activity level (table 1), with an overall prevalence of 5.6% (20/356). Dyspnea in MWC users was more commonly reported while talking (17.7%), in contrast to dyspnea while eating (4.7%) or in association with dressing and undressing or limiting one's ability to leave the house (3.5%). Dyspnea while talking was infrequent among participants who did not use an MWC. Of participants who could walk with an aid, 10.7% experienced dyspnea while dressing and undressing or limiting their ability to leave the house. Among those who could walk without assistance more than half the time, 8.1% reported dyspnea during these same activities. By contrast, in those who could use hand-propelled wheelchairs or MWCs, the prevalence of dyspnea while dressing and undressing or limiting one's ability to leave the house was 1.9% and 3.5%, respectively, (*P*=.001 comparing all wheelchair users to nonwheelchair users).

Characteristics of MWC users with and without dyspnea are presented in table 2. The mean age ± SD of MWC users with dyspnea was similar (50.2±13.6y; range, 23.3–78.1y) to that of participants without dyspnea (50.6±15.1y; range, 23.6–82.7y). MWC users with dyspnea were tested on average 17.5±13.9 years (range, 2.5–49.4y) postinjury, whereas those without dyspnea were tested on average 15.9±9.9 years (range, 1.1–46.7y) postinjury (*P*=.64). Eighty percent of participants using MWC had a cervical motor complete or cervical grade C injury. Although physician-diagnosed asthma or chronic obstructive pulmonary disease (COPD) was not greater among MWC users with dyspnea (table 3), the prevalence of cigarette smoking (see table 2), chronic respiratory symptoms, previous respiratory illnesses, and heart disease tended to be greater (see table 3). Among MWC users, factors significantly associated with dyspnea included chronic cough (odds ratio [OR]=7.8; 95% confidence interval [CI], 2.0–32.7) and any wheeze (OR=3.5; 95% CI, 1.04–13.6). Cigarette smoking (currently or in the past) was a borderline predictor of dyspnea in MWC users (OR=4.2; 95% CI, 0.9–41.0), compared with subjects who had never smoked), and the OR for dyspnea was also increased, based on cumulative lifetime smoking (OR=1.02; 95% CI, 1.00–1.03 per pack year). The ORs for dyspnea in association with persistent wheeze, chronic phlegm, chest illness within a year before testing that kept participants at home or out of work, pneumonia either at the time of the SCI or after, or a history of exposure to workplace dust, were also increased, but the CIs included 1.0 (table 4). The ORs for body mass index, SCI level, years since injury, physician-diagnosed asthma or COPD, percentage of predicted forced vital capacity, forced expiratory volume in 1 second (FEV_1), MIP, and MEP were not increased. Because of the small number of participants with each factor or symptom, it was not possible to perform a meaningful multivariate analysis that included smoking, chronic cough, any wheeze, or a history of pneumonia or chest illness in logistic regression models.

DISCUSSION

Most studies that have assessed dyspnea in association with ADLs have included elderly patients with pulmonary diseases,[8–10] but there has only been 1 previous report in which dyspnea associated with a specific ADL (ie, dressing) in SCI was assessed.[11,12] We report here the prevalence of dyspnea associated with performing common daily activities (talking, eating, dressing/undressing, or limiting the ability to leave the house) in participants with chronic SCI whose mobility was severely restricted. Dyspnea among MWC users while talking was more common than was dyspnea associated with eating, dressing, undressing or limiting one's ability to leave the house. Participants who could walk with an aid or without assistance

had a much lower prevalence of dyspnea while talking; however, dyspnea while dressing or undressing or limiting the ability to leave the house was greater. Breathlessness in MWC users was related to chronic cough and any wheeze, and cigarette smoking was a borderline predictor. Since cigarette smoking is associated with chronic cough, wheezing, and chest illness in the able-bodied,[13] we considered whether cigarette smoking could explain the association with dyspnea.[14,15] There were too few participants to conduct a meaningful multivariate analysis to assess whether chronic cough and any wheeze were associated with dyspnea in MWC users independent of smoking.

Breathlessness has been related previously to SCI level and completeness of injury in subjects able to use a hand-propelled wheelchair.[1,16] Spungen et al[2] reported that patients with tetraplegia had breathlessness more frequently than those with injuries at other levels. Their analysis was not standardized for ability to move about, although in subjects with high tetraplegia, dyspnea while dressing was experienced by 12%.[2] We extended their observations and our own related study to dyspnea in hand-propelled wheelchair users[1] to include data on specific ADLs in subjects categorized by their mobility level or ability to move about.

In our study, MWC users had the highest prevalence of breathlessness while talking. Speaking requires the interruption of breathing and variation in control of inspiration and expiration compared with nonspeech breathing. Breathing during speaking is driven by the constant struggle to simultaneously meet linguistic and metabolic needs. Speaking during high respiratory drive states—such as during exercise, in severe lung disease, or during acute hypercapnia—results eventually in a need for compensation to meet the metabolic needs brought on by the suppression of ventilation. Such compensations are increased respiratory rate and tidal volume, increased nonphonatory expirations, and the manipulation of phrasing and syllables produced while preserving linguistic needs and intent.[17] This balance between meeting linguistic and metabolic needs is more difficult to maintain and compensate for when the muscles of respiration are impaired, because nonspeech breathing is already in a compensated state. Also, the manipulation of phrasing, volume, rate, and intensity of speech is more difficult if respiratory muscles are impaired, particularly when metabolic demand is high. It is these difficulties that likely explain the dyspnea reported by many of the MWC users in our study. It is possible that MWC users who did not experience dyspnea while speaking used a different or more adaptive breathing strategy. Further study may help examine this possibility and provide a basis for relief of speaking-related dyspnea in SCI.

Several studies have examined the coordination between respiration and swallowing in able-bodied people of various ages.[18–20] Breathing becomes irregular and there is an apneic period, usually during the pharyngeal phase of the swallow, when the glottis is closed while the bolus passes through the pharynx. Respiration is usually suppressed during the exhalation phase of the respiratory cycle,[18,20–24] with a return to exhalation after the swallow. The duration of airway closure increases as the bolus volume increases.[25] Dyspnea while eating was relatively infrequent in our participants (see table 1). Dyspnea while speaking was presumably related to the need to compensate for the suppression of irregular breathing caused by impaired ventilatory muscles. MWC users are likely to need to be fed by another person, but will use speech to direct the pace of the meal. The need to use speech when eating may have influenced the reports of dyspnea in the MWC group. It is also possible that the volume of intake per bite or sip is more difficult to control since the participants are being fed, which may increase the duration of apnea and the likelihood that they will report having dyspnea.

Dyspnea while dressing or undressing was more common in participants able to walk with or without an aid compared with users of hand-propelled or motorized wheelchairs. It is likely that the most impaired participants received assistance in dressing and undressing and this may have affected our results. Metabolic demand increases when one is dressing or undressing. In

the able-bodied, sufficient ventilation is accomplished easily because the ventilatory muscles are intact. However, dyspnea may occur in SCI because respiratory muscles are impaired and undressing and dressing may require the use of such muscles as the pectoralis major,[26] that would otherwise be used in breathing. Several studies have supported this concept. Use of the arms affects ventilation and ventilatory muscle recruitment in able-bodied subjects[27,28] and in subjects with COPD. In the latter group, dyspnea is common during ADLs that require use of the arms (eg, combing one's hair).

In the able bodied, dyspnea has been associated with respiratory illness and mortality independent of FEV_1.[29,30] Percentage of predicted FEV_1 of participants with and without dyspnea was similar in our study and therefore the higher prevalence of dyspnea cannot be attributed to reduced pulmonary function. Dyspnea was also not significantly related to physician-diagnosed heart or lung disease. Cigarette smoking and respiratory symptoms (chronic cough, any wheeze) were associated with dypsnea, therefore it is possible that therapy to relieve dyspnea in MWC users with SCI should include smoking cessation and treatment of these symptoms.

CONCLUSIONS

Dyspnea may occur in SCI subjects while they are talking, eating, dressing, or undressing. Overall, dyspnea during talking appears to be most common, particularly in participants with the least mobility (ie, MWC users, who are the most impaired). The mechanisms that cause dyspnea during eating and speaking are likely related to the relation between impaired ventilatory muscles and suppression of breathing during the increased respiratory drive. Dyspnea during dressing and undressing may be related to the relation between the impaired ventilatory muscles in SCI and, during dressing and undressing, the use of limb muscles that would otherwise be used for breathing. Not all of the most impaired participants reported dyspnea when speaking, therefore it is possible that certain adaptive strategies may be effective. The same is true for those who experienced dyspnea while dressing or undressing. Identification of, and training in, such adaptive strategies may provide relief for those affected.

Acknowledgements

We acknowledge the assistance of the physicians and staff of the Spinal Cord Injury Service at VA Boston.

References

1. Ayas NT, Garshick E, Lieberman SL, Wien MF, Tun C, Brown R. Breathlessness in spinal cord injury depends on injury level. J Spinal Cord Med 1999;22:97–101. [PubMed: 10826265]
2. Spungen AM, Grimm DR, Lesser M, Bauman WA, Almenoff PL. Self-reported prevalence of pulmonary symptoms in subjects with spinal cord injury. Spinal Cord 1997;35:652–7. [PubMed: 9347593]
3. Ferris BG. Epidemiology Standardization Project (American Thoracic Society). Am Rev Respir Dis 1978;118:1–120. [PubMed: 742764]
4. ASIA Neurological Standards Committee. International standards for neurological classification of spinal cord injury. 6th ed Chicago: ASIA; 2002.
5. Standardization of Spirometry, 1994 Update. American Thoracic Society. Am J Respir Crit Care Med 1995;152:1107–36. [PubMed: 7663792]
6. Kelley A, Garshick E, Gross ER, Lieberman SL, Tun CG, Brown R. Spirometry testing standards in spinal cord injury. Chest 2003;123:725–30. [PubMed: 12628869]
7. Tully K, Koke K, Garshick E, Lieberman SL, Tun CG, Brown R. Maximal expiratory pressures in spinal cord injury using two mouthpieces. Chest 1997;112:113–6. [PubMed: 9228365]
8. Silvestri GA, Mahler DA. Evaluation of dyspnea in the elderly patient. Clin Chest Med 1993;14:393–404. [PubMed: 8222558]

9. Velloso M, Stella SG, Cendon S, Silva AC, Jardim JR. Metabolic and ventilatory parameters of four activities of daily living accomplished with arms in COPD patients. Chest 2003;123:1047–53. [PubMed: 12684292]
10. Tanaka K, Akechi T, Okuyama T, Nishiwaki Y, Uchitomi Y. Impact of dyspnea, pain, and fatigue on daily life activities in ambulatory patients with advanced lung cancer. J Pain Symptom Manage 2002;23:417–23. [PubMed: 12007759]
11. Tanaka K, Akechi T, Okuyama T, Nishiwaki Y, Uchitomi Y. Prevalence and screening of dyspnea interfering with daily life activities in ambulatory patients with advanced lung cancer. J Pain Symptom Manage 2002;23:484–9. [PubMed: 12067772]
12. Tanaka K, Akechi T, Okuyama T, Nishiwaki Y, Uchitomi Y. Factors correlated with dyspnea in advanced lung cancer patients: organic causes and what else? J Pain Symptom Manage 2002;23:490–500. [PubMed: 12067773]
13. US Department of Health and Human Services. The health consequences of smoking. Chronic obstructive lung disease. A report of the Surgeon General. Rockville: DHHS; 1984.
14. Linn WS, Spungen AM, Gong H Jr, Bauman WA, Adkins RH, Waters RL. Smoking and obstructive lung dysfunction in persons with chronic spinal cord injury. J Spinal Cord Med 2003;26:28–35. [PubMed: 12830966]
15. Spungen AM, Grimm DR, Schilero G, et al. Relationship of respiratory symptoms with smoking status and pulmonary function in chronic spinal cord injury. J Spinal Cord Med 2002;25:23–7. [PubMed: 11939462]
16. Wien MF, Garshick E, Tun CG, Lieberman SL, Kelley A, Brown R. Breathlessness and exercise in spinal cord injury. J Spinal Cord Med 1999;22:297–302. [PubMed: 10751134]
17. Bailey EF, Hoit JD. Speaking and breathing in high respiratory drive. J Speech Lang Hear Res 2002;45:89–99. [PubMed: 14748641]
18. Martin BJ, Logemann JA, Shaker R, Dodds WJ. Coordination between respiration and swallowing: respiratory phase relationships and temporal integration. J Appl Physiol 1994;76:714–23. [PubMed: 8175582]
19. Nishino T, Hiraga K. Coordination of swallowing and respiration in unconscious subjects. J Appl Physiol 1991;70:988–93. [PubMed: 2033013]
20. Preiksaitis HG, Mayrand S, Robins K, Diamant NE. Coordination of respiration and swallowing: effect of bolus volume in normal adults. Am J Physiol 1992;263:R624–30. [PubMed: 1415651]
21. Nishino T, Kohchi T, Yonezawa T, Honda Y. Responses of recurrent laryngeal, hypoglossal, and phrenic nerves to increasing depths of anesthesia with halothane or enflurane in vagotomized cats. Anesthesiology 1985;63:404–9. [PubMed: 4037403]
22. Selley WG, Flack FC, Ellis RE, Brooks WA. Respiratory patterns associated with swallowing: Part 1. The normal adult pattern and changes with age. Age Ageing 1989;18:168–72. [PubMed: 2782213]
23. Selley WG, Flack FC, Ellis RE, Brooks WA. Respiratory patterns associated with swallowing: Part 2. Neurologically impaired dysphagic patients. Age Ageing 1989;18:173–6. [PubMed: 2782214]
24. Smith J, Wolkove N, Colacone A, Kreisman H. Coordination of eating, drinking and breathing in adults. Chest 1989;96:578–82. [PubMed: 2766816]
25. Logemann JA, Kahrilas PJ, Cheng J, et al. Closure mechanisms of laryngeal vestibule during swallow. Am J Physiol 1992;262:G338–44. [PubMed: 1539666]
26. Estenne M, Knoop C, Vanvaerenbergh J, Heilporn A, De Troyer A. The effect of pectoralis muscle training in tetraplegic subjects. Am Rev Respir Dis 1989;139:1218–22. [PubMed: 2712449]
27. Carcassi AM, Decandia M, Onnis M, Piras MB, Tocco L. [Effects of passive movement of the arm on respiration in humans] [Italian]. Boll Soc Ital Biol Sper 1979;55:2301–4. [PubMed: 549592]
28. Couser JI Jr, Martinez FJ, Celli BR. Respiratory response and ventilatory muscle recruitment during arm elevation in normal subjects. Chest 1992;101:336–40. [PubMed: 1735251]
29. Vestbo J, Knudsen KM, Rasmussen FV. Should we continue using questionnaires on breathlessness in epidemiologic surveys? Am Rev Respir Dis 1988;137:1114–8. [PubMed: 3195810]
30. Vestbo J, Rasmussen FV. Respiratory symptoms and FEV_1 as predictors of hospitalization and medication in the following 12 years due to respiratory disease. Eur Respir J 1989;2:710–5. [PubMed: 2806492]

Table 1

Dyspnea According to Mobility in 441 Subjects With SCI

Mobility	Dyspnea While Talking More Than a Few Minutes	Dyspnea While Eating	Dyspnea While Dressing or Undressing, or Limiting the Ability to Leave the House	Any Dyspnea
Using motorized wheelchairs more than half the time (n=85)	15 (17.6)	4 (4.7)	3 (3.5)	20 (23.5)
Using hand-propelled wheelchairs more than half the time (n=263)	4 (1.5)	3 (1.1)	5 (1.9)	9 (3.4)
Walk with aid (crutch or cane) more than half the time (n=56)	3 (5.4)	3 (5.4)	6 (10.7)	8 (14.3)
Walk without assistance more than half the time (n=37)	0 (0)	0 (0)	3 (8.1)	3 (8.1)

NOTE. Values are n (%).

Table 2

Characteristics of SCI Subjects Who Use an MWC More Than Half of the Time

Characteristic	Dyspnea While Talking, Eating, or Dressing			
	Yes (n=20)		No (n=65)	
	n		n	
Mean age (y)	20	50.2 ± 13.6	65	50.6 ± 15.1
Mean years postinjury	20	17.5 ± 13.9	65	15.9 ± 9.9
Sex				
Male	17	85	61	93.9
Female	3	15	4	6.2
Race				
White	20	100	60	92.3
Nonwhite	0	0	5	7.7
Injury level and severity*				
Cervical motor complete and C	16	80	52	80
Other motor complete, C and all D	4	20	13	20
Body mass index				
Normal (<25kg/m^2)	11	55	25	38.5
Overweight (≥25 to <30 kg/m^2)	4	20	20	30.8
Obese (≥30 kg/m^2)	5	25	20	30.8
Smoking				
Ever	18	90	44	67.7
Current	5	25	12	18.5
Former	13	65	32	49.2
Mean lifetime pack years (ever smokers)	18	30.6 ± 28.0	44	25.6 ± 24.9
Pulmonary function test				
% predicted FVC	18	54.6 ± 18.5	61	58.7 ± 15.5
% predicted FEV_1	18	56.1 ± 18.6	61	60.4 ± 16.6
FEV_1/FVC	18	0.8 ± 0.1	62	0.8 ± 0.1
MEP (cmH_2O)	14	79.7 ± 43.8	42	64.3 ± 27.9
MIP (cmH_2O)	19	57.3 ± 23.7	60	67.9 ± 26.6
Patients taking bronchodilators	1	5.0	7	10.8
Occupational exposure to dust	12	60.0	26	40.0

NOTE. Values are mean ± SD or % unless otherwise indicated.

Abbreviations: FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity.

*See text for definition.

Table 3

Respiratory Symptoms and Other Medical Illnesses Among SCI Subjects Who Use an MWC More Than Half of the Time

Characteristic	Dyspnea While Talking, Eating, or Dressing			
	Yes (n = 20)		No (n=65)	
	n	%	n	%
Respiratory symptoms				
Chronic cough	9	45.0	6	9.2
Chronic phlegm	6	30.0	12	18.5
Any wheeze	15	75.0	30	46.2
Persistent wheeze	6	30.0	10	15.4
Medical illnesses				
Physician-diagnosed COPD	1	5.0	7	10.8
Physician-diagnosed asthma	2	10.0	5	7.7
Physician-diagnosed asthma or COPD	2	10.0	11	16.9
Chest illness within the past year keeping one at home or out of work	7	35.0	12	18.5
Pneumonia at time of SCI	9	45.0	14	21.5
Pneumonia after SCI	10	50.0	22	33.9
Heart disease treated in the last 10y	3	15.0	4	6.2

Table 4

Factors Associated With Dyspnea in SCI Subjects Using MWCs More Than Half the Time

	OR	95% CI
Chronic cough	7.8	2.0–32.7
Chronic phlegm	1.9	0.5–6.7
Any wheeze	3.5	1.04–13.6
Persistent wheeze	2.3	0.6–8.6
Physician-diagnosed asthma or COPD	0.5	0.1–2.9
Chest illness within the last year keeping one at home or out of work	2.4	0.7–8.1
Pneumonia at the time of SCI	2.9	0.9–9.7
Pneumonia after SCI	1.9	0.6–6.1
Heart disease treated in the last 10y	2.7	0.4–17.4
Occupational exposure to dust	2.2	0.7–7.2
Lifetime pack years	1.02	1.00–1.03
Ever vs never smoked	4.2	0.9–41.0