

The Validation of Work-related Self-reported Asthma Exacerbation

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Objective

To validate work-related self-reported exacerbation of asthma using the findings from serial peak expiratory flow (PEF) measurements as the standard.

Background

- Work-related asthma (WRA) includes both new-onset asthma and work-exacerbated asthma (WEA), which is the exacerbation of pre-existing asthma due to occupational exposures.
- WEA might be as common as new-onset work-related asthma, and is associated with similar adverse outcomes such as persistent breathing problems and the need for emergency care.

Methods and Materials

Participants

Adults with asthma ages 18-45 years

- Were participants in a larger study of WEA
- Enrolled as patients in a health maintenance organization (HMO)
- HMO in state of Massachusetts
- Provided inpatient, outpatient, emergency, and after-hours care, and filled prescriptions for medications
- Had doctor's diagnosis of asthma: identified first by electronic records, confirmed by manual review of medical records
- Were not cases of new-onset asthma: 1st asthma attack had to be at least 14 months before the start of the study

Collection of Serial PEF Data

Participants completed office spirometry before serial testing, where they were oriented to EasyOne™ portable spirometer

- Self-recording spirometer, date- and time- stamped data
- Alarm reminded participants when to test themselves
- Coaching statements appeared during testing
- Contained an electronic daily log where participants recorded hours worked, symptoms, and medication use
- Self-testing for 3 weeks, 5 test sessions per day, at least 3 acceptable maneuvers at each session
- Retained best of 3 acceptable maneuvers for analyses
- Participants given US \$200 honorarium for completing office and serial spirometry



EasyOne™ Spirometer

Summarizing Serial Measurements

At the end of testing, spirometry data were entered into the Occupational Asthma System (Oasys-2) software

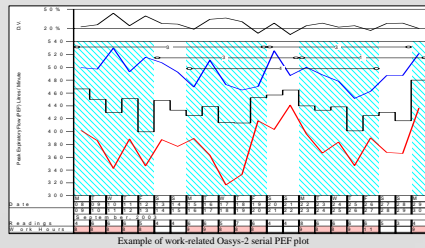
- Generates plots of max, mean, and min PEF values
- Produces a work-relatedness score ranging from 1-4
- The probability of WRA increases as the score increases

Records were reviewed by a three member panel. Before being reviewed, the records had to meet following requirements:

- At least 2 weeks of ≥4 sessions a day
- At least 2 work-rest day complexes
- Absence of a respiratory infection

Primary features considered for asthma-work relationship were:

- Worsening of PEF while working and improvement away from work
- Increased diurnal variation on work days
- Oasys-2 score



Collection of Self-reported Symptoms and Medication Use

Collection of self-reported symptoms and medication use was accomplished two ways:

- Through the electronic daily log filled out by participants during serial testing
- Through a telephone questionnaire given post-PEF-testing pertaining to his/her job and work-relatedness of symptoms and medication use for the previous 3 weeks of testing

Four operational definitions were derived:

- Reported symptoms more often on work days vs. non-work days (concurrent symptoms)
- Reported medication use more often on work days vs. non-work days (concurrent medication use)
- Asthma symptoms improved away from work (post-test symptoms)
- Medication use increased on work days (post-test medication use)

Analysis and Results

- 382 employed members of the HMO were invited to participate in the Validation Study. Of these, 95 people (25%) completed the serial spirometry and provided enough data for the records to be reviewed.
- 13 of the 95 participants (14%) were judged to be positive for WEA. There were no significant differences between the WEA and non-WEA groups (Table 1).
- Sensitivity, specificity, and Youden's index were calculated for all possible both/and and either/or combinations of the operational definitions.
- The highest Youden's Index was found for both concurrent measures or both post measures (Table 2).

Table 1. Comparison between Participants Positive and Negative for Workplace Exacerbation of Asthma Based on Serial PEF

	Workplace Exacerbation of Asthma Based on Serial PEF	
	Positive	Negative
N	13	82
% Female	85%	68%
Mean Age (yrs)	33.7	34.3
% Ever Smoked	31%	34%
%With Atopy	54%	71%

Table 2. Sensitivity, Specificity, and Youden's Index for Operational Definitions Based on Self-reported Symptoms and Medication Use *

Operational Definitions	Sensitivity (%)	Specificity (%)	Youden's Index
Symptoms (Sx) and Medication Use (Rx) Reported Concurrent (Ct) with Serial Testing			
Sx	62	54	0.16
Rx	62	65	0.27
Symptoms and Medication Use Reported Post-testing			
Sx	15	87	0.02
Rx	15	89	0.04
Combinations of Self-reported Operational Definitions **			
<i>Combinations of Two</i>			
Both Ct	54	78	0.32
Ct Rx or Post Rx	69	61	0.30
<i>Combinations of Three</i>			
Both Ct or Post Rx	62	71	0.33
Both Post or Ct Rx	69	62	0.31
<i>Combinations of Four</i>			
Both Ct or Both Post	62	73	0.35
(Ct Sx or Post Sx) and (Ct Rx or Post Rx)	62	73	0.35

* With findings from serial PEF as the standard for workplace exacerbation of asthma
** Combinations with the highest Youden's Index in each subcategory

Discussion

Participation

Low participation rate could be due to:

- Non-traditional work schedules
- Participation is demanding (3 weeks/5 sessions a day)

This could possibly be overcome by:

- Offering higher incentives that go beyond compensating them for their time
- More frequent, perhaps daily, contact with the participants

Peak Expiratory Flow

The traditional standard for diagnosis of WRA has been specific inhalation challenge (SIC). When compared to SIC, serial spirometry is:

- More readily available
- Less expensive
- Less risky

Value of Self-reports

None of the operational definitions for work-related self-reported exacerbation of asthma had high values for both sensitivity and specificity.

Symptoms and medication use reported concurrent with testing had a higher sensitivity than those reported post-test.

- Symptoms and medication use reported concurrent with testing were indications of events that occurred in the previous 2 hours (as opposed to the previous three weeks)
- Did not require the participants to describe whether their symptoms were better or worse.

Summary

- Serial PEF measurements provided objective evidence for WEA, but participation was poor in the population-based study.
- The estimated prevalence of WEA was 14%, which is consistent with the ATS estimate of the prevalence of WEA.
- Even though self-reports concurrent with testing were more accurate than post-test self-reports, they still resulted in a large number of false positives and false negatives.
- Evaluation of suspected work-exacerbated asthma is often limited to those that have self-identified based on their perceived symptom or medication use patterns. Thus, many people may not be identified, treatment is not being adjusted, and there is under-reporting to surveillance systems.
- The performance of self-reports in identifying work-related patterns of asthma suggests a need for further research in the area of questionnaire development and validation.

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