

# Quality of Life and Employment Status of Workers With Western Red Cedar Asthma

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**Objective:** The impact of current employment status and other factors on quality of life was evaluated for workers diagnosed with western red cedar asthma in British Columbia, Canada. **Methods:** Telephone interviews by questionnaire included the Short Form 36 (SF-36) and Marks Asthma quality-of-life instruments. **Results:** Of the 302 subjects contacted, 70.5% ( $n = 213$ ) participated. Employment status was the most consistent predictor of quality-of-life domains, with highest scores for employed subjects, particularly those who were no longer exposed to red cedar. Subjects who had quit work because of their asthma had worse scores, particularly for vitality and general health perceptions. Other factors independently associated with specific aspects of poor quality of life were having asthma-like symptoms, taking medication, and not being married. **Conclusions:** Continued employment was associated with better quality of life for workers with western red cedar asthma. (J Occup Environ Med. 2007;49:1040–1045)

The most prevalent occupational lung disease in developed countries is occupational asthma.<sup>1</sup> Western red cedar asthma (WRCA) is the most common form of occupational asthma in British Columbia, Canada, and in the northwest of the United States, in part because of the importance of cedar production to the local economies.<sup>2</sup> First described by Milne and Gandevia<sup>3</sup> as the development of irritant and respiratory symptoms that progresses to asthma as a result of machining western red cedar, it was further characterized by Chan-Yeung and colleagues,<sup>4</sup> who identified plicatic acid as the specific etiological agent involved.

Of concern are the long-term health outcomes of workers diagnosed with western red cedar asthma. Once a diagnosis of occupational asthma has been made, the most effective treatment method is considered to be cessation of exposure to the causative agent.<sup>5</sup> For example, workers with red cedar asthma who left the industry showed an improvement in respiratory health.<sup>6–9</sup>

As defined by the World Health Organization, “Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.”<sup>10</sup> Traditional methods of assessing health through physiological and clinical practice do not take into account the impact of disease on physical, social, or emotional well-being.<sup>11</sup> In particular, occupational medical research is only now incorporating quality of life as a focus of investigation.<sup>12</sup> Very few studies have considered quality of life for

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subjects diagnosed with occupational asthma. An exception is the study by Malo and colleagues<sup>13</sup> in which the Juniper Asthma Quality of Life Questionnaire was used to assess 134 subjects with occupational asthma who had been removed from exposure for 2 or more years. When compared with subjects with non-occupational asthma, the occupational asthma group showed greater impairment in quality of life.

We undertook a study of workers who had been diagnosed with WRCA in the past, to evaluate quality of life in relationship to current employment status and other personal factors.

## Materials and Methods

### Study Subjects

The design was a cross-sectional study of patients who were diagnosed with western red cedar asthma after having undergone plicatic acid challenge at a provincial referral center at a Vancouver hospital since 1972. Attempts were made to contact 516 patients with WRCA who were age eligible (younger than 76 years) and were still residents of British Columbia. Letters of introduction, prepared in English and Punjabi, were mailed out at intervals during 2003. After a minimum of 1 week, attempts were made to contact subjects by telephone for scheduling. Nineteen potential subjects were excluded because of severe illness, extended travel, or not speaking English or Punjabi. For others, no contact was possible, either because of an incorrect address or telephone number ( $n = 123$ ) or because of no answer despite repeated (up to seven) attempts by telephone ( $n = 72$ ). The rate of participation among the contacted subjects was 70.5%, with 213 of 302 taking part.

The University of British Columbia's Behavioral Research Ethics Board approved all study procedures before the commencement of the study.

### Questionnaire-Based Interview

All interviews were done by telephone, except for two done in person. Bilingual interviewers (English and Punjabi) facilitated the interview by a questionnaire written in English. The duration of the interviews ranged from 45 minutes to 2 hours.

In addition to questions on demographics, smoking habits, and employment history, the questionnaire contained items on acute asthma-like respiratory symptoms from the European Community Health survey.<sup>14</sup> Being "symptomatic" was defined as a positive response to one of the following symptoms occurring in the last 12 months: "wheeze," "woken with chest tightness," "breathless during day," "woken breathless," and "woken by cough." Current use of inhaled or oral corticosteroids or bronchodilators was defined as "asthma medication." We ascertained quality of life using two instruments:

1. The Short Form 36 (SF-36) domains were derived from subsets of the 36 questions, rated, and then transformed to a scale of 0 to 100.<sup>15</sup> Values closest to 100 indicated better health and overall functioning. The six domains selected were *physical functioning*, *social functioning*, *bodily pain*, *mental health*, *vitality*, and *general health perceptions*.
2. The asthma-specific Marks Asthma Quality of Life (QOL) Questionnaire consisted of 20 questions based on a five-point Likert scale scored from 0 ("not at all") to 4 ("very severely"), converted to a total score of 10 for the aggregate *scale total*.<sup>16</sup> A low score indicated better health status and overall functioning.

The main exposure group was formed according to whether subjects were currently employed and were exposed to red cedar. Those who were unemployed were further divided according to whether they indicated that the reason for leaving their most recent job was "asthma."

Test results available from the time of diagnosis included information on subject characteristics, percent predicted lung function (prediction equations by Crapo et al<sup>17</sup>), and provocative concentration (PC20) determined through methacholine challenge testing in accordance with the method of Cockcroft.<sup>18</sup>

### Data Analysis

We conducted  $\chi^2$  and analysis-of-variance testing using the Statistical Package for the Social Sciences, version 11.5 (SPSS, Chicago, IL) with the Scheffe test applied for post hoc comparisons of the continuous variables. For multiple regression analysis of the main effects, we used Statistical Software for Professionals (Stata/SE 8.0, College Station, TX). Variables entered on an a priori basis into the model were current employment status (employed and exposed to red cedar, unemployed because of asthma, unemployed not due to asthma vs employed but not exposed), age, sex, and preferred language of interview (Punjabi vs English). Other potential determinants of quality-of-life domains included smoking status (smoker, ex-smoker vs never-smoker), educational level (post-secondary vs grade 12 or less), marital status (not married vs married), and household income (\$50,000 or less vs more than \$50,000). For all analyses, a  $P$  value less than 0.05 was regarded as statistically significant.

## Results

### Characteristics

Ethnicity, gender, and smoking status were similar for the 213 participants and 303 age-eligible non-participants, along with respiratory symptoms and lung function including PC20 measured at diagnosis. Table 1 shows differences in personal characteristics and respiratory health according to current work status of the participants. Subjects were mostly male non-smokers. Almost all subjects who were unemployed because of their asthma were symp-

TABLE 1

Personal Characteristics, Symptomatic Status, Inhaled Medication Use, and Test Results at Diagnosis for Subjects With Western Red Cedar Asthma According to Current Work Status

| Characteristics                             | Current Work Status                  |                                    |                                        |                                        |
|---------------------------------------------|--------------------------------------|------------------------------------|----------------------------------------|----------------------------------------|
|                                             | Employed                             |                                    | Unemployed                             |                                        |
|                                             | Unexposed to WRC<br>( <i>n</i> = 81) | Exposed to WRC<br>( <i>n</i> = 47) | Not Asthma-Related<br>( <i>n</i> = 54) | Quit Due to Asthma<br>( <i>n</i> = 31) |
| Current age (yr ± SD)                       | 49.8 ± 8.3                           | 51.6 ± 7.2                         | 64.9 ± 8.6                             | 55.6 ± 14.2                            |
| Gender (% male)                             | 96.3                                 | 100                                | 96.3                                   | 93.5                                   |
| Ethnicity (% East Indian)                   | 51.9                                 | 55.3                               | 46.3                                   | 64.5                                   |
| Never-smoker (%)                            | 81.5                                 | 63.8                               | 64.8                                   | 71.0                                   |
| Ex-smoker (%)                               | 14.8                                 | 27.7                               | 35.2                                   | 25.8                                   |
| Current smoker (%)                          | 3.7                                  | 8.5                                | 0                                      | 3.2                                    |
| Interview language: (% Punjabi)             | 32.1                                 | 44.7                               | 35.2                                   | 51.6                                   |
| Education level >12 yr (%)                  | 21.0                                 | 12.8                               | 5.8                                    | 12.9                                   |
| Marital Status: (% Married)                 | 91.4                                 | 95.7                               | 94.4                                   | 83.9                                   |
| Household income ≤ \$50,000* (%)            | 45.2                                 | 40.0                               | 84.6                                   | 95.2                                   |
| Symptomatic (%)                             | 49.4                                 | 55.3                               | 61.1                                   | 93.5                                   |
| Asthma medication (%)                       | 33.3                                 | 57.4                               | 51.9                                   | 90.3                                   |
| Years since diagnosis (± SD)                | 17.7 ± 6.2                           | 15.6 ± 7.2                         | 21.7 ± 6.7                             | 14.5 ± 7.9                             |
| Positive skin prick at diagnosis (%)        | 54.5                                 | 51.2                               | 32.0                                   | 55.2                                   |
| FEV <sub>1</sub> (% predicted) at diagnosis | 88.6 ± 16.3                          | 96.0 ± 13.0                        | 87.0 ± 14.7                            | 80.3 ± 17.4                            |
| FVC (% predicted) at diagnosis              | 99.3 ± 13.7                          | 103.9 ± 13.3                       | 98.5 ± 14.9                            | 89.7 ± 13.5                            |
| PC20 (mg/mL) at diagnosis                   | 3.4 ± 5.3                            | 3.4 ± 5.5                          | 2.8 ± 4.3                              | 2.4 ± 4.5                              |

\*Data available for a subset (*n* = 157) of subjects.

FEV<sub>1</sub> indicates forced expiratory volume at 1 second; FVC, forced vital capacity; PC20, provocative concentration determined with methacholine challenge testing.

tomatic. As could be expected, asthma medication use was highest for this group. Subjects who were still working and were exposed to red cedar had higher lung function measured at diagnosis. Yet this working group also had higher lung function measured at diagnosis.

All subjects who had quit employment because of asthma had been exposed to red cedar in their most recent job. Apart from retirement (*n* = 40), reasons for unemployment were having been laid off (*n* = 8) or having an illness unrelated to asthma (*n* = 6).

### Quality of Life

Significant differences were observed between the four employment status groups for all quality-of-life indicators (Table 2). All the quality-of-life scores were higher for subjects who were working but were not exposed to cedar compared with both unemployed groups. The total score for the Marks Asthma Quality of Life Questionnaire confirmed worse

functioning for those who were no longer working because of problems with asthma, also having the lowest SF-36 scores, particularly for the vitality and general health perceptions domains. There were no statistically significant differences observed between the two employed groups.

The potential determinants of quality of life: age, sex, smoking status, educational level, marital status, interview language, household income, symptomatic status, and asthma medication use were each found to have significant associations with at least one quality-of-life index, based on bivariate analyses. In the multivariate model, household income was excluded because of the relatively low number of responses. Table 3 shows the results of the significant predictor variables found for the multiple regression analyses of each quality-of-life outcome. Current work status had the most consistent significant associations with quality of life. When comparisons were made to subjects who were employed and

were not exposed to red cedar, the two unemployed groups had significantly worse scores for most SF-36 domains and for the Marks Asthma Quality of Life total score. Being symptomatic or taking asthma medication reduced physical and social functioning, respectively, and both negatively affected general health perceptions and Marks Asthma Quality of Life total scale. Personal characteristics found to be associated with better scores in two quality-of-life domains included being married, speaking Punjabi, and having quit smoking (vs never smoking).

In the follow-up period for employed subjects (*n* = 185), of those who continued working with red cedar after diagnosis (*n* = 143), 30.1% remained in exposed jobs at follow-up, 25.9% switched to jobs without exposure to red cedar, and 16.8% (*n* = 24) eventually quit their jobs because of problems with their asthma. By comparison, the majority of subjects (73.8%) who began working in unexposed jobs within 1 year of diagnosis (*n* = 42) remained

TABLE 2

Comparison of Mean Scores for Selected Quality-of-Life (QOL) Domains\* According to Current Work Status of Subjects With Western Red Cedar Asthma

| Symptoms/Medication Use (%) | Current Work Status          |                            |                                |                                |
|-----------------------------|------------------------------|----------------------------|--------------------------------|--------------------------------|
|                             | Employed                     |                            | Unemployed                     |                                |
|                             | Unexposed to WRC<br>(n = 81) | Exposed to WRC<br>(n = 47) | Not Asthma Related<br>(n = 54) | Quit Due to Asthma<br>(n = 31) |
| SF-36 transformed scale     |                              |                            |                                |                                |
| Physical functioning        | 85.9 ± 17.2                  | 77.7 ± 22.7                | 63.8 ± 28.8†                   | 57.1 ± 24.7†                   |
| Social functioning          | 89.8 ± 17.5                  | 84.3 ± 18.1                | 75.7 ± 23.2‡                   | 54.8 ± 30.4†**                 |
| Bodily pain                 | 89.2 ± 20.2                  | 82.9 ± 21.1                | 77.3 ± 26.1‡                   | 63.9 ± 28.1†                   |
| Mental health               | 84.8 ± 14.6                  | 82.1 ± 14.9                | 77.4 ± 18.3                    | 67.7 ± 23.5†                   |
| Vitality                    | 64.3 ± 16.0                  | 58.8 ± 17.3                | 51.4 ± 18.8‡                   | 43.6 ± 18.1†                   |
| General health perceptions  | 69.9 ± 19.7                  | 61.6 ± 20.9                | 54.3 ± 23.7‡                   | 42.1 ± 26.21†                  |
| Marks Asthma QOL Total      | 1.3 ± 1.5                    | 1.6 ± 1.3                  | 2.3 ± 2.1‡                     | 3.9 ± 2.3†**                   |

\*P < 0.05 using one-way analysis of variance of selected SF-36 domains with transformed scale of 1 = worst and 100 = best. For Marks Asthma QOL Total Scale, 0 = best and 10 = worst.

\*\*P < 0.05 for comparison with those unemployed, not due to asthma problems, using Scheffe post hoc testing.

†P < 0.05 for comparison with each employed group using Scheffe post hoc testing.

‡P < 0.05 for comparison with unexposed employed workers using Scheffe post hoc testing.

WRC indicates western red cedar; SF-36, Short Form 36.

TABLE 3

Significant Predictors (Beta Coefficients and Standard Errors)\* of Selected Quality-of-Life Domains Among Subjects With Western Red Cedar Asthma

| Predictors                      | Physical Functioning | Social Functioning | Bodily Pain | Mental Health | Vitality     | General Health Perceptions | Marks Asthma QOL Total |
|---------------------------------|----------------------|--------------------|-------------|---------------|--------------|----------------------------|------------------------|
| Unemployed (not asthma related) | −19.6 (4.6)          | −14.5 (4.4)        |             | −9.3 (3.5)    | −10.5 (3.6)  | −13.0 (4.3)                | 0.9 (0.3)              |
| Quit due to asthma              | −19.5 (5.2)          | −27.3 (4.9)        | −19.2 (5.5) | −15.8 (3.9)   | −13.8 (4.06) | −13.0 (4.3)                | 1.7 (0.4)              |
| Symptomatic                     | −11.4 (3.6)          |                    |             |               |              | −10.6 (3.3)                | 1.1 (0.3)              |
| Asthma medication               |                      | −7.13 (3.5)        |             |               |              | −11.2 (3.4)                | 0.7 (0.3)              |
| Punjabi speaking                |                      |                    |             | 8.3 (2.8)     |              |                            | −0.6 (0.3)             |
| Education <12 yr                |                      |                    |             |               |              | −9.3 (3.1)                 |                        |
| Not married                     |                      | −12.8 (6.2)        |             |               |              |                            | 0.9 (0.5)              |
| Current smoker                  |                      |                    |             | 16.8 (6.3)    |              |                            |                        |
| Ex-smoker                       |                      | 9.4 (3.8)          |             | 7.6 (3.1)     |              |                            |                        |

\*In addition to the listed variables, the regression model included sex, age, and the group working with red cedar; each variable was always not statistically significant.

A negative SF-36 score coefficient indicates a worse score. A positive Marks Asthma QOL total score coefficient indicates a worse score.

in that position, and none had quit work because of problems with asthma.

## Discussion

Employment status was an important determinant of quality of life for workers who were diagnosed with WRCA. Those who were employed, particularly if they were no longer exposed to red cedar, consistently had the best quality-of-life scores, whereas quitting employment, especially because of problems with asthma, was associated with worsened quality of life. Our findings on

occupational asthmatics are consistent with the population-based study of 196 subjects with asthma by Mancuso et al<sup>19</sup>, in which patients not currently working were found to have worse quality-of-life scores. Complete and definitive removal from exposure is considered to be the key treatment for occupational asthma.<sup>20</sup> We found that removal from exposure favored a better quality of life only for those who continued to be employed. It must be noted that the relationship between employment and quality of life is compli-

cated by the fact that impaired physical or mental functional status can lead to unemployment, which, in turn, may lead to worse quality of life.<sup>21</sup>

Being symptomatic was associated with greater limitations in performing physical activities, and along with medication use, was related to negative evaluations of personal health and poorer scores for quality of life because of asthma. It has been shown previously that for patients with asthma or chronic obstructive pulmonary disease (COPD), the presence of respiratory symptoms,

severity of the disease, and need for medication are highly related to quality of life.<sup>13,22,23</sup> In our study, different aspects of better quality of life were associated with being married, speaking Punjabi, being better educated, and having quit smoking (vs never smoking). A strong relationship has been noted between cultural and socioeconomic indicators and quality of life measured in patients with asthma.<sup>21,24</sup> The finding of an advantage in quality of life for ex-smokers (vs never-smokers) in social functioning and mental health domains is consistent with a study of patients with COPD, which reported that current smoking had favorable effects on quality of life.<sup>25</sup>

Although the rate of participation for those who could be contacted was very good at 70.5%, the study power was reduced by outdated contact information for a large segment of the study population. The questionnaire telephone interview format allowed the maximal number of participants throughout the province. Having bilingual interviewers facilitated the participation of Punjabi-speaking subjects and therefore reduced inconsistency in response compared with using surrogate interviewees. However, with the use of questionnaires, the potential for recall bias and symptom reporting was subjective in nature. In addition to potential selection effects resulting from loss of follow-up, a "healthy worker effect" may partially account for the better outcomes among those who stayed employed.

Quality of life is an important but often overlooked measure of health. The SF-36 Health Status Survey is the most commonly used health-related quality-of-life instrument worldwide.<sup>15,26,27</sup> Compared with the many quality-of-life questionnaires that have been developed specifically for people with asthma, the Marks Asthma Quality of Life Questionnaire had the advantage of brevity and was validated for telephone administration.<sup>16,28</sup> Both instruments have been used in studies of patients

with asthma though not specifically for people with occupational asthma.

The implications of poor management of occupational asthma are increased morbidity and medication use. It was recently estimated that the annual cost of occupational asthma in the United States was \$1.6 billion, based on a population-attributable risk of 15%.<sup>29</sup> The optimal strategy for workers diagnosed with WRCA is retraining them and helping them obtain employment without exposure to red cedar, along with appropriate medical care to control the morbidity associated with their asthma. Maintaining employment and avoiding exposure to red cedar were important factors for promoting good quality of life and reduced morbidity among patients diagnosed with WRCA. Our findings are in accordance with the conclusion by Blanc<sup>12</sup> that both quality of life and working life should be of concern to the occupational health researcher.

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