Respiratory Medicine (2014) 108, 677–684

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/rmed

Indoor molds and lung function in healthy adults

Samu Hernberg [a,b,c], Penpatra Sripaiboonkij [a,d], Reginald Quansah [a], Jouni J.K. Jaakkola [a,c,e,*], Maritta S. Jaakkola [a,b,c]

[a] Center for Environmental and Respiratory Health Research, University of Oulu, Oulu, Finland
[b] Respiratory Medicine Unit, Institute of Clinical Medicine, University of Oulu, Oulu, Finland
[c] Respiratory Medicine Unit, Oulu University Hospital, Oulu, Finland
[d] Faculty of Public Health, Thammasat University, Thailand
[e] Public Health, Institute of Health Sciences, University of Oulu, Oulu, Finland

Received 4 January 2014; accepted 9 March 2014
Available online 18 March 2014

KEYWORDS
Lung function;
Molds;
Mold odor;
Dampness;
FEV_1;
FVC

Summary
Background: Indoor mold exposure is common worldwide and constitutes an important health problem. There are very few studies assessing the relation between mold exposure and lung function levels among non-asthmatic adults. Our objective was to assess the relations between dampness and mold exposures at home and at work and lung function. In particular, we elaborated the importance of different exposure indicators.
Methods: In a population-based study, 269 non-asthmatic adults from South Finland answered a questionnaire on indoor dampness and mold exposures at home or at work and other factors potentially influencing lung function, and performed spirometry. Multiple linear regression model was applied to study the relations between exposures and spirometric lung function levels.
Results: In linear regression adjusting for confounding, FEV_1 level was reduced on average 200 ml related to mold odor at home (effect estimate −0.20, 95% CI −0.60 to 0.21) and FVC level was reduced on average 460 ml (−0.46, −0.95 to 0.03) respectively. Exposure to mold odor at home or at work or both was related to reduced FEV_1 (−0.15, −0.42 to 0.12) and FVC (−0.22, −0.55 to 0.11) levels. Women had on average 510 ml reduced FEV_1 levels (−0.51, −1.0 to 0.03) and 820 ml reduced FVC levels (−0.82, −1.4 to −0.20) related to mold odor exposure at home.

* Corresponding author. Center for Environmental and Respiratory Health Research, University of Oulu, P.O. Box 5000, 90014 Oulu, Finland. Tel.: +358 40 672 0927; fax: +358 8 5375661.
E-mail address: jouni.jaakkola@oulu.fi (J.J.K. Jaakkola).

http://dx.doi.org/10.1016/j.rmed.2014.03.004

Conclusions: Mold odor exposure was related to lower lung function levels among non-asthmatic adults, especially among women.

Introduction

Indoor dampness and molds are common worldwide [1]. At least 20% of buildings in North America and Europe have one or more signs of dampness [2]. In cold climate the prevalence of water damage and dampness problems is estimated at 5%—30% and in moderate and warm climates at 10%—60% [3,4]. Thus, indoor dampness-related exposures constitute an important public health problem globally.

In a recent meta-analysis, the risk of developing asthma was significantly elevated in relation to dampness (effect estimate (EE) 1.33, 95% CI 1.12—1.56), visible mold (EE 1.29, 95% CI 1.04—1.60), and mold odor (EE 1.73, 95% CI 1.19—2.50), but not in relation to water damage (EE 1.12, 95% CI 0.98—1.27) [5]. Thus, the evidence indicated that dampness and molds in the home are determinants of asthma onset. Another meta-analyses provided evidence that dampness and mold problems increase the risk of allergic (AR) and non-allergic rhinitis: the largest risk was observed in relation to mold odor (rhinitis: 2.18 [95% CI, 1.76—2.71]; AR: 1.87 [95% CI, 0.95—3.68]). The risk related to visible mold was also consistently increased (rhinitis: 1.82 [95% CI, 1.56—2.12]; AR: 1.51 [95% CI, 1.39—1.64]; rhinoconjunctivitis: 1.66 [95% CI, 1.27—2.18]) In addition, exposure to dampness was related to increased risk of all types of rhinitis [6].

On the basis of the evidence on these adverse respiratory effects, lung function is a plausible target for adverse effects of dampness and mold problems. Our systematic literature search identified only four previous studies assessing the association between mold or dampness exposure and lung function levels in adults with no lung diseases [7—10]. All studies provided suggestive evidence of some reduction in lung function in individuals exposed to molds or dampness. One study presented some result separately for men and women [10]. Two of them focused on work exposure [7,8] and two on home exposure [9,10]. Our knowledge of the effect of mold and/or dampness on lung function among non-asthmatic adults is therefore limited.

Our objective was to assess the relations between dampness and mold exposures at home and at work and lung function among working aged adults without current or previous asthma. In particular, we elaborated the importance of different exposure indicators that have been found relevant in the studies on asthma and allergic rhinitis.

Methods

Study population

We conducted a population-based cross-sectional study of working aged non-asthmatic adults in a geographically defined area in Finland. The study population served as controls in the Finnish Environment and Asthma Study (FEAS), a population-based study on incident asthma [11—19].

The study population was derived from a source population consisting of adults 21—63 years old living in the Pirkanmaa Hospital district, in South Finland identified from the national population registry, which has full coverage of the population. All together there were 1016 (response rate 67%) controls of which 299 performed spirometry. After excluding 21 people diagnosed with asthma, two who were over 64 years old, three without questionnaire data and 4 duplicates, the study population constituted 269 adults with spirometric lung functions and exposure data.

Exposure assessment

Exposure was assessed based on questionnaire information on indoor water damage, damp stains and other marks of structural dampness, visible mold, and mold odor, both at home and at work [11,20—22]. For water damage, damp stains, and visible mold, we asked information about their occurrence during the past year, 1—3 years before, or >3 years ago. For mold odor, we asked about occurrence during the past 12 months and inquired if such odor appeared almost daily, 1—3 days a week, 1—3 days a month, <1 day a month, or never.

Measurement methods

Questionnaire

The self-administered questionnaire has been described in detail elsewhere [11—19].

Lung function measurements

We conducted a baseline spirometry with a pneumotachygraph spirometer connected to a computer using a disposable flow transducer (Medikro 905; Medikro Ltd., Kuopio, Finland). Measurements were conducted according to the standards of the American Thoracic Society [23]. We judged the presence of obstruction using the reference values derived from the Finnish population [24].

Statistical methods

Our outcome of interest was spirometric lung function at baseline, i.e. FEV_1 and forced vital capacity (FVC) measured before the bronchodilation test. We applied multiple linear regression to estimate the relations between the dampness and mold exposure indicators and the lung function levels. First, we adjusted for three core covariates: age, sex and height. We built the full model by