THE UNIVERSITY OF CALGARY

The Hermeneutic Application of Indoor Air Quality Surveys to Examine the Health of Courthouse Occupants Exposed to Fungi

By

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A MASTER'S DEGREE PROJECT

SUBMITTED TO THE FACULTY OF ENVIRONMENTAL DESIGN

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER'S OF ENVIRONMENTAL DESIGN

ENVIRONMENTAL SCIENCE

CALGARY, ALBERTA

JANUARY 2004

Your file Votre référence
ISBN: 978-0-494-37478-8
Our file Notre référence
ISBN: 978-0-494-37478-8

Abstract

This study examined the health perceptions of courthouse workers considered occupationally exposed to fungi with a hermeneutic approach. This method focussed analysis on the expected susceptible and hypersusceptible populations and identified transdisciplinary literature surrounding health effects of exposure to fungi.

Fungi were speciated from indoor air samples in the Court of Queen's Bench (CQB) building. Four hundred and ninety occupants received the MiniRQLQ and a "hybridized" survey.

Results indicate that more full-time CQB occupants than expected in a hypersusceptible population reported more severe respiratory and fatigue symptoms than did occasional occupants (MiniRQLQ: RR = 2.12 and Hybridized Survey RR = 3.05). Symptoms occurred Monday to Friday during respondents' workdays, however the timing data beyond that was inconclusive.

Occupants and building owners may wish to adopt a hermeneutic method to examine health risks when understandings of levels of exposure to fungi are unclear or when exposure analysis is unavailable.

Key words: courthouse occupants; fungi; health-related quality of life; hermeneutic; hybridized survey; indoor air quality; respiratory symptoms; rhinoconjunctivitis, Calgary, Canada.

Acknowledgements

I extend a very big thank you and appreciation for the time, support and the passion for good questions of my committee members, Professor Tang Lee, and Dr. Tim Lambert.

The additional guidance and mentorship from my faculty advisor, Dr. Grant Ross and the excitement about the fungi I learned from Dr. Dennis Parkinson in his lab have been inspirational.

I greatly appreciate the financial assistance provided to me from the Faculty of Environmental Design Research Scholarships and Graduate Teaching Assistantship. The Alberta Union of Public Employees formally supported this study by copying and mailing it to over 400 of their members who have worked at the Calgary Court of Queen's Bench building. Without their concern for occupants who have been ill, and their practical and financial support, this study would not have happened.

I sincerely appreciate the time and efforts provided by all of the courthouse occupants involved with this research.

I started this program because of a wonderful family, whose son T. has asthma. The many families along the way, directly affected by indoor air quality, helped me to continue.
I finished this project because of the ongoing support from my employer, and colleagues at Calgary and Area Child and Family Services Authority, especially Dr. Brenda Rumpel.

To Colleen, Nancy, Adele and, of course the Duck Night Group...

To my parents and family I thank you. Very special thanks to Christine and Thomas; two great young people who continue to teach me about learning.

Most of all I would like to thank my best friend, Murray, who taught me about doing more than one profession at the same time.

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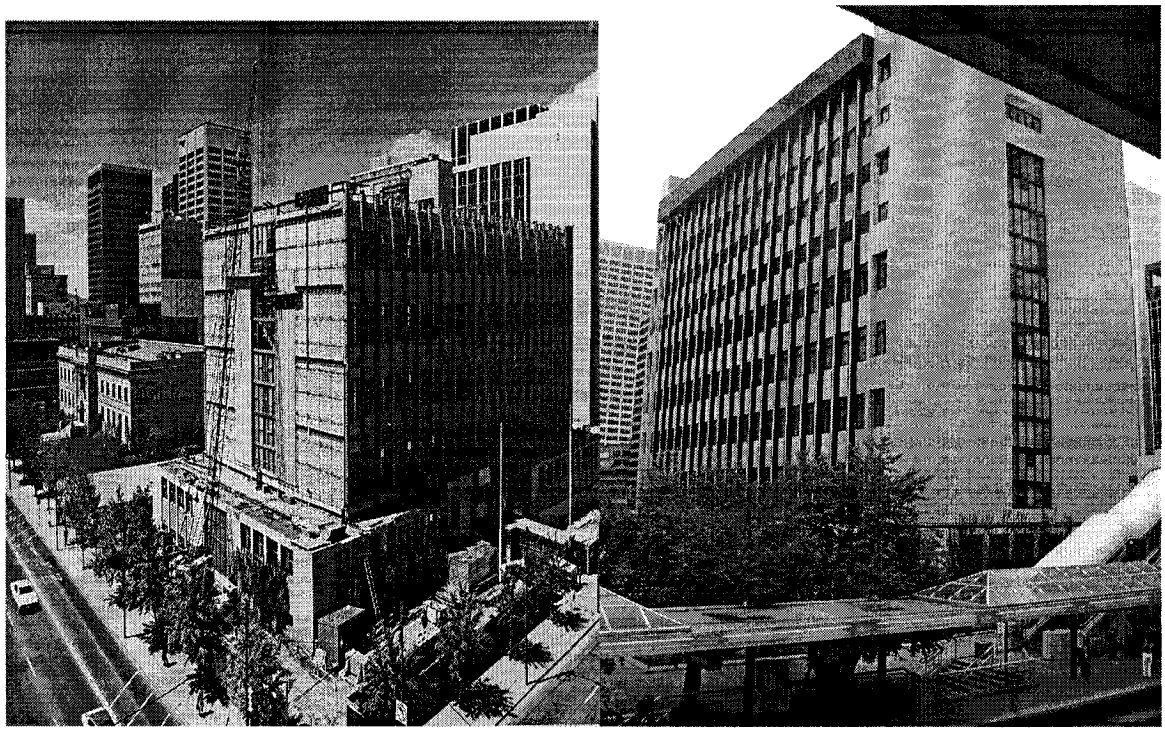

Photo 1: "Courthouse Construction took 43 months" (Bobrovitz 1998) Photo 2 Court of Queen's Bench 2003

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The world is no longer the garden we evolved to live in.

Maintenance means tending

Irun Cohen

Tending Adam's Garden:
Evolving the Cognitive Immune Self (2000), p.247

Executive Summary

This study describes the perception of health effects from fungi by courthouse occupants in Calgary, Alberta using a hermeneutic approach.

Two sampling teams found fungi (including *Stachybotrys chartarum*, *Epicoccum nigrum* and *Aspergillus versicolor*) in indoor air samples at the Court of Queen's Bench (CQB) building during 2001-2002. Occupant health concerns had also been raised (AUPE 2002).

A pair of surveys, interviews and observations draws the picture of these occupants' health perceptions. The survey has two parts, the Mini Rhinoconjunctivitis Quality of Life Questionnaire (MiniRQLQ) (Juniper 1997) along with a hybridized indoor air quality survey developed for this sample of occupants. The Alberta Union of Public Employees (AUPE) mailed the surveys confidentially to 404 CQB occupants' homes. The Chief and Associate Chief Justices permitted their staff to distribute 86 surveys to judges and staff who work regularly or occasionally in the Court of Queen's Bench building in Calgary.

The overall response rate to the survey was 13.1 %. The response rate for the sample of interest was 20% (N = 36 of a possible 180 full-time CQB building occupants). Occupants returned sixty-four valid questionnaires and five of those respondents who were full-time CQB occupants participated in an interview. A limitation of this study is

that interviews with the internal control group did not occur (no consents received from healthy, occasional CQB occupants).

This study stratified six symptom clusters in the hybridized portion of the survey. The symptom cluster domains are rhinoconjunctivitis, respiratory, vascular, endocrine/immune, dermal and digestive. The hybridized portion of the survey contains the same "0 – 6" rating scale as is contained in the MiniRQLQ. "0" is the rating for responses of "Not at all troubled" and the response "Extremely troubled" is scaled as "6".

Mean score results over all domains of the MiniRQLQ were used to direct the selection of persons to interview. Interview results assisted in focussing the relevant data from the survey.

Overall, in this study, respondents rating their symptoms as "Somewhat (or more) troubling" (2+) responded to the entire questionnaire in greater detail, rated air quality and ventilation less positively, and were experiencing more than one symptom, Monday to Friday. The majority of full-time occupants of the CQB building rated their perception of indoor air and ventilation as "fair" or "poor". The primary odours noted by all respondents in the building areas that they primarily work in are "stale" and "mouldy". The occupant interviews provided additional information, namely that the timing of some symptoms occurs at 8:00 a.m. and noon, and smells of car exhaust odours, probably

drawn in from the parkade are experienced during those times. This information was not evident from the questionnaire data alone.

Eighteen of the 36 full-time CQB building respondents reported that they were "somewhat troubled" (cut point of 2.0 mean or higher) to more than "very troubled" (5.86 highest mean) by their nose and eye symptoms during the last week, as indicated from the MiniRQLQ section results. From the hybridized survey, 36.87 % of all respondents rated the severity of all of their symptoms (across all buildings) as at least "somewhat troubling" (2) or worse, Mondays to Fridays. Twenty-three of 36 full-time CQB building occupants rated their symptoms "4" ("Quite a bit" troubling) to "6" ("Extremely" troubling) in the respiratory, rhinoconjunctivitis, dermal, endocrine/immune or vascular symptom domains. Thirteen of seventeen occasional CQB building occupants also reported symptoms of the same severity (4-6) but only in the domains of endocrine/immune or vascular (headaches and fatigue).

A mean of 2.0 or higher on the MiniRQLQ seemed to be the cut point for respondents reporting that their symptoms of runny noses and eyes are affecting their quality of life at work. Twenty-four of the 36 full-time Court of Queen's Bench building employees responding indicated that they have health concerns (high blood pressure, allergies, asthma, and immune conditions) considered to constitute additional health risks when indoor air pollution is present.

The relative risk of survey respondents having any symptom scores higher than 4.0 on the hybridized portion of the survey (Quite a bit, Very or Extremely Troubled) was calculated as three times greater (RR = 3.05) for full-time Court of Queen's Bench occupants than for occasional CQB occupants. Similar assessment of the results from the MiniRQLQ survey showed twice the relative risk (RR = 2.12) arising from the relative risk analysis of those responses.

A hermeneutic analysis assisted in evaluating whether these findings are representative of the susceptible and hypersusceptible full-time occupants of the CQB building in Calgary. These results indicate that more full-time CQB occupants than would be expected in a hypersusceptible population experienced more serious respiratory and rhinoconjunctivitis symptoms than did occasional CQB occupants. The experiences of these courthouse respondents can be generalized to other susceptible and hypersusceptible office workers.

Proactive IAQ management and design practices that incorporate the needs of susceptible and hypersusceptible office workers would likely prevent complaints. Inclusion of occupant participation through surveys is essential and contributes critical information to guide integrated indoor air quality management systems. A hermeneutic approach assisted in the application of evidence-based research from many points of view in order to examine the risks from fungi indoors and the experiences of susceptible and hypersusceptible people. Poor indoor air quality most adversely affects this large group of office workers.

This approach to indoor air quality surveys will help building owners and managers understand health risks when levels of exposure to fungi are unclear or direct exposure analysis is unavailable.

1.0 Chapter One: Introduction

This document will describe the results of an occupant survey and interviews in the context of the literature surrounding chronic health effects from long-term indoor air exposures to fungi found in the occupational setting of the Court of Queen's Bench building in Calgary, Alberta, Canada.

Since over 90% of our time is spent indoors (Godish 2001) there is interest in the effects of indoor air on health. Non-specific health effects related to indoor air quality (IAQ) among indoor workers in the United States alone are estimated to affect two-thirds of that segment of the workforce, an estimate of up to 60 million people (Mendell, Fisk et al. 2002). Canadian exposure patterns for office workers are likely similar. Bioaerosols, specifically fungi, are of increasing importance in our understanding of rhinoconjunctivitis symptoms as a possible trigger to, or a cause of asthma and other respiratory health conditions (Stewart and Sales 2000). "Sick building syndrome" (SBS) is another name for some of these health effects with most definitions including "sensory irritation of the eyes, nose, throat and lethargy, headaches and fatigue" (Godish 1995).

There is a great deal of controversy and examination of the research that attempts to link exposure to fungi with human health effects (Burge 2003; Chapman, Terr et al. 2003; Gots, Layton et al. 2003). Air contaminants easily migrate throughout office buildings' heating, ventilation and air-conditioning (HVAC) systems, between floors [from stack

effects resulting from improperly balanced HVAC systems] and also through introduction of contaminants into the workspace through occupancy usages, materials transport or inadequate maintenance (McCammon 1992; Gill and Hyman 1995; Chang, Foarde et al. 1996; Kowalski and Bahnfleth 1998; Hiipakka and Buffington 2000; Law, Chau et al. 2001; Chao, Schwartz et al. 2002; Daisey, Angell et al. 2003).

1.1 Study design

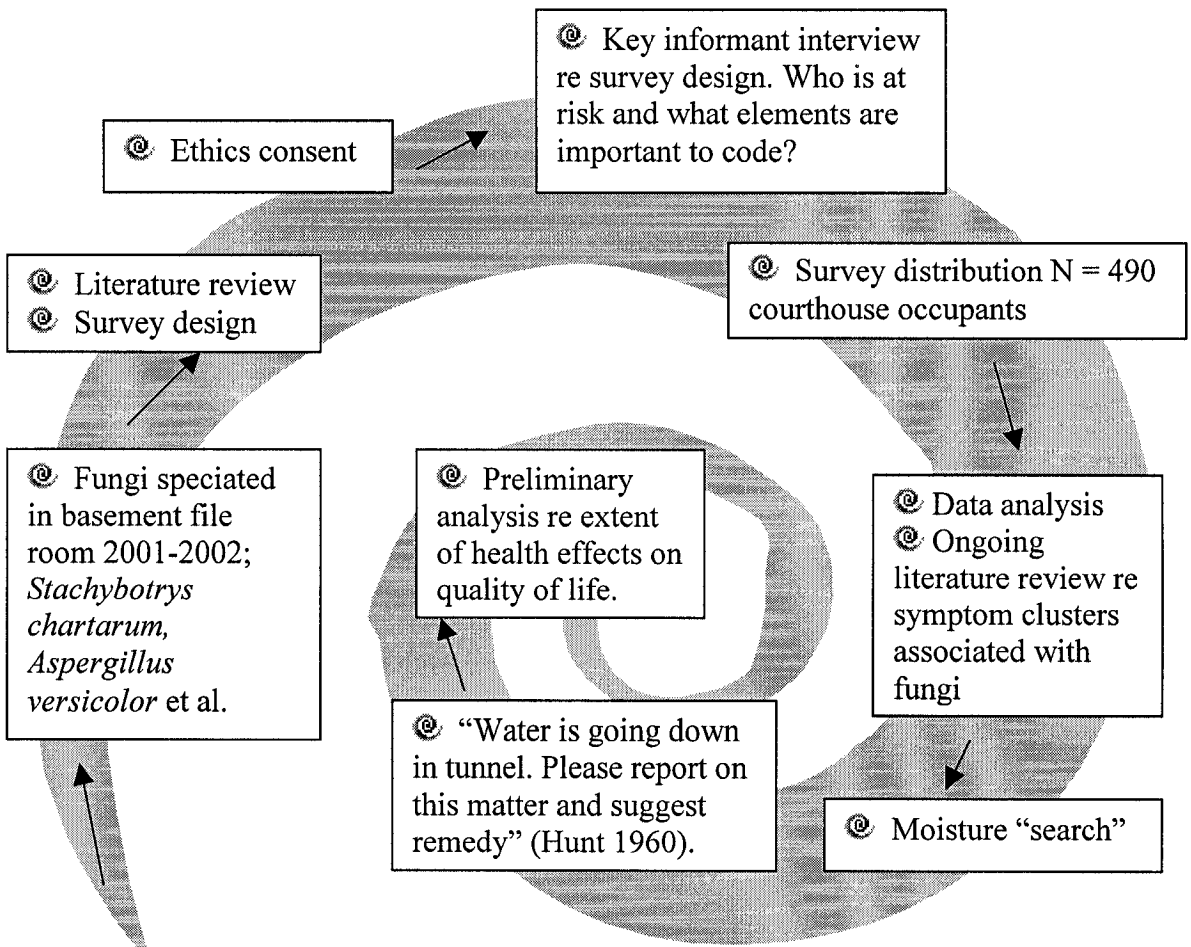
Hermeneutic examination entails methods that are circular and iterative in nature. The beginning parts of this study involved design of a survey that was paired with the Mini Rhinoconjunctivitis Quality of Life Questionnaire (MiniRQLQ) (Juniper, Thompson et al. 2000) and is a "hybridized survey" (Stefani 2002). A hybridized survey as is used in this paper, is one that draws elements from many other questionnaires, to meet the particular purpose and unique circumstances of the field investigation. This hybridized survey was not pre-tested beyond family and friends. It incorporates segments from other IAQ survey tools as described in Section 3.2.2 "Methods".

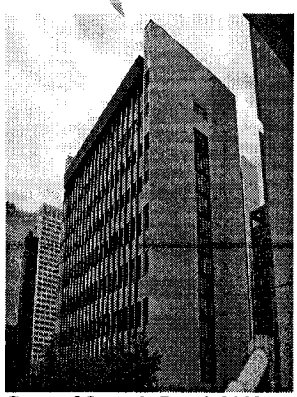
The Juniper MiniRQLQ was selected for administration because:

- Rhinoconjunctivitis is linked with asthma in the literature, a life threatening health condition if not controlled;
- *Quality of life* is a significant indicator of comfort/discomfort and;
- This tool is a reliable indicator of a chronic health condition that does not require concurrent medical assessment for validity of results.

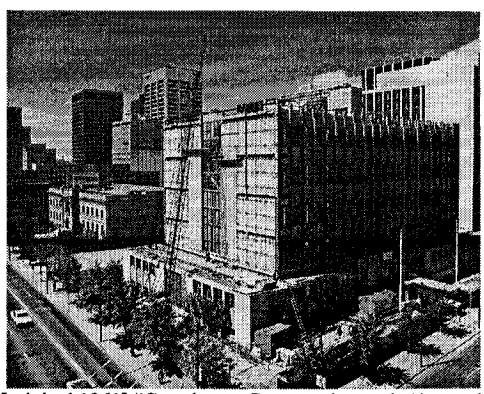
Decisions regarding selection of individuals for interviews and the internal control group were based upon the results from the MiniRQLQ, a standardized questionnaire. Figure 1 represents the first half of this study's design. (Figure 3 describes the last half of the study's design).

Figure 1: Hermeneutic Design – Part One





Court of Queen's Bench 2003



[original 1961] "Courthouse Construction took 43 months" (Bobrovitz 1998) Reprinted with permission of The Calgary Herald

1.2 Courthouse as a study location

Two sampling teams found fungi in indoor air samples collected at the Court of Queen's Bench (CQB) building during September 2001 and January 2002 (see Appendix 7.1). Eleven species of fungi were speciated from those indoor air snapshot samples. The basement file room was subsequently identified as a possible source of fungal contamination (Slade 2002).

The CQB building is located in the downtown core of Calgary, adjacent to an above ground light rail transit (LRT) station. Court operations are currently scattered among many downtown (or relatively central) locations. An underground parkade adjoins the building and a tunnel system connects the CQB with the former Court of Appeal building, closed in January 2001 due to poor indoor air quality. Data analysis in this study will utilize the term "Plus 15" as a reference point for elevation. The term "Plus 15" is a designation for the pedestrians walkway system between downtown Calgary office buildings that is fifteen feet above pavement level. This would be a common visual identifier for Court of Queen's Bench building occupants who work downtown, even though their building does not have a direct connection to this above ground system.

In order to understand the effects of exposure to fungi (as an indoor air contaminant) the use of a hermeneutic approach included survey and interview methods to examine occupants' quality of life from a variety of perspectives.

1.2.1 Courthouse occupants as a sample group of interest

This research focussed on courthouse occupants as a target population for five reasons.

1. Laboratory analyses identified eleven types of fungi to species level from samples taken at this building, although the laboratory reports include eleven other identifications to probable-genus from samples collected (See also, Appendix 7.1 and Chapter Two, Table 1). Health effect linkages to the literature would only be speculative for the latter group and any review of mycotoxins that may be associated in the literature with these genera of fungi are speculative without that identification to species. Recent literature indicates that unless the species are identified to their chemotype (a sub-species or strain), linkages to understanding the possible toxicity from co-existing compounds such as mycotoxins may not be possible (Andersen, Nielsen et al. 2002). The interpretation of fungal measurements or possible levels of fungi at the Court of Queen's Bench building is considered outside of the scope of this study, since access to the building for coordinated investigation was not possible.

2. This opportunity arose at a time when indoor air quality at the Court of Queen's Bench building was undergoing scrutiny as a result of an indoor air quality investigation at the Alberta Court of Appeal building in Calgary, an adjacent courthouse. The previous Court of Appeal (COA) building and the Court of Queen's Bench (CQB) building are courthouses that shared resources including staff, materials storage and are physically adjoined by an underground mechanical and occupant tunnel used by occupants of both

the COA and the CQB until the Court of Appeal building closed in January 2001. Occupants then entered the tunnel for maintenance purposes, or to retrieve COA documents that had been in that closed-down building, until the new Court of Appeal facilities were ready two years later in early 2003.

3. Indoor air quality investigations of public buildings such as schools, hospitals and courthouses have appeared more frequently in the literature and this is important when attempting to draw some conclusions from the findings of this research to susceptible occupants of other public office buildings. This courthouse represents a valuable community repository of documents considered vital to the functioning of justice in the community and society. As well, the judges and their trusted staff hold a unique societal role, and as an occupational group, are not easily replaced if they become ill. Many more people work occasionally in the building than just the full-time courthouse staff and judges. Alberta Justice staff; Solicitor General staff who guard and/or transport prisoners to and from court; Alberta Law Society and Alberta Legal Archives staff (their interest is in ensuring the safe-keeping of many law library documents with original, and old papers) are significant groups of occupants who ensure court operations run smoothly. Other full-time, temporary or occasional occupants of the CQB building include defence and prosecution lawyers, police officers, jurors, members of the media and the public.

4. Information regarding the assessment of the indoor air quality at privately owned and privately managed buildings is often much more difficult to access, as many reports

written by private consultants for private office buildings are written for the building manager or the owner alone. Implicit or explicit non-disclosure restrictions, and confidentiality agreements in order to manage risk perceptions or liability, are often built into terms of reference for consultant reports, rendering much of the information exclusive to those who pay for its generation. This is not conducive for public health research or prevention efforts (Burge 1996).

5. Lastly, private office buildings often have many tenant groups, with dissimilar occupational work exposures to one another. Utilisation of a building where the occupants have as similar a set of occupational activities and exposures as possible across the sample assisted in the identification of an internal control group.

2.0 Chapter Two: Relevant Trans-disciplinary Literature

2.1 At Risk (Susceptible) and Hypersusceptible Populations

As a part of a hermeneutic analysis, this study is concerned with a full description of persons who may be experiencing symptoms. This approach allows an examination of interactions between exposures within the building and how those exposures may be triggering symptoms for those people genetically or socially more vulnerable to illness when exposed to pollutants. Foster and Aston's concept of "habitus" reveals that:

> "..social conditions (life chances) that shape a common habitus are more functionally central to the illness in question than is individual agency (life choices)" (Foster and Aston 2003).

Complex diseases are thought to result from gene-environment interactions (Sing, Boerwinkle et al. 1985; Foster and Aston 2003). How and what numbers of office workers would "typically" be expected to demonstrate illness upon exposures to indoor or outdoor air contaminants due to genetic hypersusceptibilities and how many office workers are experiencing respiratory or other illnesses that may go beyond that very small group expected in this study sample?

2.1.1 Dose Response Distributions

Determining the size of the occupant group that may be experiencing effects from indoor air quality because of "hyper susceptibility" is aided by the known distribution of a normal population. The assignment of the terms "hypersusceptible" or "persons with immuno- compromised status" are frequently made in the literature due to high-risk prevention orientations, or to incorporate wider public health preventive perspectives (Rose 1992). The grouping of the health status of such persons requires further clarification.

In this study, a person without intact immunities is defined as "hypersusceptible" or persons with "immuno-compromised status" and includes people with those conditions identified as autoimmune diseases by Cohen as below:

- More commonly identified diseases include: multiple sclerosis; type 1 diabetes; rheumatoid arthritis; thyroid inflammation; lupus; and inflammatory bowel diseases.

- Less commonly encountered are conditions such as: myasthenia gravis (muscle weakness); eye or kidney inflammation diseases; diseases that destroy blood platelets or red blood cells; skin conditions such as scleroderma (unnecessary scar tissue); pemphigus, (skin blistering), and vitiligo, (skin patches with no pigment) (Cohen 2000).

Exposure to fungi has not been *causally* linked to respiratory or other health problems, (and debates rage regarding associative relationships based on a lack of exposure studies). Persons with HIV infections or those who are undergoing cancer treatments are also typically considered to have highly elevated risk from pollutants, due to the immune suppressing treatments required to arrest these diseases.

This study will therefore use the more conservative estimate of 2.3% (two standard deviations below the median of a theoretic normal population in Fig. 2) as the expected fraction of persons with hypersusceptibilities who will react if exposed to fungi (or other indoor air contaminants) in indoor air.

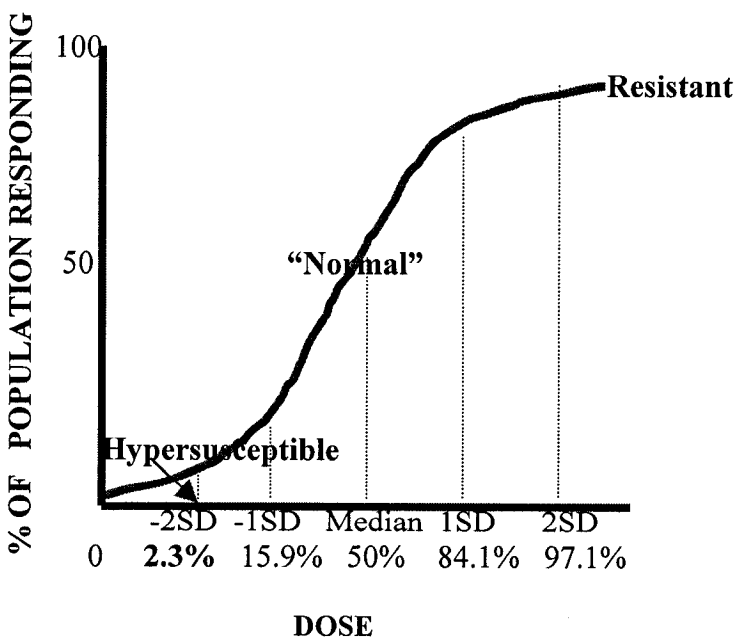


Figure 2. Typical cumulative dose-response curve for normal populations. (Casarett 1975; Palys 1997; Casarez 2001; Lambert 2003; Lillquist 2003).

Thus, one of the assumptions this study contains is that hypersusceptible occupants would be more likely to respond to heightened or longer exposures to fungi than occasional occupants because this is a ubiquitous contaminant, commonly found in the outdoor environment.

This study describes persons with intact immunity (but at greater risk from exposure to environmental contaminants) as "susceptible" occupants and includes:

- The elderly (over 65 years) (Simoni, Jaakkola et al. 2003; Yang, Chen et al. 2003) who are estimated to compromise approximately 9% of the Calgary population (Lambert 2003);
- Pregnant or lactating women who comprise approximately 1.5% of the Calgary population (Thornton, McCally et al. 2002; Lambert 2003);
- Smokers/alcoholics (Rose, Kreiss et al. 1999; Cohen 2000);
- 7.7 % of Calgary's population who are estimated to have vascular or heart disease (Costa and Kodavanti 2003; Lambert 2003);
- People with chronic exposures to the public such as health care workers and public service workers (Nardell and Macher 1999). The 58,000 workers in Alberta Union of Public Employees comprise approximately 1.9% of the total Alberta population (Alberta Union of Public Employees 2003; Municipal Services Branch 2003),
- 21% of the general population are estimated to have existing respiratory diseases. This breakdown includes the following groups:

- Asthma prevalence is estimated at 6.5% across the adult population in Canada (Stewart and Sales 2000) and at 5.2% of the population working indoors in the United States (Mendell, Fisk et al. 2002). Individuals over 45 years are at increased risk for asthma in Alberta (Sin, Heather Wells et al. 2002; Thornton, McCally et al. 2002);
- Chronic obstructive pulmonary disease estimates of 5.5% (bronchitis 4.7% and emphysema 0.8%) are estimated within the total population (Lambert 2003); and
- Atopy (allergic to many things) (Health Canada 2003) - 9% of the Calgary population is estimated to have hay fever (Lambert 2003) while up to15 % of the population has been described as "clinically atopic"(Burrell 1991). United States estimates of American indoors workers with allergies are up to 20% of that population (Mendell, Naco et al. 2002).

Using the above estimates of persons with hypersusceptibilities (2.3%), existing respiratory diseases (21%), heart disease (7.7%), as well as the elderly (9%), we could estimate the percentage of adults who would be at significant health risk from indoor air exposures to fungi in Calgary to be 40% of the total population. Estimates by the Calgary Health Region have estimated the susceptible population in Calgary to be approximately 30% (Figure 3) to account for overlapping populations, (i.e. the elderly, with heart or respiratory conditions (Lambert 2003 personal communication).

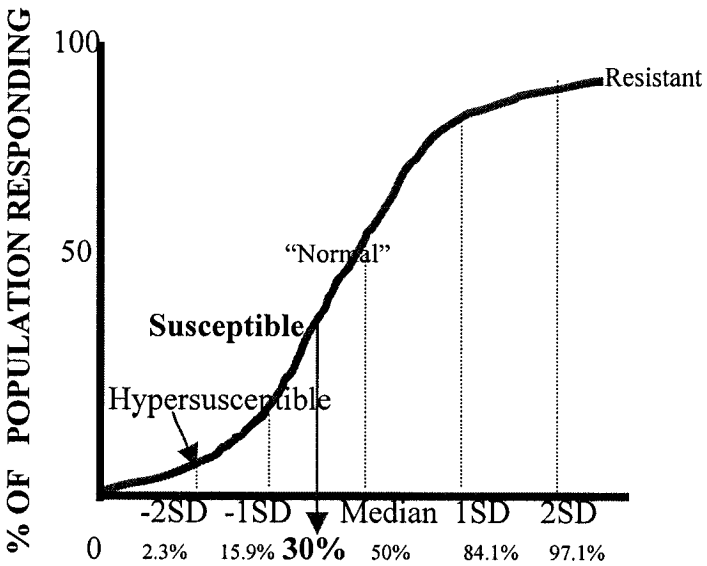


Figure 3. Typical cumulative dose-response curve for normal populations (Casarett 1975; Palys 1997; Casarez 2001; Lambert 2003; Lillquist 2003).

The question remains concerning the larger "normal and resilient population".

Irun Cohen's work on immunity again assists in the understanding of research required regarding causation of autoimmune diseases:

> "**Inappropriate persistence of healing as well as tissue destruction leads to disease**...Autoimmune diseases are not reducible to one or another defective agent working in isolation; rather autoimmune diseases emerge from the interactions of many factors. **The blame is not on the agents, but on their interactions in time and space**" (emphasis added) (Cohen 2000)

The wider public health, preventative perspective then is to include all of the above groups as well as people whose intact immune systems are reacting or perhaps over-reacting 'normally' to environmental contaminants.

2.2 Coherence with Health and Fungi/Indoor Air Research

Several disciplines are crucial to the understanding of fungi's potential effects on human health and are reflected further in the methods, data analysis and results (see Section 2.3, "Summary of Pertinent Literature"):

- Health issues relating to clusters of symptoms contained in this study,
- Routes of exposure,
- Characterizations of the fungal species and,
- Building and occupant perception factors.

The extent of understandings of how fungi (as a function of moisture damage inside buildings) are currently associated with chronic health effects, especially rhinoconjunctivitis symptoms, was examined. The growth of sick building symptom concerns regarding indoor air quality and health (Scott 1996) has been associated with energy efficiency initiatives in the late 1970's and 1980's (Gusdorf and Parekh 2000) and more recently with exposure to fungi as a result of water damaged materials indoors (Craner and Stetzenbach 1999). In Medline, citations on "indoor air pollution and health" numbered 18 from 1978 to 1982. From 1989 to 1996 the citations numbered 210 (Koenig 1997), and a current Medline search of "indoor air pollution and health" yielded 898 citations (November 2003). A database search of Medline's current indoor air pollution citations (not limited to health only) includes 6801 articles and reflects the continued exponential increase in this body of literature.

When acute health effects (CDC 2001) cannot be linked to a visible contaminant reservoir or when health effects are chronic in nature, assessment of impacts on health from environmental sources becomes more challenging and requires shifting to a trans-disciplinary approach, also called a domain approach (Macher 1999; Nazaroff, Weschler et al. 2003). Using a trans-disciplinary approach provides a systematic organization of the tools available across disciplines in order to answer the types of questions posed about indoor air quality. In this study, those questions centre around occupants' health and occupants' perceptions regarding effects of symptoms on their quality of life.

Hermeneutic principles assisted the organization of literature reviewed surrounding health effects from fungi. The literature review (Section 2.3) contains summaries of case reports (Table 2), epidemiological studies (Table 4) and basic science studies (engineering, biological, chemical, building science/materials sciences) (Table 3). Review articles, books, and World Wide Web sites of particular importance are contained in Tables 5 and 6 respectively. One of the more challenging aspects of this study was selecting the fragments of trans-disciplinary knowledge critical in guiding the development and analysis of the standardized and hybridized questionnaire, and using the literature as an ongoing guide to continuously re-align and re-weight the data during analysis.

2.2.1 One airway – Effects of inhalation of fungi

Rhinoconjunctivitis covers a large group of non-specific health complaints, typically described in the literature under the headings of sick building syndrome symptoms. Macher's chapter "Health Effects of Bioaerosols" provides guidance regarding building related symptoms and 26 of the 30 medical conditions or symptoms listed as significant to exposures from bioaerosols that are respiratory in nature (Macher 1999). The literature has previously presented exposures to airborne fungi as an associative trigger mechanism (Verhoeff and Burge 1997). Current exploration is now moving towards examination of exposures to fungi as a cause of asthma (Douwes and Pearce 2003), where conditions such as occupational rhinitis are seen as a possible precursor to development of this more serious condition, depending on the type and extent of exposures experienced by the individual (Slavin 2003).

The symptom clusters or domains selected for the analysis of the symptoms reported by building occupants were grouped as follows:

Respiratory♦
Rhinoconjunctivitis♦
Dermal,
Vascular,
Endocrine/Immune and
Digestive.

♦ This project separated rhinoconjunctivitis symptoms from respiratory symptoms in the analysis of the questionnaire in order to examine the relationships between those factors queried in the MiniRQLQ and this researcher's hybridized survey. However, discussion of rhinoconjunctivitis and respiratory symptoms findings is more intertwined than for the other four symptom clusters.
♦ibid

One airway, one disease is a concept that has been described in medical literature for over a century (Grossman 1997; Braunstahl and Hellings 2003) but has more recently received widespread support (Togias 2003). Sole discipline research on respiratory effects has often limited airway research to components of the upper airways (for example the nose and rhinitis) or the lower airway (for example lungs and asthma). Research is beginning to examine how peoples' entire airways may be reacting to or defending from air contaminants (Pedon 2001; Boulay and Boulet 2003). Now both persistent and non-specific symptoms such as runny eyes and noses are possible pre-cursors to asthma or other serious respiratory diseases. This requires both individual and cumulative exposure perspectives.

Several articles review linkages among fungi, respiratory health concerns and indoor air in environments similar to courthouses, including libraries (Righi, Aggazzotti et al. 2001; Fischer 2003) and schools (Cooley, Wong et al. 1998; Kowalski and Bahnfleth 1998; Bayer, Crow et al. 2000). A review of nine cross-sectional studies found associations between allergies and fungi in homes (Verhoeff and Burge 1997). Verhoeff provides extensive evidence surrounding the association between home dampness, exposure to fungi and respiratory diseases of susceptible persons (Verhoeff 1994). Studies that provide evidence of altered structural functioning of the immune system have more recently examined the connection between environmental contaminant mixtures and clinical diseases such as asthma, cardiovascular disease and cancers (Carpenter, Arcaro et al. 2002).

The surge in DNA analytical techniques has created knowledge pockets for certain species of fungi. For example *Stachybotrys chartarum* is described as significant to study because it is considered a 'major indoor environmental threat' (Birren, Fink et al. 2003). *Penicillium* was studied with similar intensity during the first half of the 20th century to meet demands to provide antibiotics for soldiers at war (Parkinson 1999-2002). Focus on DNA analysis has provided some fundamental shifts in capacity to plan for attribution of risk to genetic and/or environmental factors and all the permutations of interactions between these "two" variables.

Risks from the cumulative effects of mixtures of indoor air contaminants (fungi with other particles) have not been studied to the same extent as environmental tobacco smoke (Ott 1995; Zeliger 2003). Tobacco continues to be a cause of increasing mortality among Canadians with over 47,000 deaths in 1998 attributed to smoking representing an increase of nearly 20% over the last ten years (Makomaski Illing and Kaiserman 2004).

2.2.1.1 Rhinoconjunctivitis symptoms

This study defines rhinoconjunctivitis in adults as irritation of the eye and nose tissues that extends in magnitude, frequency or duration beyond what a person would describe as typical upper respiratory functional purposes (Cohen 2000; Rothenberg and Chapman 2000). In order to measure this individually described condition, it is important to utilize

what *an individual describes as having a significant effect on their daily life* (Carr and Higginson 2003).

Several studies have examined the potential for inter-related eye and nose reactions with indoor environments. Literature themes and studies of significance to this indoor air quality topic include:

- The length of time that symptoms remain after exposure to fungi (usually the variable is expressed as moisture damaged indoor environments) (Rudblad, K. Andersson et al. 2002),
- Rhinitis as a risk factor for asthma (Togias 2003),
- How humidity and previous sensitization to dust in a building in healthy occupants may interact with fungi or dust to cause inflammation in the eyes over time (Molhave, S.K. Kjaergaard et al. 2002; Korpi, J.-P. Kasanen et al. 2003),
- Examination of biomarkers that can be used for determining ranges of normal functioning of the eyes and nose and which may be indicators of early impairment or signs of respiratory problems (Norback 2002) and,

- Following the length of nasal hyperreactivity symptoms in teachers who worked in schools repaired due to water damage or inadequate ventilation. The extent and duration of respiratory effects were not significantly diminished after two years

(Rudblad, Andersson et al. 2001; Rudblad, K. Andersson et al. 2002; Rudblad, K. Andersson et al. 2002).

2.2.1.2 Respiratory symptoms

Respiratory symptoms may also encompass symptoms resulting from end disease states caused by chronic irritation or toxic reactions affecting the lower airway and lungs such as asthma, pneumonia and cancers. While it would be difficult to dispute cancer's high negative impacts on quality of life it is interesting to also note that poorer quality of life has been reported by persons with rhinitis than by persons with asthma (Bousquet, Bullinger et al. 1994; Bousquet, Knani et al. 1994; Juniper 2002).

Asthma is an under-reported and under-diagnosed disease and only one of many adverse health effects of air pollution (Samet, Buist et al. 2000). Persons living in poverty, or who have compromised access to health care for other reasons tend to have greater risk factors for asthma. In Alberta, visits to emergency departments and respiratory specialists for asthma and chronic obstructive pulmonary disease (COPD) are disproportionately experienced among Aboriginals when compared with non-Aboriginals in the province (Sin, Heather Wells et al. 2002). Asthma rates appear to increase in persons over the age of 45 years in both Aboriginal and non-Aboriginal populations (Sin, Heather Wells et al. 2002).

Evaluation of exposures to fungi presents an interesting set of respiratory challenges to the body in the following ways:

- The spores and the fragments of spores are well within the size where they can lodge within the alveoli of the lungs when inhaled. [See Appendix 7.4 (Bode 2003; Canada's Digital Collections 2003; Canadian Lung Association 2003)].
- As discussed next in the dermal section, body rashes often accompany exposure to fungi, and may be related to overall systemic stress from inhalation exposures rather than absorption through the skin (Xu, Shi et al. 1989).
- Fungal spores (similar to most airborne matter of like size ($PM_{2.5}$, smaller pollen fragments, and bacteria) provides opportunity for contaminants of smaller molecular size that may "piggy-back" on those particles. (D'Amato 2002)
- Some of the piggybacked components may include various mycotoxins produced by fungal colonies for protective and opportunistic purposes. When, and under what conditions, a fungus will produce mycotoxins remains a large gap in the literature (Burge 2003). The elimination of conditions elemental for growth of fungi do not remove the fungal fragments that remain, and do not necessarily eliminate any mycotoxin residue that may possibly be present. This residual material is then available for inhalation due to the numerous circulating air currents and micro-environments within occupied spaces (Engelhart, Loock et al. 2002; Górny, Reponen et al. 2002).

Such cumulative effects are described in a study on the health of elderly adults and their exposures to the bacteria, *Streptococcus pneumoniae* after exposures to $PM_{2.5}$ (Zelikoff 2003). Zelikoff's study speculates (based on animal model research) that immunosuppressive conditions increase after even one exposure, making it more difficult for the lungs to recover from encounters with *Streptococcus pneumoniae*. Similar types of studies conclude that the increased impact of outdoor air pollution, likely respirable particulate matter interacting with bioaerosols, is associated with higher mortality from heart disease (Zanobetti, Schwartz et al. 2003) or from severe acute respiratory syndrome (SARS) in China (Cui, Zhang et al. 2003).

Regardless of the actual mechanisms, more research is supporting the findings that fungi have serious respiratory effects on even young healthy adults. A Swedish study of young adults found that breathlessness and long-term cough were more prevalent in occupants of moisture damaged homes where mould was found (Gunnbjornsdottir 2003).

2.2.1.3 Dermal symptoms

Immediate flushed skin rashes are just one of the toxic effects associated with exposure to mycotoxins from fungi (Albright 2001; Ong, Ohtake et al. 2002). As well, skin rashes are associated with exposures to a number of other indoor environmental conditions. Low humidity exacerbated by increasing co-location of electronic equipment (such as computers and printers) in occupied areas; contaminants such as volatile organic compounds (VOC's) from numerous synthetic materials such as carpets, paints, plastics;

or fibreglass insulation and man-made mineral fibres (MMMF) can cause direct skin irritation (Barber 1984-6; Enk 1997).

The route of exposure with dermal symptoms is not always by direct contact with a particular contaminant, through skin absorbing that contaminant's toxic properties. One study has examined the difficulty in research on absorption exposures due to an over reliance on "route-to-route extrapolations" (use of animal models to make estimations) and studies that are confounded by respiratory exposures that could be inducing the dermal effects reported in the literature (Rennen, Nordheim et al. 2002).

A study that described dermal symptoms among airline crews found higher numbers of dermal complaints in airline crews relative to office workers (Lindgren, K. Andersson et al. 2002), but this study did not examine fungi. Exposures to VOC's has been associated with dermal symptoms however (Molhave 2000). A more recent study goes on, not to address the question of whether or not dermal symptoms can come from repeated respiratory exposures, but to outline how the uncertainty factors are approached by regulators (Felter, Ryan et al. 2003). It would seem prudent to take proper precautions for protection of exposed skin while research on the possible cross reactions of dermal and inhalation routes of exposure to fungi continues.

2.2.1.4 Vascular symptoms

Headaches and bleeding have been frequently reported symptoms associated with exposure to fungi (Dewey, Sagunski et al. 1995; Seltzer 1997; Dearborn 1999; Vesper

2000; Anyanwu, Campbell et al. 2002; Fischer 2003). There are many reports and studies on these symptom clusters in the much larger body of literature associated with sick building symptoms in general, which will not be repeated here.

Blood pressure is a factor that has been studied in relation to circadian rhythms, which may be more connected to the analysis of fatigue and sleepiness in the following section on immune related symptoms (Halberg, Cornelissen et al. 2003). While stroke has been associated with particulate matter interacting with ozone and carbon monoxide (Hong, Lee et al. 2002; Weinhold 2002), it does not appear to have been investigated with respect to exposures to fungi.

2.2.1.5 Endocrine/Immune symptoms

As discussed in the introduction, the literature is beginning to focus on the integration of immunity concepts with knowledge regarding systemic illnesses (Togias 2003) and the possible environmental triggers or causes of those conditions. Cohen's description of autoimmune diseases such as rheumatoid arthritis, thyroid dysfunction and Myasthenia gravis (muscle weakness) (Cohen 2000) provides a wider understanding of immunity factors. Immune suppression capabilities of some of the mycotoxins associated with fungi are discussed with both passion and scepticism in the literature (Dales, Miller et al. 1998; Albright 2001; Gerrity, Bates et al. 2002; Woodfolk 2002; Alonso, Pionetti et al. 2003). Currently there are no viable field technologies to conduct measurements of mycotoxin releases inside buildings. Development of such a method would help to quantify possible

human dose-response relationships to these poisons. As a result, the American College of Occupational and Environmental Medicine recently issued a position paper stating that "Current scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in the home, school or office environment" (ACOEM 2002).

The unexplained syndromes often presumed to have environmental causes can be grouped under the umbrella of "toxicant induced loss of tolerance" (Miller 2001). This is a concept developed by Dr. Claudia Miller, and provides a framework for describing and assessing multiple chemical sensitivities, chronic fatigue syndrome, fibromyalgia, and perhaps migraine headaches that could also include sick building syndrome (Seltzer 1997; Terr 1997; Miller 1999; Wargocki, Baik et al. 1999; Ammann 2001CPI; Ammann 2001APHA; Miller 2001; Anyanwu, Campbell et al. 2002).

2.2.1.6 Digestive symptoms

The ingestion route of exposure manifesting through digestive type illnesses were not of primary interest for this study, but are significant in the research affecting indoor air for several reasons. In industrial workers exposed to very high levels of contaminants (Kahn 2003) or for asbestos type exposures, cancer-causing fibres have been found in tissues outside but near the stomach (Stroyan 1960; Feldstein 1980; 1981; Dodson 2001).

Smith's work on nasal clearance found that a much greater amount of inhaled material is transported to the gastrointestinal system than previously thought (Smith 2003). This may lead to greater frequency of digestive system symptoms resulting from chronic indoor air respiratory exposures.

Bacterial sources such as *Escherichia coli* have driven basic public health design strategies in public buildings in Canada to include features such as hand washing stations for workers, lavatory facilities separate from the public, cleaning practices that allow easy cleaning of surfaces and finishes, and maintenance practices that keep plumbing and mechanical systems in good repair (Terpstra 2003; Skulberg, Skyberg et al. 2004). One unique feature of courthouse design is that many judges have their own lavatory facilities, but hand washing stations for some building occupants appear to have been difficult to access in the past as shown in Photo 3.

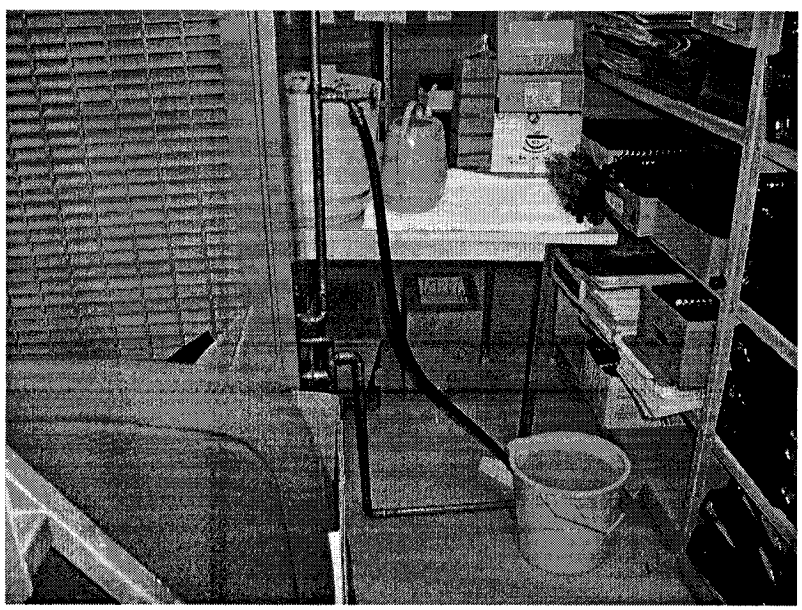


Photo 3: Bucket reported as hand washing station in basement exhibit room, 2002.

Gastroesophageal reflux disease (GERD) is one often-overlooked cause of airway distress. Triggers [ETS, asthma, environmental contaminants, obesity, diet are speculated] that stimulate the mucous membranes in the esophagus or micro amounts of aspirated gastric acid are some of the reasons that the lower airway may become irritated or constricted. Many treatments for asthma can make GERD worse if not diagnosed. Healthy lifestyle promotion and appropriate medical assessments are vital to combat or mitigate effects (Makkar and Sachdev 2003).

2.2.2 Quality of Life as a Chronic Health Indicator

We know that chronic disease requires environmental interaction (Ward 1985; Weiss 1985). Health related quality of life (HRQL) measures have been in place for many years to assist in understanding the effects of such diseases. Many HRQL measures have been developed in response to the inability of physiological measurements alone to indicate improvements to quality of life for chronic conditions (Barnes 2001; Juniper 2002). In addition, numerous interventions for chronic conditions such as allergies are non-pharmaceutical in nature and revolve around environmental control or avoidance of triggers. The American Thoracic Society considers air pollutions' impact on quality of life to be an adverse health effect (Samet, Buist et al. 2000).

Research on choices of health related quality of life scales recommend instruments that fit with what needs measuring. Since this study is more similar to a cross-sectional study, specific properties such as a higher number items in the survey (length), its simplicity and relevance to quality of life factors across the sample population are described as applicable to survey designs of this nature (Hyland 2003).

Health related quality of life researcher, Elizabeth Juniper, has had a significant impact on studies in this area. Her Mini Rhinoconjunctivitis Quality of Life Questionnaire (MiniRQLQ) (Self Administered), the Rhinoconjunctivitis Quality of Life Questionnaire and the Rhinitis Quality of Life Questionnaire, are valid instruments demonstrating a high degree of reliability to identify changes in rhinoconjunctivitis for the individual (Juniper 1997; Meltzer 1997; Juniper, Thompson et al. 2000; Carr, Gibson et al. 2001; Davis 2001; Kessler, Almeida et al. 2001).

Several indoor air quality researchers are also examining quality of life. Cain, an otolaryngologist, identifies indoor air as a 'construct of comfort', as a function of perception of all of our senses based on a great deal of sensory input (Cain 1996; Wargocki 2001; Cain 2002). Discomfort then is a logical fit with the MiniRQLQ tool, which asks occupants "How troubled are you…?"

2.2.3 Routes of Exposure

For people to develop illness, the source of the contaminant has three possible routes of exposure to reach the person: inhalation, ingestion and absorption. This study is primarily interested in effects from inhalation.

The olfactory bulb is the receiving organ that regulates our sense of smell from the nose, with the brain. The protective chemical sense (Cain 1996) of our nose is our sense of smell and it enables most people to quickly identify some of the distinctive odours associated with fungal decomposition of building materials. Olfactory nerve fatigue can occur between two and fifteen minutes (ATSDR 2003) which means that we generally no longer smell the offending substance after that time, even though we are still inhaling the substance. If the odour does not immediately incapacitate us, we are often able to adapt to that odour and it becomes familiar over time. These are chemical and olfactory processes that are not yet well understood for a wide range of possible indoor air contaminants (Knasko 1996).

2.2.3.1 Pathways

Since spores of fungi that cause health concerns have been found primarily from the subphylum, Ascomycotina, a known exploiter of cellulose (Kendrick 1992; Parkinson 1999-2002) we understand that the most likely source of the pathway for our fungi of interest are those places that contain cellulose indoors. Cellulose is contained in items

such as paper, wood, books, wall materials, finishes and the furnishings in the materials brought inside buildings. Fungal growth also occurs indoors on debris left from inadequate cleaning or maintenance over time, including dust. The mechanisms of airborne travel of the spores of fungi are the air currents created by or within mechanical air systems or in ductwork, through building cavity spaces, drawn by air currents from pressure differentials across the building envelope or simply within a room resulting from changes in temperature and lighting throughout the occupied times. Spores are very small in both diameter and mass and so are subject to the myriad of aerodynamic forces present in the countless microenvironments resulting from these variations in mechanical ventilation, material temperatures, daytime radiant heating and evening cooling cycles within typical office spaces (Utrup, Werner et al. 2003). As a result, fungal spores can remain airborne for many days depending on the unique air currents in the thousands of spaces in office buildings. People can easily inhale spores into the lower parts of their lungs, due to bioaerosols' small size (see Appendix 7.4) and this potential for lengthy suspension within indoor air.

People, ambient air currents, or mechanical ventilation move materials with mould spores or the spores themselves to various parts of the building. These spores are then available for release in the new location to new substrates. Of course, fresh air ventilation continually introduces "outdoor" spores to the indoor environment. Modelling and experimental estimates of indoor and outdoor relationships of particulates found that about one-third of outdoor particulate levels migrate indoors (Alzona, Cohen et al. 1978).

Other authors have found that the indoor levels, where colonization originates from indoor fungal colonization, remains much more stable over six-hour periods, "despite changes in the outdoor fungal ecology profile" (McGrath, Wing C. Wong et al. 1999).

2.2.4 Fungi

Fungi are ubiquitous in the environment and these microbiological organisms convert up to 90% of 10^{15} kg of biomass on earth yearly (Wessen, G. Strom et al. 2001). Fungi's consumption of building materials is a natural outcome if water and building conditions are not carefully controlled.

There are four ways that fungi can cause health effects. Fung's review of the literature around mould and illness from 1966 to November 2002 describes supportive literature for three mechanisms of human illnesses attributed to fungi: irritation, allergy and infection. The inhalation potential for irritation and allergy are of most interest for the purposes of this study. Infections tend to occur in people with compromised immune status, although certainly not exclusively, since the level and length of exposure play significant roles. The literature does not yet support the fourth mechanism - toxic reactions - very well. Some researchers believe that toxic reactions may precede the other three types of illnesses. Therefore toxic reactions are discussed only briefly below (Fung and Hughson 2003) but are included as possible mechanisms for disease in the context of this study.

Measurements of mycotoxins are not routine lab analyses for IAQ evaluations (nor likely available outside of a research or secure laboratory settings). Although air sampling for volatile organic compounds occurred at the CQB building, it is unlikely that the testing was meant to determine concurrent potential for toxicity from fungal secondary metabolites (MVOC's), as that is not a test that is often conducted. Since bacterial sampling does not routinely get included in office settings, that analysis will also be outside of the scope of this study. The role of airborne bacteria in indoor air and health is poorly understood, but there is recent evidence that bacteria in water-damaged buildings may be even more significant than fungi in creating inflammation responses (Huttunen, Hyvärinen et al. 2003).

2.2.4.1 Microbial Volatile Organic Compounds (MVOC's)

As a natural function of biomass consumption, fungi can produce volatile metabolites. The production of these metabolites gives fungi their unique odours (Bayer, Crow et al. 1999). Many, but not all of the metabolites result in odours, easily detected by the human nose. Growth of fungal colonies (mycelial masses containing countless hyphae and spores) is primarily a function of moisture. The majority of opportunities for spores to reproduce on a suitable substrate occur when enough available moisture activates or maintains survival of the fungi. Water activity level (a_w) is a description of available moisture in the fungal environment and is defined as "$1/100^{th}$ of the relative humidity (RH) of the air in equilibrium" with the substrate (Flannigan and Miller 2001). Other

causes of sporulation are speculated to result from nutrient or time variables (Kendrick 1992).

Since growth is primarily a function of moisture, the link that is crucial among fungi, indoor environments and the production of these metabolites is moisture. MVOC's can be emitted however, long after moisture in materials has disappeared (Wessen, G. Strom et al. 2001). Mycologists have identified approximately 100,000 species of fungi although it is speculated that between five to fifteen times more species remain unidentified (Kendrick 2003). This presents logistical challenges to link specific MVOC's to a particular species of fungi, given the relatively small current scientific knowledge base relative to the numbers of unknown species of fungi.

MVOC's, due to their molecular size, can pass through plastic sheeting as would be used in air and vapour barriers in building construction (Wessen, G. Strom et al. 2001). MVOC's may be produced by fungi on substrates that experience various wetting and drying cycles as may be found in wall cavities with water leaks, or in areas with insufficient vapour or air barriers to control condensation or water intrusion (de Miguel 2003).

2.2.4.2 Mycotoxins

As a natural function of biomass competition, fungi are speculated to produce secondary or tertiary metabolites known as mycotoxins as a means of either protection, survival or as a bit of chemical territorial warfare against other species of fungi. During natural growth cycles, it is speculated that spores store the toxins produced during the waxing and waning of the mycelial mass and the hyphal structures' growth. Increased levels of mycotoxins are found during times of active and ideal hyphal growth (high a_w, high cellulose content) (Johanning, Biagini et al. 1996) but perhaps initiated during restricted growth (Bayer, Crow et al. 1999; Parkinson). Quantification of mycotoxin production, storage or release has not been well studied either, leading to a great deal of speculation as to the validity of human disease being caused by mycotoxins. Wessen (2001) argues that the issue is not whether or not mycotoxins are naturally produced by these ubiquitous structures, but whether or not we can currently measure those releases effectively (Wessen, G. Strom et al. 2001). Methods of estimating exposures are being developed that instead would measure the amounts of (1→3)-ß-D-glucan and ergosterol, both of which are unique fungal cellular components. Extrapolation regarding mycotoxicity could then be made on that basis (Miller 2001). Such procedures are still in their infancy since measurements do not typically occur outside of a research facility or very large and probably narrow epidemiological study. Measurements of the bacterial cellular component, endotoxin, are more commercially available and were conducted in the Florida courthouse examinations, as reported in 2001 (Jarvis 2001; Miller 2001).

Anyanwu however reports that headache, pains, fever, cough, memory loss, depression, mood swings, sleep disturbances, anxiety, chronic fatigue, and seizures may be attributed to mycotoxin activity (Anyanwu, Campbell et al. 2003).

2.2.5 Building factors related to exposure to fungi

2.2.5.1 Moisture

While a broad literature review was done at the commencement of this project, the examination of what is relevant and what was not became clearer as the data were analyzed again, as occupants were interviewed and as various possible result interpretations examined. The literature does not contain much guidance regarding the standards or techniques for collecting coherent evidence in a trans-disciplinary or hermeneutic fashion. Several good reviews of the indoor air quality (fungi) literature assisted in this regard (see Table 5). The overriding theme is moisture damage as associated with fungal growth inside buildings. Such moisture damage is associated with the health effects of irritation, allergy and infection in susceptible, and immune compromised persons.

2.2.5.2 Building design

Acoustics, lighting, finishes and furnishings receive regular attention in courtroom design and are important factors in themselves (McLaurin and -Chief Justice 1960; Reid 1999). Other design factors more significantly related to the assessment of exposure to fungi are:

- The amounts of time spent by occupants in the building and the numbers of occupants in the building relate to occupancy loads and ventilation;
- Court scheduling and vacation weeks taken (usage patterns of the building by full staff complements, summer relief staff or not, and amounts of occupational indoor air exposure for each person annually);
- Ease of maintenance of the building's surfaces, resources allocated to maintenance and support of cleaning practices, and
- Examination of the amount of control employees may have over their immediate work environment with respect to leaving the area if required and the extent of individual environmental controls or manipulation of conditions that are possible.

Individuals who perform administrative and support functions generally must stay or move to where their work is located and often less design attention is paid in buildings to the needs of staff performing those lower paying jobs. Rostron noted that the design of the cores of many older office buildings were for storage, washrooms, elevator and heating and cooling mechanical areas, not for ventilation (nor for workers). The exterior

(window) areas around building cores were usually designed for operable windows (Rostron 1997).

2.2.5.3 Work-related factors and sampling techniques

One aspect of office workers jobs, especially public service office workers, includes daily requirements to handle paper records, books, files or other cellulose containing objects. While computerization has reduced overall paper requirements for office based business, many court transactions continue to rely on original documents in paper-based files. In order to approximate actual exposure of occupants in a work setting, typical air sampling techniques may require adaptation.

Hodgson describes aggressive fungal sampling techniques for rooms with fungal contamination, where books and documents are stored, that involves "vigorously opening and closing books"(Hodgson, Morey et al. 1998). This sampling method has also been referred to as "fluffing the files" in order to approximate worker exposures to using paper file materials.

2.3 Summary of Pertinent Literature

The analysis of the literature provided some positive findings indicating a movement towards trans-disciplinary practice. Firstly, most studies' designs are incorporating broader domain approaches rather than discipline-specific design.

Secondly, there were two pertinent studies to note, with a focus on courthouse occupants as the sample group, examining health effects from exposures to fungi. The Florida courthouse studies (Jarvis 2001) included a control group of courthouse occupants, while the Newmarket, Ontario study (Kudla and Oudyk 2000) utilized a simple and elegant questionnaire instrument to collect complex health information in the context of a time sensitive air quality investigation.

Thirdly, it is reassuring that the body of review articles was substantial enough that a selection had to be chosen. Articles were included or excluded based on a subjective analysis of applicability to the topics of fungi, healthy indoor air and trans-disciplinary approaches.

The only piece of health-based writing applicable to this body of literature, incorporating a specific reference to hermeneutics as a consideration, was Cohen's work on immunity (Cohen 2000).

Lastly, the literature is quite strong regarding how exposure to fungi contributes to increases in allergic and irritative symptoms, even at very low levels of exposure. Active, rather than reactive monitoring in large buildings is required to prevent mould growth. Building materials exposed to building moisture sources are excellent substrates for fungi. Occupants who are immune compromised, have autoimmune diseases or perform stressful work are placed at overall higher risk for immune-related diseases. These additive risk factors require incorporation into IAQ risk assessments and investigations for office building occupants in occupational settings using a hermeneutic approach to examine literature across disciplines.

Table 1 outlines specific health-based literature sources regarding fungi speciated in the CQB building, applicable toxicity issues and the sources of that information. The range of contributing disciplines was summarized for selected studies in Tables 2 through 6 that follow.

TABLE 1: HEALTH RISKS OF FUNGAL SPECIES IDENTIFIED AT THE CQB BUILDING

FUNGAL SPECIES	CHARACTERISTICS OF THESE SPECIES REPORTED IN THE LITERATURE		
	GROWTH	HEALTH RISK FACTORS - MVOC ODOUR IF KNOWN	MYCOTOXINS
Alternaria alternata	Tertiary colonizer [A pg 40]	Inhalation hazard for immune compromised [Apg40]	Yes [B pg 24-3] [A pg 145]
Aspergillus versicolor	Xerophilic Low a_w Indicator species [A pg 250] Spore diam. 2-3 μm [I]	Systemic illness speculated. Obstructive lung diseases in courthouse workers in Florida [A pg 132]	Yes- on building materials, Sterigmatocystin (IARC class 2A carcinogen) [A pg 324, C]
Cladosporium sphaerospermum	Mesophilic (wide temperature range)	Allergenic [A pg 344]	Unknown
Epicoccum nigrum	Extremely xerophilic [A pg 39]	Inhalation hazard [A pg 356, J]	Unknown
Eurotium amstelodami	Xerophilic [A pg 358]	Poses an inhalation/barrier break hazard for immune compromised persons [A pg 358]	Unknown
Penicillium aurantiogriseum	Lower water activity [A pg 392]	No studies record inhalation hazard [A pg 392]	Yes, approximately 20 [A pg 145, E]
Penicillium sclerotiorum	Strong degradative activity [A pg 56]	Antibiotic [D]	Yes [E]
Penicillium solitum	Produces ketones [F]	Unknown re health -"Ant-y" odour [F]	Yes, approximately 20 [A pg 145]
Stachybotrys chartarum	Tertiary colonizer [G, A pg 40] Spore diameter 5-25 μm [I]	Inflammatory agent, Immuno suppressive, dermal, hemorrhagic [B pg. 24-3]	Yes [A pg 145] Yes [B pg. 24-3]
Talaromyces flavus	Xerophilic, Thermo tolerant Similar DNA structure to *P. chrysogenum* [H]	Unknown	Unknown
Ulocladium chartarum	Grows with *Cladosporium sphaerospermum* [H]	Inhalation, deep skin and barrier break hazard for immuno compromised persons [A pg 462]	Unknown

[A](Flannigan and Miller 2001), [B](Burge and Ammann 1999), [C](Gravesen, Iversen et al. 1999), [D](Pairet, Wrigley et al. 1995), [E](Biosciences 2003), [F](Whitfield 1998), [G](Fung and Hughson 2003), [H](Birren, Fink et al. 2003), [I](Gregory 1972; Kendrick 1992), [J](Hogan, Patterson et al. 1996).

TABLE 2 LITERATURE REVIEW: CASE REPORTS

Year/Author(s):	Literature area examines:	Case reports - significance:
(Bernstein, Sorenson et al. 1983)	T/E, E, B, EBS, Q	Case report of Hypersensitivity pneumonitis in 2 of 14 office workers (n= 11 in control office)
(Craner and Stetzenbach 1999)	E, EBS, Q	Case report of government office building in Nevada (650 occupants). Moisture damage from 40% of 250 leaky VAV boxes in building. Alternaria and Stachybotrys chartarum speciated on ceiling tiles.
(Fung 2000)	T/E, B	Case report/ police officer, asthma/exposure to fungi at work
(Trout, Bernstein et al. 2001)	T/E, EBS, B	Case report, exposure documentation including assessment of IgG antibodies to mycotoxins in hotel employee exposed to fungi
(Myllykangas-Luosujarvi, Seuri et al. 2002)	T/E, E, Q	Retrospective case study of ten occupants with rheumatic diseases had twice incidence ratio for working in a moisture-damaged office.

T/E=Toxicology/Exposure E=Epidemiology B=Basic Sciences EBS=Engineering/Building Science Q=Occupant Questionnaire

TABLE 3 LITERATURE REVIEW: BASIC SCIENCES

Year/Author(s):	Literature area examines:	Basic science studies - significance:
(Bondy and Pestka 2000)	T/E, B	Discusses relevance of rats/mice studies to human immunomodulation effects from mycotoxins.
(Bholah and Subratty 2002)	B, EBS, Q	Studied 23 office buildings & SBS with strong association with fungi exposures
(Gravesen, Iversen et al. 1999)	EBS, B,	23 non-industrial public buildings, 'risk' materials=wood, linoleum, pipe insulation, gypsum, mineral fibre, wallpaper, plaster
(Górny, Reponen et al. 2002)	B, EBS	Experimental chamber study found fungal fragments numbers higher than viable spores
(Havermans and Steemers 2002)	EBS, B	8 year report of 10 yr study - optimal conservation methods for archival materials
(Juniper, Thompson et al. 2000)	E, Q, B	Concordance of MiniRQLQ n=100 adults with rhinoconjunctivitis, with RQLQ. (RQLQ has been validated with 245 persons in previous published studies by Juniper)
(Lee, Li et al. 1999)	B	Macrocyclic tricothecenes from Stachybotrys chartarum induce immune dysfunction (in vitro evidence –cell line research)
(Konsa, Kodassaar et al. 1997)	EBS, B	Degradation of library materials by fungi
(Korpi, Kasanen et al. 2002; 2003)	T/E, B,	Upper and lower respiratory effects of inhalation of *S. chartarum* on mice
(Shelton, Kirkland et al. 2002)	B, EBS, Q	12,026 fungal samples in USA (n = 9,619 indoor samples, n = 2,407 outdoor air samples). The area most similar to Southern Alberta, Canada would be the Northwest USA region. For those samples overall highest-lowest indoor samples are summer, fall, spring, winter. Highest to lowest outdoor samples are fall, summer, spring, winter. Overall, median concentrations of indoor air fungi is 6 to 7 times less than outdoors.

T/E=Toxicology/Exposure E=Epidemiology B=Basic Sciences EBS=Engineering/Building Science Q=Occupant Questionnaire

TABLE 4 LITERATURE REVIEW: EPIDEMIOLOGICAL STUDIES

Year/Author(s):	Literature area examines:	Epidemiological study - significance:
(Chao, Schwartz; et al. 2003)	T/E, E, B, Q	Fungi on chairs in office spaces and upper respiratory symptoms (n = 98 occupants, 4 buildings, 21 offices).
(Chao, Schwartz et al. 2002)	T/E, E, B, EBS	Underestimation of exposures due to variability of sampling periods. Longitudinal study. N = 4 office buildings (21 offices)
(Cooley, Wong et al. 1998)	E, B, EBS, Q	Study across 48 schools with identified IAQ/health concerns found possible association with *Stachybotrys & Penicillium sp.*
(Dales, Burnett et al. 1991)	E, Q	Canadian study regarding residential exposures to dampness and mould (n= 14,799 adults) with lower respiratory symptoms.
(Gunnbjornsdottir 2003)	E, T/E, Q	N= 1853 young adults.4% had water damage & visible mould at home and higher rates of respiratory symptoms
(Hodgson, Morey et al. 1998)	T/E, E, B, EBS, Q	Courthouse occupants, 197 respondents to questionnaire Recommendations regarding safety for occupants
(Jaakkola, Laitinen et al. 2002)	T/E, E, B	IgG antibodies as biomarkers. N = 521 adults with new asthma diagnosis
(Jarvis 2003)	T/E, E, Q	County owned office building 286 occupants Control building n= 108 Higher rate of respiratory disease in building with fungi
(Jarvis 2001)	E, Q	Five courthouses in Florida with significant findings of fungi and illness in occupants: N = 1031 across five courthouses N= 129 in one control courthouse
(Johanning, Biagini et al. 1996)	E, B, T/E, Q	N=53 office bldg below ground. N=21 control group. Immuno chemistry alterations described in group exposed to *S. chartarum*

T/E=Toxicology/Exposure E=Epidemiology B=Basic Sciences EBS=Engineering/Building Science Q=Occupant Questionnaire

TABLE 4 CONTINUED, LITERATURE REVIEW: EPIDEMIOLOGICAL STUDIES

Year/Author(s):	Literature area examines:	Epidemiological study - significance, continued:
(Kudla and Oudyk 2000)	E, EBS, B, Q	Courthouse occupants Newmarket Ontario. N= 239 occupants of 288 surveyed. N=206 control building occupants. Asthma onset suspected for 60 occupants via questionnaire screening questions.
(Meyer, Würtz et al. 2002)	E, B, EBS, Q	1053 adolescents studied in eight "wet" and seven "dry" schools. Fungi in floor dust were a better predictor of building related symptoms than in "wet" building. More eye symptoms found in the "dry" building.
(Patovirta, Reiman et al. 2003)	T/E, E, Q, B, EBS	26 teachers (19 exposed and 7 reference) two-year follow up study found associations between IgG antibodies to fungi with occurrences of sinusitis, bronchitis and allergic rhinitis.
(Riediker, Monn et al. 2001)	T/E, E, Q	Increased air pollution associated with increased rhinoconjunctivitis symptoms in 15 persons with pollen allergies.
(Rudblad, Andersson et al. 2001; 2002)	T/E, E, EBS, B, Q	Longitudinal study of 44 teachers (n=26 in school with moisture problems and n=18 in reference school). Upper airway reactivity still heightened for teachers two years after remediation of school with previous moisture problems.
(Weber and Martinez 1996)	EBS, B, E	Improper courthouse remediation for fungi contributed to increase in spores outside of the containment areas and exposure to remediation workers.

T/E=Toxicology/Exposure E=Epidemiology B=Basic Sciences EBS=Engineering/Building Science Q=Occupant Questionnaire

TABLE 5 LITERATURE REVIEW: REVIEW ARTICLES

Year/Author(s):	Literature area examines:	Review article significance:
(Bayer, Crow et al. 2000)	EBS, E	Review – summary of HVAC colonization by fungi, MVOC's, and mycotoxins with supporting literature from school based studies
(Bornehag and Sundell 2002)	T/E, E	Review: assessed 107 IAQ/dampness studies regarding exposure and health, selection of subjects, statistical analysis.
(Bornehag, Blomquist et al. 2001)	T/E, E	Review - 61 studies re dampness and increased health effects in airways
(Brown 2003) (CDC/IOM report: Damp Indoor Spaces and Health)	E	Review of evidence: "For biological exposures possibly associated with exacerbation of asthma: Sufficient evidence of an association for fungi/moulds"
(Bush and Portnoy 2001)	T/E, E, Q	Review of methods to measure exposure, brief commentary on questionnaires as a good low-tech method of investigation - validated survey methods recommended.
(Burge 2003; Chapman, Terr et al. 2003)	T/E, E	Reviews acknowledges irritation, allergic and infectious components of fungi for building related exposures, but states no medical evidence re mycotoxicity in literature, and continued emphasis on this component without evidence is irresponsible scientific practice.
(Fung and Hughson 2003)	T/E, B	Review of 26 studies -5 case control studies -16 cross-sectional studies -7 case reports
(King and Auger 2002)	E, Q	Review of MEDLINE articles, similar findings to Fung above, regarding association between respiratory problems and fungi

T/E=Toxicology/Exposure E=Epidemiology B=Basic Sciences EBS=Engineering/Building Science Q=Occupant Questionnaire

TABLE 5 CONTINUED: LITERATURE REVIEW: REVIEW ARTICLES

Year/Author(s):	Literature area examines:	Review article - significance, continued:
(Kolstad, Brauer et al. 2002)	E, B, EBS, T/E	Review of mould exposure literature in non-industrial work environments identifies and rates quality of 47 articles.
(Kuhn and Ghannoum 2003)	E, T/E, B	Review of Stachybotrys and associated toxicity. Concludes that valid concerns exist but methodologies very flawed to date.
(Lacey and Crook 1988)	E, T/E, EBS, B	Early review on occupational exposures to fungi.
(Nathanson 2000)	EBS, B	Review of Canadian analyses based on over 3,000 fungal samples in hundreds of buildings.
(Nielsen, Hansen et al. 2002)	T/E, B	Review of international studies regarding IgE antibodies, fungi and other aeroallergens with respect to health effects of allergic airway disease, allergic rhinitis and allergic asthma.
(Rylander 1999)	T/E, Q	Reviews studies of over 90 buildings and nearly 600 people where measurements of exposures to the fungal cell wall component (1→3)-β-D-glucan are associated with airway inflammation, fatigue and headache.
(vandenBergh, Verweij et al. 1999)	T/E, E, B	Review nosocomial fungal infections. Highest risk factors for neutropenia. Primarily affect people with infections, rheumatoid arthritis, and leukemia.

T/E=Toxicology/Exposure E=Epidemiology B=Basic Sciences EBS=Engineering/Building Science Q=Occupant Questionnaire

TABLE 6 LITERATURE REVIEW: BOOKS AND WEBSITES

Year/Author(s):	Literature area examines:	**Book** – significance:
(Flannigan, Samson et al. 2001)	B, T/E-limited	*Microorganisms in Home and Work Environments*: Specific documentation to published date focussing on the biological aspects of various species of fungi commonly found indoors.
(Macher 1999)	T/E, E, B, EBS	*Bioaerosols: Assessment and Control*. Valuable interdisciplinary approach to the practice of indoor air quality with respect to fungi. Industrial hygiene linkages
(Johanning 1999)	T/E, E, B, EBS, Q	*Bioaerosols, Fungi and Mycotoxins: Health Effects, Assessment, Prevention and Control*: Collection of 87 articles on these topics.
Year/Organization	Document Date	**World Wide Web site** – significance:
http://www.hc-sc.gc.ca/hecs-sesc/air_quality/pdf/fungal.pdf	1995	Specific remediation guidelines for investigation and removal of fungal contamination in public buildings in Canada.
http://www.lung.ca/cando/workplace.html	2003	General information only from Canadian Lung Association for workplace settings
http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html	2000 revised January 2002	Guidelines on Assessment and Remediation of Fungi in Indoor Environments (also known as the New York City protocols)
http://www.who.dk/document/e69828.pdf	15-17 May, 2000	WHO statement on rights to healthy indoor air
http://www.infras.gov.ab.ca/Content/doctype486/production/IAQGuideline.pdf	August 2003	Alberta Infrastructure guidelines regarding Indoor Air Quality
http://www.aegis-in-canada.com/	Accessed January 2004	Product used to encapsulate file/exhibit materials in CQB building

T/E=Toxicology/Exposure E=Epidemiology B=Basic Sciences EBS=Engineering/Building Science Q=Occupant Questionnaire

3.0 Chapter Three: Methods

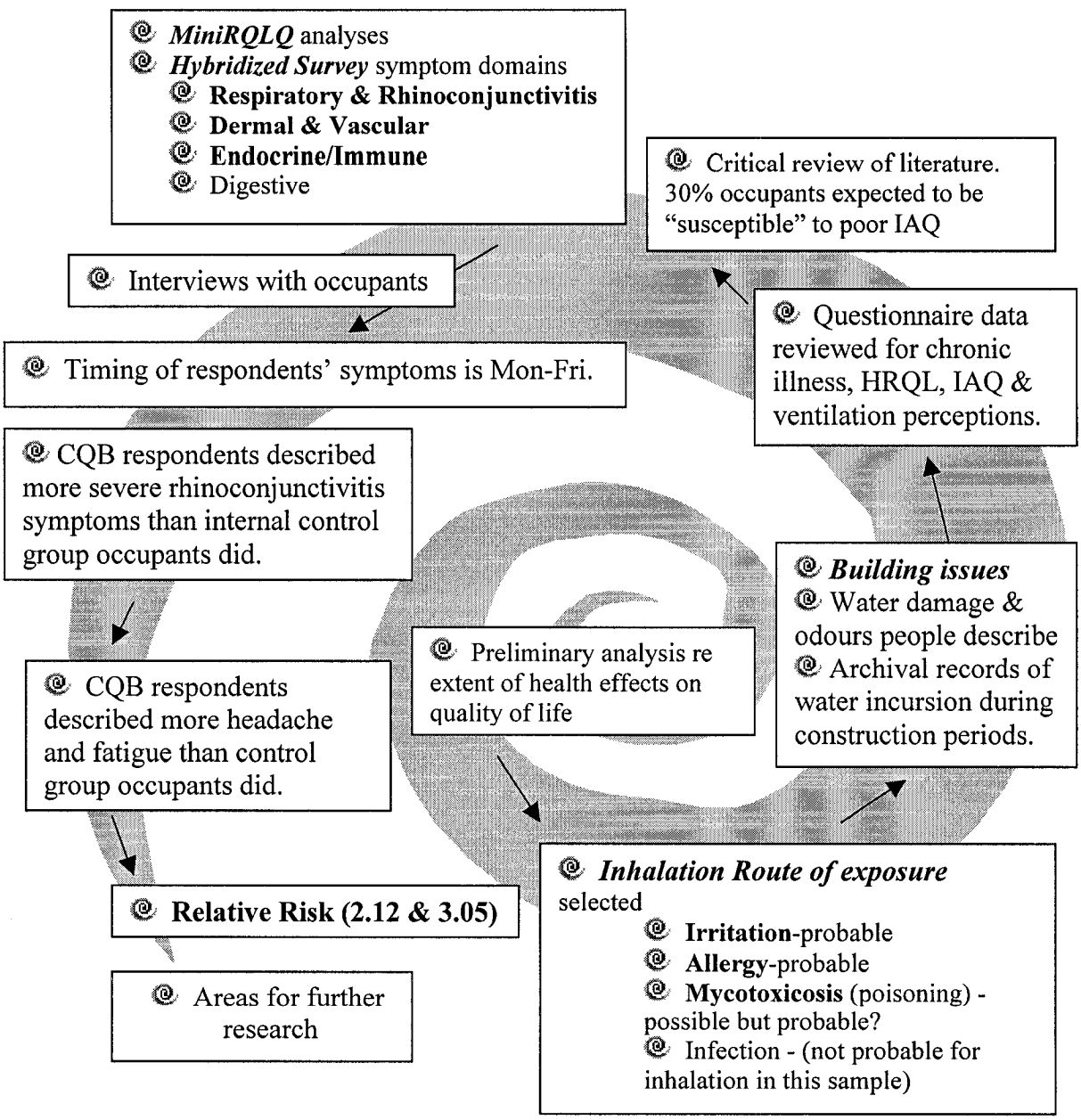
3.1 Hermeneutic

Hermeneutic engagement in research entails an ongoing process of uncovering horizons of truth (Jardine 2000). The written works of Hans-Georg Gadamer provided additional assistance in operationalizing this compelling approach:

> "A horizon is not a rigid boundary but something that moves with one and invites one to advance further. This is not a true conversation-that is, we are not seeking agreement on some subject-because the specific contents of the conversation are only a means to get to know the horizon of the other person. Examples of this are oral examinations and certain kinds of conversations between doctor and patient." (Gadamer 2003)

In Calgary, we are fortunate to have the assistance of understanding hermeneutics from the perspective of David Jardine, a Professor of Education at the University of Calgary. When trying to begin this study in January 2002, I managed to easily interrupt his work for some urgent advice I required on how to "do hermeneutics". [I admire the patience he exerted for that basic and "monstrous" question (Jardine 1998)]. I only recall now his comments on my most wonderful prospect of being able to ask people about the smells they encounter and being able to delve into the experience of the "grossness" of mould smells in places where we spend our days. Figure 4 illustrates the rest of the hermeneutic that began in Chapter One:

Figure 4: Hermeneutic Design – Part Two



This project began then as a rather enormous and somewhat intimidating opportunity to design and uncover the perspectives of courthouse occupants, via literature searches, questionnaires, interviews, and observations. My attempt is to describe the possible effects of the air where respondents work indoors at the Court of Queen's Bench building from the perspective of understanding occupants' complete reliance and trust on each other for the cleanliness and sustainability of the air that they breathe. This paper will describe the hermeneutic, circular methods required to determine how (or if) fungi found in the courthouse might be affecting those occupants' health.

Starting from such a wide perspective requires substantial rigor so as not to get lost in the many possibilities of such an inquiry. Utilization of typical protocols required for investigation, assessment and analysis of data included ethics approval. Before the commencement of the administration of the questionnaire (September 2002) and interviews (summer 2003) with occupants, the Conjoint Faculties Research Ethics Board at the University of Calgary granted ethics approval (See Appendix 7.3).

Hermeneutic analysis entails a great deal of revisiting the problem in order to make some determination of the accuracy of the issue from as many perspectives as possible.
The tasks are more circular than linear in nature, and require constant revisiting of the data from the questionnaires or an interview as new information is incorporated. The overall focus remains on the narrowing and refinement of the research question, that is: how can occupants and building managers determine if "sick building" symptoms such as fatigue,

runny eyes and noses, are related to exposures to fungi? What are the effects on quality of life for occupants at work?

As information from the literature, the questionnaires, the interviews and the further analysis is developed and worked on, the actual matters become easier to explain and document. Incorporation of literature that is trans-disciplinary in nature is required to successfully utilize this technique since the problem of indoor air implies examination from many different viewpoints. Microbiological, medical, environmental management, building science, engineering, philosophy and epidemiology are just a few of the primary fields required for this study.

As described previously in Section 2.1, a hermeneutic approach's largest impact relates to the focus on susceptible and hypersusceptible respondents as the target sample group. In any occupational sample of office workers chosen for study, one would expect to find a range of persons who may be very fit and healthy and those who may be experiencing health issues, with the bulk of employees in the upper midrange as illustrated previously in Figures 2 and 3.

Appendix B of the American Society for Heating Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE) standard of Ventilation for Acceptable Indoor Air Quality has stated for many years (as an apparent deflection of the need for superior air quality for susceptible occupants):

> "The elimination of all effects, e.g., unpleasant smells or mild irritation, is not attempted....The air can be considered acceptably free of annoying contaminants [by at least] 80% of a panel of 20 untrained observers [or visitors to the space]" (ASHRAE 2001).

The latest ASHRAE standard for ventilation, ASHRAE 62.1 2001, is receiving a substantial amount of new interpretation and continuous maintenance in order to stay abreast with emerging indoor air quality research and litigation (ASHRAE 2002). Environmental health assessments in workplaces are somewhat challenging in that the "healthy worker effect" may be precluding an examination of the full spectrum of workers who may be experiencing illness. Workers exposed to indoor air quality contaminants may leave through attrition, transfer or medical leaves (Zock, Heederik et al. 1998). This results in either an extraordinarily healthy workplace or high attrition contributing to a skewed sample. Surveys went to previous or retired occupants of the CQB building even though this study does not directly examine the possible interaction of a healthy worker effect.

A hermeneutic approach also assisted in the understanding of findings from the mailed-out survey before seeking further information from occupants through interviews and to assist in recognizing differences in the data between the full-time and occasional occupants of the CQB building. The ongoing literature review assisted in further focussing the data analysis. "After" the primary data analysis occurred, the interviews were conducted in order to further understand air quality issues from the occupants' perspectives (Brown, Weston et al. 1989; Gladwin 1989; Stewart, Brown et al. 1989; Jardine 2000; Clive Brown

2001; Jarvis 2001). An internal control group was used as a suitable reference group (Andersson 1998) and was comprised of those occupants who occasionally or previously worked at the CQB building, or whose primary work location is one of six other Alberta Justice or Solicitor General facilities, in or near Calgary's downtown core area. AUPE's internal mailing list was the source of the list of all possible CQB occupants, and in order to maintain confidentiality AUPE mailed the surveys.

Interviews were structured so that the selection of occupants for interviews were those people who either experience many health problems or those who describe themselves as healthy. In order to do this, the total mean scores from the MiniRQLQ (of only the sub-sample of regular occupants of the CQB building) were rank ordered. Interviews occurred in either the occupants' office, or home, depending on their preference. Respondents were selected for interview from the "ends" of the list with one occupant with MiniRQLQ scores in the midrange (see Appendix 7.12). Five interviewed occupants provided more in-depth characterization of their experiences of indoor air quality in the CQB building (see interview guide, Appendix 7.3). This provided a substantial ability to focus the analysis of data as relevant to the occupants' concerns and get further substantiation of emerging trends observed in the data.

Of great concern in small population studies is the presentation of findings, which would allow for sufficient rigorous review, while protecting the identity of respondents contributing data to this study. A few studies provide guidance in this regard but the

techniques implemented to present findings in this study draw primarily on the work of Lawrence Cox (Cox 1996). Where required to assist with confidentiality the data are abbreviated, aggregated or modified by rounding. Data are aggregate in the symptom clusters section (hybridized section of the survey), but less so in the MiniRQLQ section. An example of a data abbreviation method utilized is the stratification of data by location(s) and a subsequent "re-sampling" in order to examine and draw inferences from the data. See Appendices 7.7, 7.8,7.9, 7.10 and 7.13 for examples of this method used in both the MiniRQLQ and hybridized sections. Data analysis methods utilize basic descriptive statistics, frequencies, means, maximum scores and qualitative ranges.

Observations (or research through the Provincial Archives of Alberta) regarding the Court of Queen's Bench building supplemented the interviews and survey information (Gladwin 1989).

3.2 Health Symptom Clusters Related to Fungi in Indoor Air

The general philosophical approach for this section draws on the work of Geoffrey Rose's *The Strategy of Preventive Medicine* with respect to incorporating hermeneutic principles to examine indoor air and fungi in a different way. The idea of using a population within a population to assess what is "common" and to investigate whether or not 'common' also means "healthy" are concepts identified in Rose's work (Rose 1987; 1992). The internal control group is the group of respondents who worked occasionally at the Court of Queen's Bench building, but generally within court operations elsewhere. AUPE, judges or their staffs sent surveys to people based on the likelihood of any part of the employee's work being performed within the Court of Queen's Bench building, as a part of their regular (or past) job duties.

3.2.1 MiniRQLQ – Rationale and sources

To methodically examine the health effects of fungi then requires a validated and reliable tool such as the MiniRQLQ. In addition, assessing the severity of chronic conditions was of interest, since one objective of the study is to measure the extent of possible effects from the occupants' points of view. An ideal parallel to Juniper's MiniRQLQ would have been to conduct concurrent respiratory measurements of occupants. That was outside of the scope of this study, as that is a function of someone with skills of an occupational/ environmental nurse or a respiratory technician specially trained to conduct and assess

respiratory measurements, or a physician with experience or specialized training in this area.

While the selection of indoor air quality indicators has been studied by Schuh, that study specifically excluded bioaerosols from examination (Schuh 2000). The MiniRQLQ measures effects of nose and eye symptoms as an aspect of quality of life. Quality of life measures have been identified significantly in recent medical literature as a more person-centred way of evaluating disease states, and evaluating interventions designed to treat them (Brown, Weston et al. 1989; Stewart, Brown et al. 1989; Weston, Brown et al. 1989; Carr and Higginson 2003). The MiniRQLQ provides less obvious focus on person-centred measures, due to its brevity, however the first three questions are more "individually-structured" for this purpose. Quality of life measures are also identified as a practical way to describe and monitor diseases with public health implications (Robinson, Carr et al. 2003).

3.2.2 Hybridized section – Rationale and sources

Ethnographic approaches are of assistance in examining how to combine qualitative and quantitative methods (Gladwin 1989; Foster and Aston 2003) and to understand how to use hybridized designs in order to analyze complicated gene-environment interactions.

Responses to symptom questions in this hybridized questionnaire are grouped for analysis through review of the literature, by review of other survey instruments and examining plausibility of fit in Tables 7 to 12. The symptom clusters are Rhinoconjunctivitis, Respiratory, Dermal, Vascular, Endocrine/Immune and Digestive as follows:

Table 7: Rhinoconjunctivitis symptom clusters

# Order in survey	Individual symptoms from questionnaire pages 8 and 9 See Appendix 7.2
1	Eye irritation
6	Watering eyes
7	Dry throat
9	Sore throat
20	Runny nose
23	Sinus congestion
25	Nasal irritation
31	Stuffy feeling
9	Dry eyes
38	* Sore eyes and headaches *occupants wrote in "Other"
38	* Red eyes *occupants wrote in "Other"

Table 8: Respiratory symptom clusters

# Order in survey	Individual symptoms from questionnaire pages 8 and 9 See Appendix 7.2
2	Cough
4	Cold or flu like symptoms
8	Wheezing
11	Shortness of breath
24	Respiratory tract irritation
27	Asthma medication less effective
28	Cough at night
37	Hoarseness
38	*Tightness in Chest *occupants wrote in "Other"

Table 9: Dermal symptom clusters

# Order in survey	Individual symptoms from questionnaire pages 8 and 9 See Appendix 7.2	
3	Chapped lips	
15	Skin rashes or sores	
16	Itchy skin	
17	Dry, flaking skin	
38	*Itchy scalp	*occupants wrote in "Other"

Table10: Vascular symptom clusters

# Order in survey	Individual symptoms from questionnaire pages 8 and 9 See Appendix 7.2	
10	Headaches	
30	Dizziness	
32	Bleeding nose	
38	*Migraine	*occupants wrote in "Other"
38	*Hypertension	*occupants wrote in "Other"

Table 11: Endocrine/Immune symptom clusters

# Order in survey	Individual symptoms from questionnaire pages 8 and 9 See Appendix 7.2
12	Sleepiness, tiredness
14	Fatigue
18	Weight loss
21	Difficulty sleeping at night
26	Menstrual/menopausal problems
29	Irritability
33	Inability to concentrate
34	Joint pain/Swelling
35	Forgetting
36	Thyroid

Table 12: Digestive symptom clusters

# Order in survey	Individual symptoms from questionnaire pages 8 and 9 See Appendix 7.2
5	Nausea
13	Abdominal pain
19	Diarrhea
22	Vomiting

Epidemiological and exposure survey studies were the literature sources utilized to develop this section of the survey. The hybridized survey's elements came from other exposure type surveys applicable to indoor air evaluation. This study relied on the Calgary Health Region's symptom matrix contained in *Questionnaire A, Section 1* (Alberta Health 1993) (Stefani 2002). The major modification made for this study to the Calgary Health Region's symptom matrix was assessment of severity from the occupants' points of view, rather than frequency of their symptoms. This was done to align with the MiniRQLQ's focus on utilizing an indicator reflecting quality of life and Cain's work regarding assessing level of discomfort (Cain 2002).

Surveys of courthouse occupants specifically have been administered by incorporating spatially related questions with validated asthma or respiratory screening questions, again, a hybridized model of accessing valid, yet descriptive occupant data (Kudla and Oudyk 2000; Jarvis 2001). Jarvis's Florida courthouse study utilized an epidemiological approach with medical team members, while the Newmarket Courthouse study's authors are Certified Industrial Hygienists. The Newmarket team selected the English edition of the Swedish MM 040 EA Questionnaire, a valid tool in use since 1988. The advantage of the MM040 EA tool is that it is brief (easier to analyze) and does not require physician resources to administer or directly interpret findings.

The *Vital Signs* curriculum tool is a method of assessing occupant symptoms that was utilized with the occupants of the previous Court of Appeal building in Calgary (Lee, De Biasio et al. 1996).

Dr. Lynn Marshall's *Exposure History* model is an excellent document as well (Marshall 2000; Marshall, Weir et al. 2002; Stefani 2002). Smoking, diet and medication usage are included issues that affect an individual's immunity. Marshall's format was also very clear and readable for occupants of any building, but seemed much more suited for administration by a physician in a general family practice setting as a way of doing medical/legal documentation for a patient. Although home exposures are a significant portion of any persons' day, the emphasis on home exposures in the Marshall instrument was not a good fit with the more narrow assessment of occupants' work environments in this study.

The Citizens for a Safe Learning Environment (CASLE) website▼ information provides a succinct way of describing and analysing occupant complaints (Robinson 2003) including spatial patterns, timing patterns and exposures to pollutant sources.

▼ http://www.chebucto.ns.ca/Education/CASLE/casle.html

3.2.3 Interviews

In-person conversations with individuals most likely to be affected by poor indoor air quality provided further refinement to the process of understanding the health experience of occupants and led to greater specificity of analysis. Interview details are as follows:

- A sub-sample of the respondents who work fulltime in the Court of Queens' Bench Building was selected from those people who indicated that they experience many symptoms and have sought medical attention or who indicated that they felt healthy. Five confidential interviews with those respondents occurred between July and September 2003.

- Indoor observations of the building occurred during one of the interviews (accompanied by an authorized occupant) of some non-public areas of the top four floors of the CQB building and other public areas of the building including the library on the seventh floor.

- D. Stefani, Air Quality Specialist, with Healthy Communities/Environmental Health, Calgary Health Region was interviewed as a key informant on July 31, 2002. Mr. Stefani's experience as a Public Health Inspector, with his specialization in indoor air quality was extremely valuable in the development of this survey.

- A key informant interview was held with K. Ferguson, Board Member with the Healthy Indoors Partnership (national Canadian not for profit organization) and president of Citizens for a Safe Learning Environment (CASLE) in Halifax, Nova Scotia on August 27, 2003. Her experience underscored that indoor air quality surveys with occupants are critical steps in documenting complaints, and tracking exposures and risk factors in large buildings where there are numerous stakeholders.

4.0 Chapter 4: Results

4.1 Occupants' Perceptions

A critical piece of the hermeneutic design included interviews of respondents to the questionnaire (three women and two men). Of the persons interviewed, two persons were judges, and three were AUPE members. All worked full-time in the CQB building. These occupants' perceptions of indoor air quality (IAQ) in general became integral analysis points.

A respondent interviewed (with midrange/mean symptom score of 2.36 -MiniRQLQ) articulates the qualitative experience of upper respiratory symptoms (See Appendix 7.12):

> Respondent 2:
>
> "I went to another allergy doctor and he gave me a different nasal spray and that seemed to work pretty good, where you just give a couple shots
> cuz your nose gets so runny.
> And he says, the allergy doctor says,
> 'you have Rhinitis'.
> I didn't have it before and it just progressively got worse to where I just had to do something about it, because
> all of a sudden your nose starts dripping, and
> you get these sinus infections and
> it was a constant,
> that sort of thing."

Since not all respondents to the questionnaire agreed to be selected for an interview, there were few, available, "healthy" individuals (very low scores on the MiniRQLQ scale) to choose from.

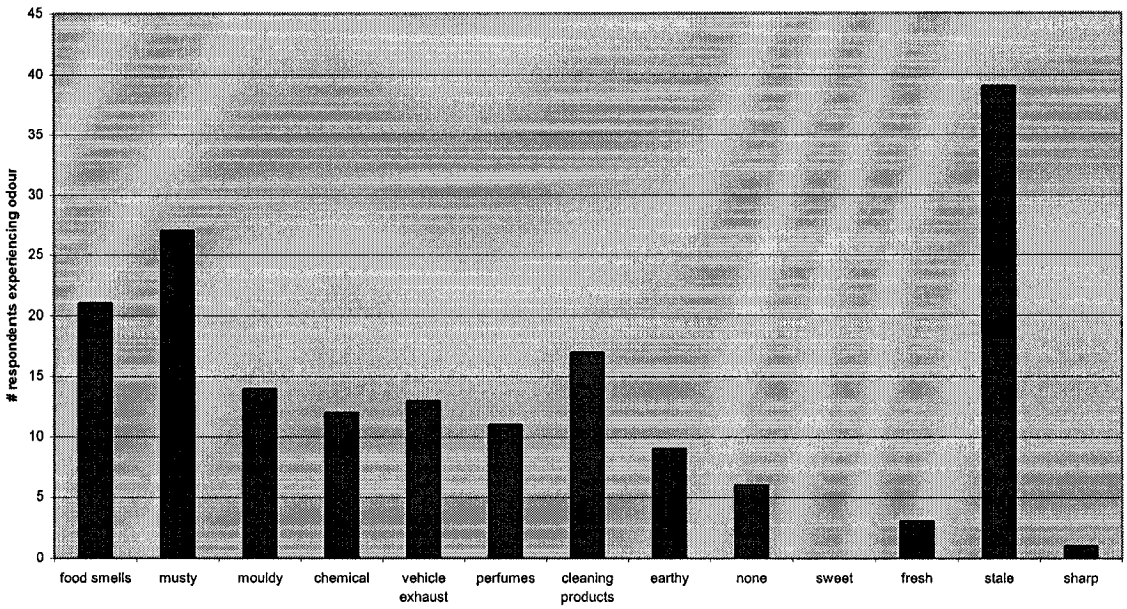
It was not surprising therefore, that one of the occupants interviewed from the "healthy" group revealed significant health problems, unrelated to rhinoconjunctivitis, which subsequently moved that person into the "susceptible" group. Although desired, no "healthy" occupants had consented to an interview from the control group. As a result, no interviews with the internal control group (occasional CQB occupants) occurred.

4.1.1 Odours

Courthouse occupants reported odours they smelled at work. As discussed, (Section 2.2.3, "Routes of Exposure") odours are a key mechanism that is available to assist people with avoidance of some adverse effects of airborne contaminants.

The majority of odours identified by all courthouse respondents in the hybridized portion of the survey were stale and musty, mouldy or earthy (see Chart 1).

Chart 1: Occupants' Perceptions of Odours



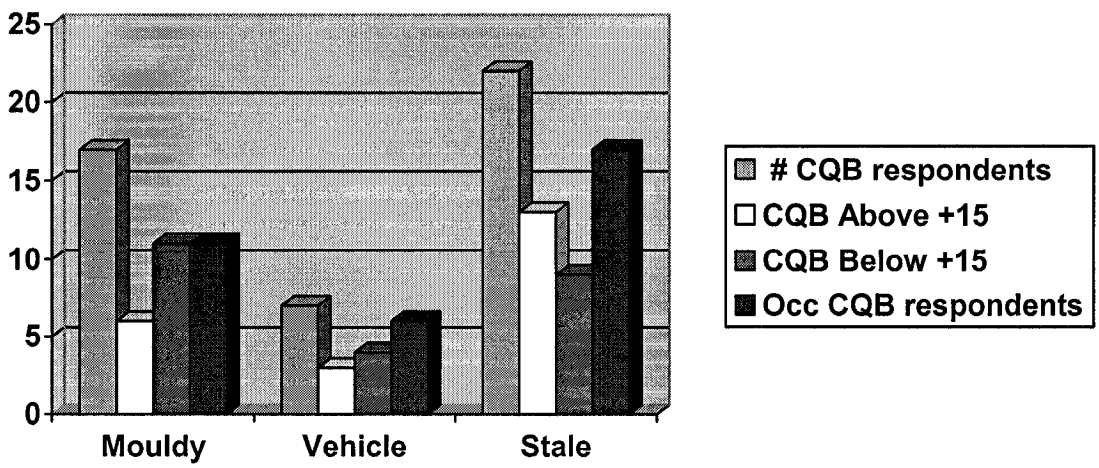
The sensation of staleness could be a result of inadequate ventilation design or operation. Musty, mouldy, and earthy odours are good indicators of active fungal growth. The next most frequent categories of odours were food smells (two kitchens on CQB site) followed by vehicle exhaust, cleaning product smells and chemical smells. Vehicle exhaust and food smells in building areas other than the kitchens or parkade are possible indicators of inadequate ventilation design or operations. Cleaning product smells indicates possible scheduling of cleaning during occupancy hours.

Socialization pressures appear to play a part in adapting to, ignoring or disbelieving this particular sensory input:

Respondent 1: " We were told we're nuts, people would come in and couldn't smell anything."

More respondents working below Plus 15 level in the CQB reported mouldy, musty and earthy odours than did respondents working above Plus 15 level (see Chart 2). Respondents reported slightly more stale odours above Plus 15 level in the Court of Queen's Bench building than occupants below Plus 15 level did. Responses of "mouldy" also include any respondent who reported the odour of musty or earthy.

Chart 2: Comparison of odours across locations



The occupants of the CQB building provided their rating of their perception of indoor air quality and ventilation in workspaces as summarized in Charts 3 and 4 respectively. The possible response ratings ranged from 1 = Excellent to 5 = Poor. Overall, the Court of Queen's Bench respondents rated the indoor air and ventilation as "Fair" (4).

Chart 3: IAQ Perception

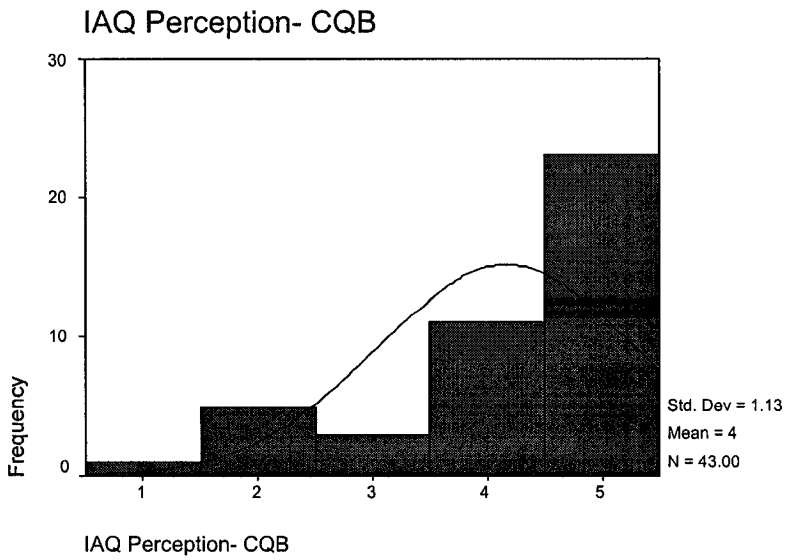
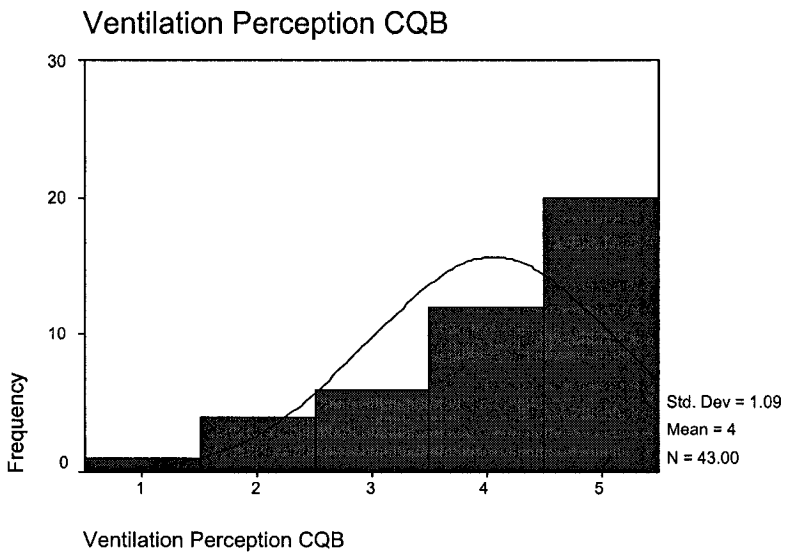


Chart 4: Ventilation Perception



Occupants' definitions of "Good IAQ" include:

> "The air is fresh, I feel energized, my whole being feels good, my breathing is clear, I breathe properly, without congestion, no humidification is necessary, the air is not dry, I don't need my fan, I don't detect anything incorrect, the air is free of odour."

Occupants state that when they feel healthy they:

> " Feel OK, my energy levels are good, I have lots of energy to do lots of extra work, things go smoothly, I feel like I'm 18! I have an optimistic attitude, I like to come to work, I have energy, and I am in a good mood."

Occupants made the following comments regarding what it is like when they feel sick and/or have to stay home from work:

> "I don't stay home from work, I'm a "go-er"; I've never missed a day of work in my life; I don't use work time to deal with my health issues; I deal with the treatment, move forward and maintain a positive attitude; I can't get to my <other work> that I love to do; I can't concentrate; my stress level is heightened; sometimes depressed and frustrated that I am having to compromise".

All of the five occupants interviewed indicated that they took personal steps to attempt to maintain a comfortable work environment. Of the occupants with fewer nose/eye symptoms on the MiniRQLQ the steps they took include:

- Going out for a walk every day, during the work day
- Setting the thermostat to 12 ° C so that the fresh air stays on
- Getting a bigger fan because the "air isn't on in the evenings or weekends"

- Encouraging other occupants to take action. Said that <another> occupant's office has "heavy air" and that <the other occupant> should do something about it".

Of the occupants experiencing more nose/eye symptoms on the MiniRQLQ the steps taken to try to increase their comfort at work include:

- "Bringing a heating pad while <I work> so that my hands don't get cramped"
- "Bringing a heater to work to stay warm"
- "Going outside of the building whenever I can, but I can't always get out because of <work requirements>".
- "Reporting the times when the air is bad"

Few survey respondents reported any awareness of IAQ mitigation measures in the fall of 2002. Respondents interviewed ten to twelve months later were able to comment on a great number of mitigation steps that occurred and had copies, or were aware of an indoor air quality bulletin issued in June 2003. Respondents interviewed with few health symptoms speculated on the lack of resiliency of colleagues with health problems and stated that they "felt sorry; but like you would if someone at work has the flu-it doesn't affect me". Persons reporting symptoms commented that supervisors had received awards for "handling the air quality problem so well" but that they were still feeling sick.

Occupants described mitigation measures undertaken as including: initiation of an expert panel process to examine IAQ and effects on occupants; administering a voluntary survey for an *Allergy Database and Health History*, interviewing affected occupants; spraying

ozone into the file room; increasing ventilation; changing file/exhibit storage practices and spraying file documents with an encapsulating product".

The encapsulating product (see Photo Four) used on courthouse file documents was AEGIS Microbe Shield ™ and requires that a trained worker complete the application to ensure that the three-year warranty is valid (Qureshi and Wildgrube 1999).

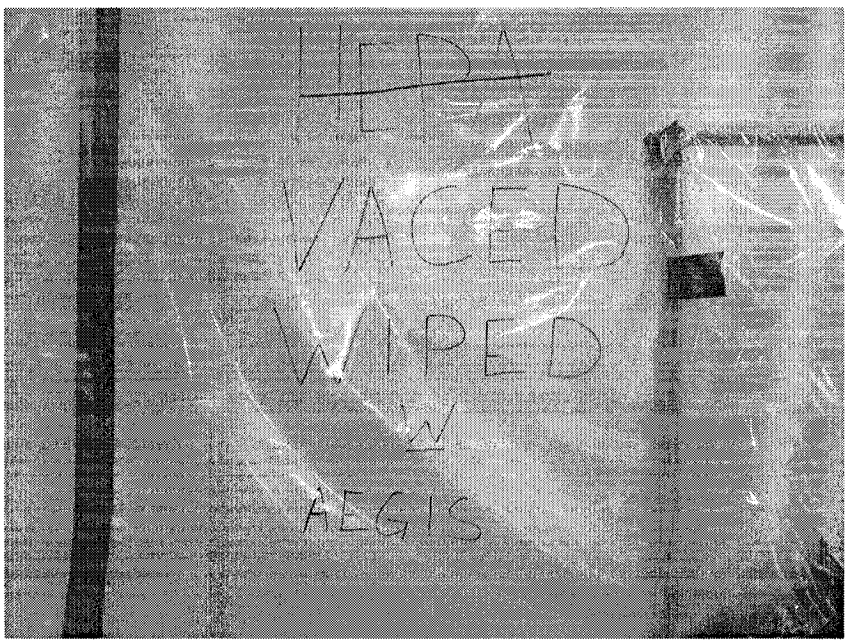


Photo 4. Mitigation treatment of cellulose surfaces

Occupants received some personal protection (gloves, masks) but provided inconsistent information regarding utilization of that equipment. When building managers attempted to mitigate the basement file areas due to mould growth, ozone treatment of the area was an

initial mitigation strategy (Knapp 2002). Ozone however is a known respiratory irritant (Macher 1999; Vagaggini, Taccola et al. 2002; Yang, Chen et al. 2003; Dales, Cakmak et al. 2004) and is readily detectable by its pungent odour.

> Respondent 2: "Opened it [the plastic bags used to package exhibits] and then my throat would get raw from the ozone and the bleach they used. And they would say 'oh you must be sensitive to these things, but they're not in it all the time like we are. *It's not bothering them but they're not in it all the time.* [Researcher Q. When you say them?]...Respondent 2. .. well the supervisors, the big cheezes. Anyone else who worked...helping us, they felt the same way, but the big cheezes they say that nothing's wrong."

Interview responses indicated that the procedures for handling exhibits and storing files changed with the new policy, dated June 2003. Occupants interviewed reported that the basement file room is now "bright white", "so bright that you need sunglasses" from the recent painting. Other interview data of significance included: "the no smoking policy has been in place for about ten years but 100% compliance has only been in place <on my floor> for about the last five years".

Occupants reported some fears and reasons about reporting complaints. The somewhat low response rate to both this questionnaire (n=67) and the survey of October 2002 conducted by Personnel Administration Office's J. Krushinsky (n=20) may reflect the deep concerns of occupants to medical questions without accompanying coordinated, trans-disciplinary assurances about the privacy and benefits of public health/IAQ surveillance models. Alternatively, since the planning had commenced for a new consolidated courthouse

facility, occupants may not have felt it worth their effort to participate. Regardless, many responses to the hybridized portion of the questionnaire reveal a variety of reasons for lack of follow through on making indoor air quality complaints, seeking more information or even for not seeking medical attention. For detailed results on this aspect of the survey, see Appendix 7.6.

4.2 CQB Building Findings

4.2.1 Moisture

Unwanted moisture sources were described in archival sources regarding problems during CQB construction (Hunt 1960), and by occupants' descriptions of their work activities during interviews as follows:

> Respondent 1 "We knew when we started that ..we had a mess. We knew that there were water soaked [items]... like old rugs... with old drugs spilt in them.... -elastic bands so dried up... they had... mouse turds in them. Stuff so old that it fell apart."
>
> R.2 "We know it flooded because something broke upstairs" [R.2 mapped locations of where there were buckets to catch the drips].

Occupants were able to recall specific water leak events ranging from 1987 to within the last few months from various sources (plumbing, roof, basement, or of unknown causes from "the ceiling").

The Court of Queen's Bench building contains many private lavatory facilities, as do other court facilities. This creates additional plumbing design and maintenance requirements. Building trades have long noted the connection between moisture control and health.

> "A neglected leak in your plumbing may seriously impair the health of some one of your family. The Plumber Protects the Health of the Nation" (Advertising for Standard Sanitary Mfg Co. Limited, Toronto circa 1940 Glenbow Trade Catalogue). Through the history of the plumbing and heating industry in Southern Alberta one can observe the development of civic responsibility as well as the improvements in comfort and sanitary conditions within the province. For city dwellers, the advice "Choose your plumber as you would your physician" was more than just an advertising slogan." (Lounsberry 1995)

4.2.2 Building Design Issues

The original design for usage of the interior core sections of the CQB building are difficult to determine without close visual inspection of the premises and the original mechanical-architectural and subsequent renovation drawings. Occupants indicated that renovations or major maintenance appeared to be regular. Regardless, the location of many of the support staff in the building appeared to be in the central core of the building or within/near courtroom locations that do not lend themselves to manipulation or influence of environmental controls for that group of staff. Occupant descriptions of building usages beyond planned design are as follows:

> [Occupant description of a meeting about indoor air quality] " OK [Person X], I want to know, and I want the truth. Should staff have ever been in that basement working? [Person X] hemmed and hawed and .. didn't have any choice but to say 'no they should never have been placed down there'. Then [Person Y] quickly said 'we plan on getting them out, we plan on getting them out', and THEN we were moved out." "The files/exhibits were all HEPA vacc'd, then wiped down with Aegis, then put in bags."
>
> Respondent 2 "You adapt to their situation, they do not adapt to you. There is no control over my environment. I'm just lucky to have a job."
>
> Respondent 3 "have a look at this – [showed this researcher large portable oscillating fan that the occupant recently purchased for use in workspace when ventilation is not sufficient in evenings or on weekends]

Ventilation is an important component in removing the air used by occupants and replacing it with fresh, ideally filtered air. Ventilation is also outside of this scope of this study, however the ventilation rate, the amount of conditioned air delivered to all occupied spaces

and the role that air movement plays for the transport of spores and the comfort of occupants is significant. The survey asked occupants about their perception of ventilation, as an aspect of building operation, and as an important variable. The extent to which fresh air can be introduced to a building from the HVAC system is of significance not only for energy consumption reasons but especially if occupant complaints seem to occur at certain times of the day, week or year.

> R. 1 " We were told we're nuts, people would come in and couldn't smell anything"
> R. 2 "There was one time I knew it got so bad that they were all practically falling asleep"
> R. 2 "The way it was explained to me is that they have trouble balancing the heat. It all seems like the same air to me [throughout the building], [it is] more the temperature differences [I notice].
> R.3 "I've felt a little better since moving."

Several occupants kept a record of their air quality concerns. Excerpts of some issues recorded as significant to the occupants are:

> Respondent 3 "1992 Tuesday January 21, noon, quite strong smell of exhaust"
>
> Respondent 3 "1992 Friday May 8, 8:40 am, air down"
>
> Respondent 3 "1997 Wed October 15
> - 9:15 am, exhaust smell
> - 9:30 am, very strong-reported it
> - 9:40 am, couldn't find anyone's car running"
>
> Respondent 3 "2000 Wed February 23,
> - 11:50 am flood in <bldg location> - 2:30 pm fixed"

Respondent 3 "Friday, July 12 No air - has been down for a while now, feel terrible, eyes heavy, headaches, etc."

Respondent 3 "The fans were put on high especially since the air is now being tested"

Respondent 2 "Here is the site on the information regarding the product called Aegis that was used on the files and exhibits. http://www.aegis-in-canada.com/posttreat.html"

Respondent 1 "we had sore eyes, sore nose, rashes, fatigue, whatever. My doctor said I wasn't to go in there anymore"

Respondent 2 "Some steps were taken January 5th & 6th, 2002, to remediate the contaminant by closing the building. Staff was told that the area had been cleaned using ozone generating equipment and some bleaching agent. The source of the mold is not known except that it is apparently present in the basement file room. The odor that emanated from the basement file room and hall area was overpowering on Monday morning and caused headaches and eye, throat, skin and respiratory irritation to those members of staff that accessed the basement hall area. Steps were taken to clear the odor by opening the one door of the file room to the rest of the basement area. The odor remains quite strong and staff has concerns over health issues that may arise from this situation as well as the overall air quality in the building especially since this mold is an airborne contaminant."

Respondent 2 "The Court of Queen's Bench building was closed once again on February 3 & 4 for more ozone treatment because more "minute" quantities of Stachybotrys were found in the basement exhibit control area."

4.2.3 Potential Fungi Substrates Indoors

General information regarding the CQB building is drawn from some first hand knowledge[♦] since the building is physically adjacent to the Court of Appeal building in Calgary, and from some inferences regarding historic shared infrastructure supports between the two buildings (a parkade, cleaning practices, equipment, mechanical systems, and some staff resources are understood to be shared or similar). Architectural details of the CQB building are remarkably similar to the neighbouring former Court of Appeal building including the two private (judges and staff) elevator systems (Bobrovitz 1998) in the Court of Queen's Bench building, the incorporation of library materials with historical legal significance in working areas, and a propensity for individual lavatory facilities for judges. The methods of document or exhibits storage loose on shelving in secure areas or in cardboard boxes (prior to June 2003) and routing (mechanical, people, documents) through a tunnel system as required were similar business practices between the two buildings.

Additionally, indoors observations were made of portions of non-public areas on the ground floor and basement by the researcher during collection of fungal samples (See Appendix 7.1) in the file rooms of the CQB building on January 24, 2002 (accompanied by an authorized occupant).

[♦] This researcher assisted with the IAQ assessment of the adjacent Court of Appeal Building in 2001 as a preceptorship in the Faculty of Environmental Design, University of Calgary, with Professor Tang Lee.

The building envelope (floor, exterior walls and roof), the interior walls, fixtures and furnishing are susceptible to design, material choice, construction, maintenance or cleaning flaws. This building is not unique in that respect; however the analyses of those issues are outside of the scope of this study. The original five-storey building was completed in 1962, (took 43 months to build) and between 1974 and 1976, the four-storey addition to the top of the structure was completed (Bobrovitz 1998).

File material and books travel from all parts of the building to other areas or floors for staff/judges to use during their workdays. While older court buildings such as the former Court of Appeal building in Calgary have historic significance, the CQB building in Calgary does not have this designation. Courthouses of Alberta have held special interest for research historians however (Mills 1977; Bryant 1984; Mittelstat 2003). The site's location does have special significance, as it is on the spot of Calgary's first courthouse, built in 1888 (Government of Alberta 1959).

The many historic documents that courthouses contain such as historic law books, pieces of evidence, or the repositories of legal documents for the community may act as unique fungal reservoirs. The basement file room and seventh floor law library have some volumes that dates from the 18th, 19th and early 20th centuries (See Photo Five).

Photo 5: Court of Queen's Bench basement file room, early 20th century records

Archival documents indicate that the CQB building was constructed with asbestos as an insulating material, supplied by Grant Industries, and the building was the subject of asbestos remediation (encapsulation) in the 1980's (Currey 1960; Henderson 1960; Stroyan 1960; Alberta Government 1980; Campbell-Hope 1980; Feldstein 1981; Hargreaves 1981).

Weeping tiles were recommended to be omitted from the design in March 1959 by the Chief Engineer on the basis that:

> "Past experience on the A.G.T. Toll Building indicated it was a good arrangement to use membrane floors without weeping tile below where the floors were located below the water table, or very close to it, and for floors at a higher level weeping tile was provided inside the foundation walls." (Hunt 1959)

A further comment regarding water infiltration stated:

> "April 8, 1960
> Attached please find copy of supervision report from Strong/Lamb & Nelson. The last remarks for March 25 are disturbing: -
>
> "Water is going down in tunnel"
>
> Please report on this matter and suggest remedy."
>
> Handwritten comments on bottom of letter: April 11, 1960. "D [....?] on site, saw condition of tunnel – appears as though waterproofing poorly done + this can be [remedied?] on completion of tunnel construction in future."(Hunt 1960).

A short letter indicates further last minute construction/design challenges:

> "A ventilating duct opening was originally intended adjacent to the exterior wall between column rows 8 and 9 on the ground floor. Although this opening has always appeared on our ground floor plan it is apparently now not required under the present system and should be covered over. We were not advised of this previously. The attached sketch shows details of covering this opening with a concrete slab."(Connor 1960).

The significance of these records for the ongoing maintenance requirements of the building cannot be determined without review of architectural and mechanical drawings and records, as well as consultation with current building managers' records on building operations and challenges. One would assume that since the new Courthouse design calls for replacement of the current CQB building, that the challenges of maintaining the current building are not as cost effective as building a new and larger building that can accommodate the additional space requirements of consolidated court operations.

Most occupants work in several locations within the CQB building (or other buildings). This finding limits conclusions of specific contaminant exposures from this data alone. Air in high rise buildings migrates, from stack effect (warm air rising), through elevators, stairwells, and conduit openings between floors (Wilson and Tamura 1968) unless properly controlled through building design and careful balancing of mechanical HVAC systems. Occupants of the entire building breathe re-circulating air (and any contaminants of varying doses) from other parts of the building.

While generally the level of contamination will decrease in distance from an original source, transport of airborne contaminants such as fungi to other locations provides additional challenges. Adsorption of contaminants within air ducts, onto building finishes and furnishings provide further unpredictability to determine potential exposures to occupants if contaminants become re-released in new locations. Photo Six illustrates only one of many wall and ceiling penetrations from the basement file room to other areas of the building.

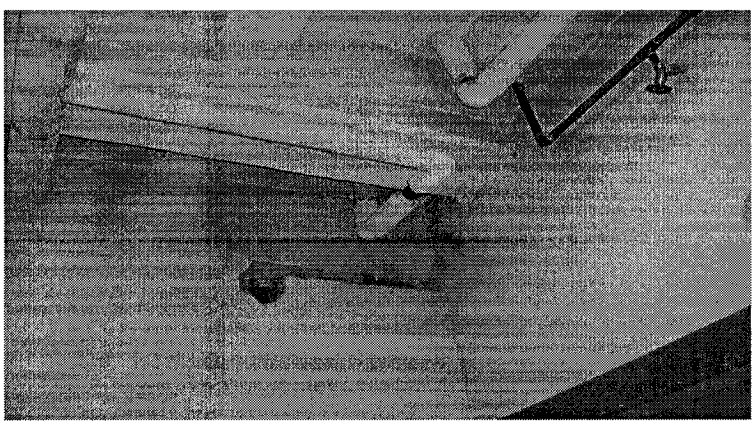


Photo 6: Basement CQB file room; detail of penetrations in wall, ceiling

4.3 Susceptible and Hypersusceptible Occupants

The data were re-visited many times. Patterns of respondents' susceptibility and hypersusceptibility arise from that work (Appendices 7.8, 7.5, 7.7). As each individual has their own subjective response to discomfort and pain, the challenge of deciding the level of significance for the hybridized (albeit un-validated) instrument was addressed through these analyses of the data. Respondents who ranked symptom items 2 ("somewhat troubled") or higher tended to complete the questionnaire more completely than those respondents who ranked items as 0 – not at all troubled, or 1- hardly troubled. The stratified data for both the MiniRQLQ and the hybridized survey response scales further separates respondents into three subgroups:

- 0 - 1 "Not at all troubled" to "Hardly troubled": Questionnaires with these lower score ranges were included as healthier respondents.

- 2 - 3 "Somewhat troubled" to "Moderately troubled": Increased level of detail in completing survey questions – may be an indication of respondents' higher interest in participation, and so possibly a higher consideration by the individual of their personal health risks.

- 4 - 6 "Quite a bit", "Very" to "Extremely troubled": Respondents ranking their symptoms as a four or higher also tended to report higher numbers of symptoms and chronic health conditions. This level of response would be considered to be indicated by susceptible and hypersusceptible persons experiencing symptoms.

Table 13 summarizes survey results using the above noted groupings, by symptom cluster and analysis by area of the CQB building (above 'Plus 15' level or below 'Plus 15' level), or the internal control group.

Hybridized survey results are that the total number of CQB respondents working full time experiencing any symptom which they rated a 4 or higher "Quite a Bit" (4), "Very" (5) or "Extremely Troubled" (6) was 23 of a possible 36. The MiniRQLQ results show 20 people of a possible 36 full-time CQB respondents rating any symptom 4 or higher.

The internal control group had 13 of a possible 17 respondents ratings of 4 or higher on the hybridized survey, and 13 of a possible 16 respondents rating 4 or higher on the MiniRQLQ.

Table 13: Survey results summary.

SYMPTOM CLUSTER A. Above Plus 15 Level B. Below Plus 15 Level MINIRQLQ BASELINE MEANS*: i. 0 - 1.99 ii. 2.0 - 3.99 iii. 4.0 - 6.0	HYBRIDIZED SURVEY % RATING 4.00 – 6.00		HYBRIDIZED SURVEY % RATING 2.0-3.99		HYBRIDIZED SURVEY % RATING 0-1.99		JUNIPER'S MINIRQLQ* – NUMBER OF PEOPLE	
	Area of CQB building	Occasional CQB occupants (six other court operations locations)	CQB	Occasional CQB occupants	CQB	Occasional CQB occupants	CQB:	Occasional CQB
Respiratory	A - 50% B - 18%	0	A–13% B - 15%	50%	A –37% B - 67%	50%		
Rhinoconjunctivitis	A - 26% B - 46%	0	A - 26% B - 6%	87%	A –48% B - 48%	13%	*i - 18 ii - 14 iii - 4	*i - 9 ii - 7 iii - 4
Endocrine/Immune	A - 78% B - 33%	22%	A -0% B - 6%	44%	A - 22% B - 61%	34%		
Dermal	A - 38% B - 44%	0	A –35% B - 6%	100%	A –27% B - 50%	0		
Vascular	A - 25% B - 8%	33%	A –25% B - 25%	0	A –50% B - 67%	67%		
Digestive	A - 0% B - 6%	0	A -0% B - 19%	0	A –100% B - 75%	100%		
Total persons experiencing **any** symptoms 4 (quite a bit troubling) or higher	23 of possible 36 full-time occupants (n = 43)	13 of possible 17 full-time occasional CQB occupants (n=21)					20 of possible 36 full-time CQB occupants	13 of possible 16 (full-time) occasional CQB occupants

A pattern of particular interest arises from Table 13 regarding respondents above Plus 15 level. They reported more endocrine/immune related symptoms than occupants below Plus 15 level including fatigue, sleepiness, tiredness, difficulty sleeping at night, irritability, an inability to concentrate, joint pain/swelling and forgetting.

Retired, part time and occupants of the Court of Queen's Bench building who were on medical leave did respond to this survey (n=7) with all four part time employees reporting MiniRQLQ mean scores ranging from 0.14 to 1.50. The three retired employees of the CQB mean MiniRQLQ scores ranged from 0.86 to 2.86.

The general summary of the numbers of occupants (across all buildings) experiencing additional health conditions is contained in Table 14, with occurrence described among respondents by building area. The survey asked respondents about existing health conditions and whether or not they had been receiving diagnosis/treatment for that condition by a family doctor or specialist. This secondary question provided another way to examine possible effects of fungi on occupant health by providing additional validation to the scaling of severity of occupant perceptions.

The Court of Queen's Bench building was estimated to have 180 occupants at the time of the survey. Of these, a certain number are going to be hypersusceptible, as described earlier in Figures 2 and 3 (Section 2.1.1, "Typical cumulative dose-response curve for

normal populations"). We can estimate the expected number of hypersusceptible occupants by considering those general numbers from the population at large:

- Assuming 2.3% of population is hypersusceptible of 180 people would be 4.14 people
- Assuming 30% of the population is susceptible of 180 people would be 54 people

If the 36 respondents working full-time in the CQB building were drawn randomly and representatively from the 180 occupants, then we would expect that:

- 2.3% of 36 persons would be 1 person responding
- 30% of 36 persons would be 11 people responding

If the survey self selected the hypersusceptible population of the 180 full time employees then we would expect in the 36 responses that:

- 4.14 people of 36 respondents represents 11.5% of respondents
- 54 people of 36 respondents represent more than 100% of the respondents.

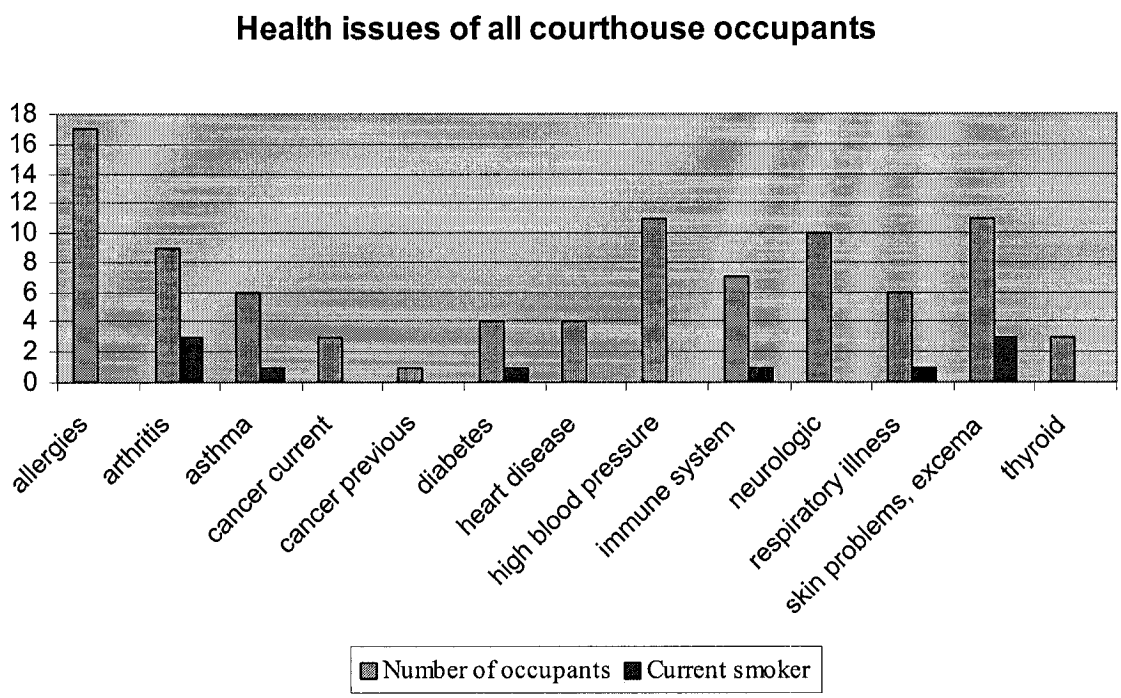
In the hybridized survey, 23 of the 36 respondents were experiencing symptoms (See Table 13). If this is an actual reflection of the general population then this would mean that about 64% of the occupants at the Court of Queen's Bench are experiencing illness. This does not appear to be the case, and so it is more likely that this survey has indeed self-selected the susceptible and hypersusceptible occupants.

If the 23 respondents to the hybridized survey are considered within the actual occupant group of 180 people, then approximately 13% of the population has responded with symptoms. This is perhaps more reflective between the two extreme estimates of the 2.3%

hypersusceptible group and the 30% susceptible population estimate. This sample however could be containing the hypersusceptible group and some others.

We cannot assume that all people are responding strictly from indoor air quality conditions at the Court of Queen's Bench building. There is always be a background of people who will experience symptoms, and some of those additional gene-environment factors are included in Chart 5.

Chart 5: Medical conditions as compared with smoking status



Courthouse respondents appeared to place a high priority on health creation and health maintenance activities such as balanced diet, exercise and social supports. These factors as

well as "habitus" factors enhance or compromise one's personal ability to defend from indoor or outdoor environmental contaminants (Foster and Aston 2003). A significant limitation to this study then is the lack of a full examination of some of these wellness factors from the perspectives of occasional courthouse occupants♦.

Table 14: Numbers of occupants with chronic health conditions by location

Hypersusceptible: Immune Dysfunction	All respondents -Including f/t, p/t, retired, loa	**Total CQB-** Including f/t, p/t, retired, loa	CQB-full time only		Internal Control (Occasional full-time CQB respondents)
			Below Plus 15	Above Plus 15	
Cancer	N=3	**2**	1	1	**1**
Arthritis	N=9	**5**	2	3	**4**
Diabetes	N=4	**3**	1	1	**1**
Thyroid	N=3	**1**	0	0	**1**
Susceptible: Chronic Medical Conditions					
Heart disease	N= 4	**2**	0	2	**2**
Dermal (eczema, other conditions)	N=11	**6**	4	1	**5**
Blood pressure dysfunction (high, low, stroke)	N=14	**8**	3	3	**6**
Respiratory Disease	N= 21	**12**	5	5	**9**
▪ Subgroup allergies	N=17	**8**	2	3	**8**
▪ Subgroup asthma	N=5	**3**	1	1	**2**
▪ Subgroup respiratory illness- e.g. bronchitis	N=6	**5**	4	1	**1**

In order to understand the contextual significance of this sample then, there are two issues to examine to help determine whether indoor air quality is affecting the CQB occupants'

♦ Further discussion on this study's limitations can be found in Section 4.6

health or not. The key question to examine is how many hypersusceptible respondents may be experiencing symptoms from external air pollution levels or from poor indoor air quality within the Court of Queen's Bench building.

One way to analyze this question is to examine the internal control group. The assumption is that exposure of occasional CQB occupants to airborne fungi has not occurred to same extent as for full-time CQB occupants.[▫] Secondly, the question of timing of occupants' symptoms assists in understanding if exposure to fungi indoors may be affecting occupants' health or if other explanations are required. Discussion on this second point is located in Section 4.5, "Timing of symptoms".

4.3.1 Internal control group

With respect to the internal control group (occasional CQB occupants, n = 310), the same calculation principles of hypersusceptible and susceptible numbers expected in the general population are used:

- Assuming 2.3% of 310 people are hypersusceptible would be 7.13 people
- Assume 30% of 310 people are susceptible would be 93 people

Of the 310 surveys sent to occasional CQB occupants, thirteen of the seventeen full-time respondents to the hybridized survey rated their symptoms as higher than 4 (quite a bit

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[▫] Respondents from three of the six non-CQB court buildings however reported issues of potential indoor air quality concern including water damage, mice in building and a very dusty workplace.

troubled), or 4%. This is very close to the 2.3% expected in a self-selecting survey of this nature (See Table 15).

Table 15: Response Summary

Action	# Surveys Sent	Valid	Overall Response Rate	Response rate by Location	Assigned to location based on survey responses	# Full-time respondents	Hybridized survey respondents with **any** symptom score above 4.0 (Quite a bit, Very or Extremely Troubled)	MiniRQLQ respondents with symptom **means** over all domains above 4.0 (Quite a bit, Very or Extremely Troubled)
CQB	490	64	13.1%	20.0%	43	36 of (n=180)	23	4
Control				5.5%	21	17 of (N=310) 16 respondents to MiniRQLQ	13	4

A relative risk calculation is one tool to compare a control group with the sample group of interest. From the survey, the occasional CQB (working full-time) respondents with symptoms (4%) are compared with the full time CQB respondents with symptoms (13%).

In order to understand relative risk, the examination of how different contaminants affect individuals at different times of the day, or how a cumulative exposure to a contaminant throughout a day or week also become significant questions to examine. When calculating from such low estimates of hypersusceptible cases, as many variables as possible need to

be controlled for. For this reason, only the full time respondents, and not the part time respondents of the courthouses were included in the relative risk calculation as outlined in Tables 16, 17, and 18. The expected relative risk of working in either building as having an effect on health is 1.00.

Calculation of relative risk (RR) provides an understanding of how the susceptible and hypersusceptible sample responding to this survey compare in incidence. The assumptions used in the calculation of relative risk are set out below:

Table 16: Relative Risk Calculation

Disease (Rhinoconjunctivitis or other symptom clusters)	No Disease	Incidence
A = # People exposed to fungi in CQB	B = # People exposed with no symptoms	A / (A+B)
C = # People with no or limited exposure to fungi @ CQB	D = # People not exposed and no symptoms	C / (C+D)

- A + B + C + D = Total sample (n=490). Symptom scores chosen for sample (A) and control (C).
- Assumption is that B = no response + responded but no symptoms, D is the residual.
- $RR = \frac{A/(A+B)}{C/(C+D)}$

The occupants who responded have a range of immune related medical conditions including individuals who have or are seeking medical support for their existing health conditions as described previously in Chart 1. Several occupants experience a cascade of health effects, while others have "only" one chronic condition.

Table 14 (chronic health conditions experienced by respondents) provided an additional way to understand respiratory or health conditions that may be occurring as a result of the incidence in the general population or whether results may be associated with indoor air pollution in the CQB building. As shown in Tables 17 and 18 below, the incidence of respiratory disease is about twice and general health symptoms are about three times higher for full-time CQB occupants. This is consistent with the higher numbers of respiratory health conditions reported in Table 14 by CQB respondents (n= 10 of 180 CQB occupants, vs. n= 9 of 310 internal control, occasional CQB occupants).

Table 17: Relative Risk: Hybridized Survey

Disease / Exposed	Hybridized survey respondents with **any symptom score** higher than 4.0 (Quite a bit, Very or Extremely Troubled)	Hybridized survey respondents without any symptom score higher than 4.0 (Quite a bit, Very or Extremely Troubled)	Incidence
Court of Queen's Bench building occupants	23	157♦	23/180 =0.127778
Occasional Court of Queen's Bench building occupants	13	297♦	13/310 = 0.041935

Relative Risk is 3.05 (Confidence interval not calculated)

♦ Assumes that people not responding to the survey were healthy.
♦ ibid

Table 18: Relative Risk: MiniRQLQ

Disease / Exposed	MiniRQLQ symptom **means** over all domains higher than 4.0 (Quite a bit, Very or Extremely Troubled)	MiniRQLQ symptom **means** over all domains lower than 4.0 (Not at all, hardly troubled, Somewhat or Moderately troubled)	Incidence
# of Court of Queen's Bench building occupants	4	176♦	4/180 = 0.02272
# of Occasional Court of Queen's Bench building occupants	4	306♦	4/310 = 0.01307

Relative Risk is 2.12 (Confidence interval not calculated)

Table 23 (Section 4.5.2.1) provides further support for increased inhalation symptoms. Respondents (68%) in the CQB perceived their respiratory symptoms more severely (rating of 4.0 or higher) than did occasional CQB respondents (0%).

We know that actual exposures to fungi indoors can vary dramatically depending on occupants' work activity patterns and length of exposures to various locations in the building. However, for the purposes of this study, we assume that the full-time CQB building occupants have *similar* exposures♦. If we assume that the population of the CQB is a normal population, then we would expect 2.3% hypersusceptible to be in this

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♦ ibid

♦ ibid

♦ Most occupants described numerous "primary" work locations throughout the building of interest, (Court of Queen's Bench building) making coding a challenge. The lowest floor that the occupant describes as their primary work location, is the location used for data analysis.

population with respiratory health susceptibilities or just over four people. As shown in Table 14 there were ten people working full time in the Court of Queen's Bench reporting respiratory health susceptibilities which corresponds quite closely with the relative risk calculations in Tables 17 and18, that approximately two to three times more people than expected in a non-exposed sample are reporting symptoms.

4.3.1.1 Hermeneutics and significance of responses to survey

Reviewers of research typically frown on survey methodologies with low response rates (Editor- CMAJ 1999). Perception, social science and marketing research however have long been recognized as having high (85 % or higher) non-response rates (Palys 1997; Tanner 1999). The concern in health literature regarding this low response rate is that it likely reflects respondents' "self selection bias" (Wilson 1999). As a way of commencing data collection for this hermeneutic approach, it was anticipated that the respondents would in fact represent a "more interested, involved and/or experienced" (Wilson 1999) segment of the overall population of occupants of the Court of Queen's Bench building with respect to possible effects of fungi in indoor air.

Strategies to increase survey responses such as second and third reminder notices or incentives were considered and rejected because concurrent but unconnected health/indoor air questionnaires and interviews of occupants, sanctioned by the building owner, were conducted with occupants at approximately the same time as this survey (Krushinsky

2002). Since the details of and participation with this survey was offered to (but not sanctioned) by the building owner, it was decided that only further confusion to occupants would arise should the strategies of reminder notices be used by this researcher. This study instead employed strategies that tend to increase qualitative analysis, such as a longer questionnaire -17 page, and the use of open-ended questions (See Appendices 7.2 and 7.3).

Occupants who currently work at the CQB building or are retired, part time, occasional workers (who are usually full-time in other buildings) or on a leave of absence received questionnaires (N=490). The demographics of occupants of the CQB building includes older adults, pregnant or lactating women, and all are public service workers coming into regular and occasionally extended contact with air breathed by members of the public in high-risk health groups (people with alcohol/drug/crime behaviours and/or living in poverty).

Although the analysis of exposure is limited to occupants of the CQB building in order to compare similar exposures to fungi, building analyses and microbiological examination of the other six buildings did not occur as a part of this study (see Section 4.6 "Limitations" for more information).

However, occupant 'habitus' (Foster and Aston 2003) factors can also have an influence on immune status and include:

- Current smokers (n= 10)
- Previous smokers (n=23)
- Persons consuming more than 10 drinks of alcohol per week (n= 5)
- Courthouse occupants whose homes have visible signs or smell of mould (n=3)

  Two of these occupants are full-time CQB occupants and one person is an occasional Court of Queen's Bench occupant. Of the three persons reporting mould at home, their highest symptom rating on the hybridized survey was 2, 6, and 6 respectively.
- Persons who identified their home as having moisture damage or needing extra insulation (n=6). Of this subgroup, one person was a full-time Court of Queen's Bench occupant (highest symptom rating of 6), one person was a part time occupant of the Court of Queen's Bench (highest symptom rating of 2) and the remaining four were occasional CQB occupants with symptom severity ratings of 6, 6, 5 and 6 respectively). Only one occupant indicated that their home required more insulation and had moisture damage.

Courthouse occupants identified that they are concerned about coming into contact at work with the following: possibly toxic cleaning products; blood/bodily fluids (from exhibits or courthouse clients); fungi/bacteria in the court file rooms; bad smells in a courtroom on the fourth floor; illicit drugs (as court exhibits) and gasoline.

Diet and types of medication information was collected, but not with enough clarity of the question to report findings of any significance.

The overall response rate of all mailed or distributed questionnaires was 13.1%. Table 19 outlines the data regarding the distributions and receipt of questionnaires. As has been shown in Table 15 the response rate for full-time CQB occupants was 20%, while the response rate for occasional Court of Queen's Bench occupants is 5.5%. Of the sixty-seven survey packages returned (see Table 19) sixty-four surveys were valid.

Table 19: Response Rate

<table>
<tr><td colspan="9">Total surveys sent September 1, 2002 N = 490</td><td>Overall Response Rate</td></tr>
<tr><td rowspan="2">Building</td><td colspan="3">CQB Building
CQB♦</td><td>Previous COA bldg</td><td colspan="4">Other Primary court Locations</td><td rowspan="5">13.1%</td></tr>
<tr><td>Occupancy</td><td colspan="2">Judges & staff</td><td>AUPE members</td><td>Judges & staff</td><td colspan="4">In other parts of Calgary or Alberta</td></tr>
<tr><td># Surveys sent</td><td colspan="2">55</td><td>253</td><td>31</td><td colspan="4">151</td></tr>
<tr><td>Not surveyed</td><td colspan="3">4 Managerial staff</td><td colspan="5">N/A</td></tr>
<tr><td>Total current # occupants</td><td colspan="2">38</td><td>138</td><td>N/A</td><td colspan="4">N/A</td></tr>
<tr><td colspan="10">All Questionnaires received by October 8, 2002</td></tr>
<tr><td rowspan="3">Respondents' locations</td><td colspan="3">CQB Building Respondents</td><td colspan="6">Internal Control - occasional CQB respondents and their "usual" location if not the CQB building</td></tr>
<tr><td colspan="3" rowspan="2">CQB</td><td colspan="5">Building name coded for small populations</td><td rowspan="2">Unknown Returned blank - not included in response rate above</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td></tr>
<tr><td>Total respondents = 67</td><td colspan="3">43</td><td>4</td><td>7</td><td>3</td><td>3</td><td>3</td><td>1</td><td>3</td></tr>
</table>

♦Based on Respondents' estimates and (2003) website information
http://www.albertacourts.ab.ca/calendar/qbjustices.htm

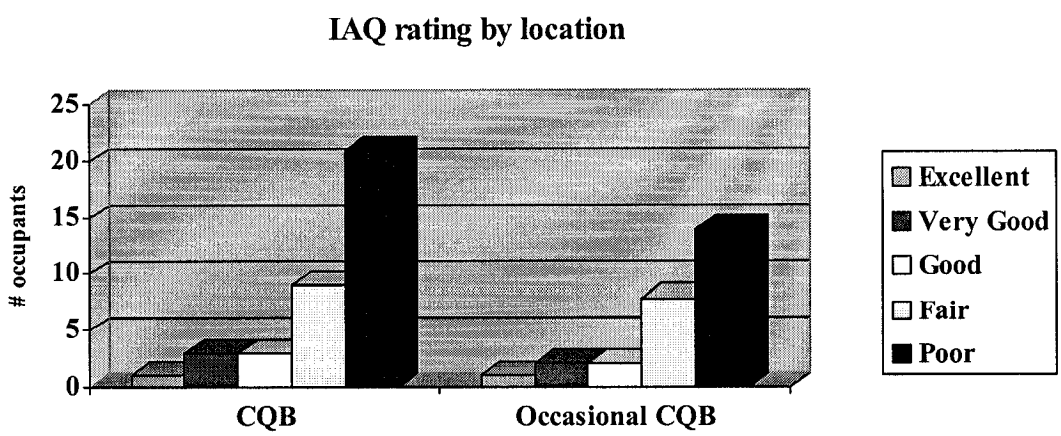
4.4 Timing of Symptoms

Two important factors regarding timing of the respondents' symptoms suggest that a building-related indoor air quality problem exists at the Court of Queen's Bench building. The times that occupants' symptoms' emerge (with the exception of one person) were within two hours of arrival at work, and within a half hour of arriving at work for nearly half (n=15/33) of CQB respondents answering this question.

Nearly half of all respondents to this survey indicate that their symptoms are work related, that is, occurring Monday to Friday, with more severe symptoms occurring all the time. Less severe symptoms (those rated 2-somewhat troubling or 3-moderately troubling) appear to be more difficult for respondents to affix a time of onset (no specific time) (Appendix 7.11).

Chart 6 compares IAQ ratings of CQB building with occasional CQB occupants' ratings of their respective buildings.

Chart 6: Respondents ratings of IAQ by location



This is a general presentation of perception of indoor air quality for individuals at work, and by itself, does not present enough specific information regarding attribution of timing of symptoms. Charts 7 and 8 (below) summarize the length of employment with respect to occupants' perception of indoor air quality for the sample and control locations. Very few "veteran" occupants rate the indoor air quality of their building as very good or excellent, regardless of their primary location. Almost equal numbers of newly hired and senior employees in the CQB building rate the indoor air quality as either fair or poor. This would seem to indicate that indoor air quality perception is independent of length of employment.

Chart 7: CQB full-time respondents' ratings of IAQ by years worked in CQB building

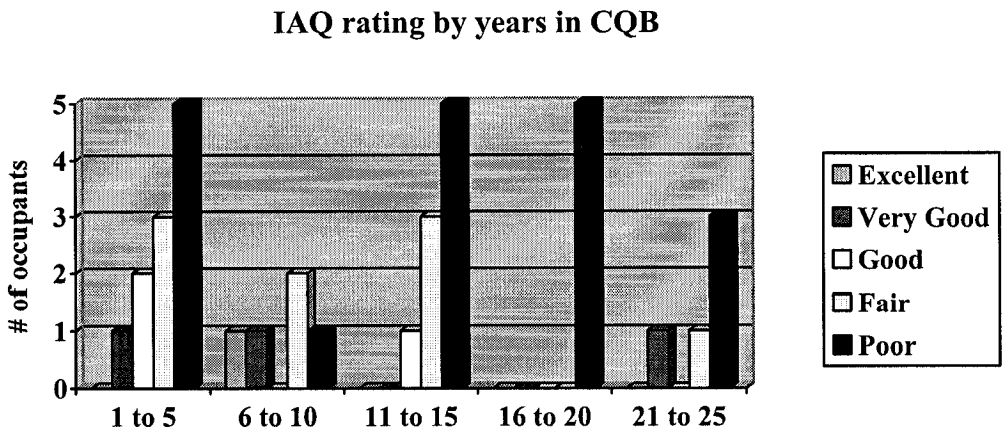
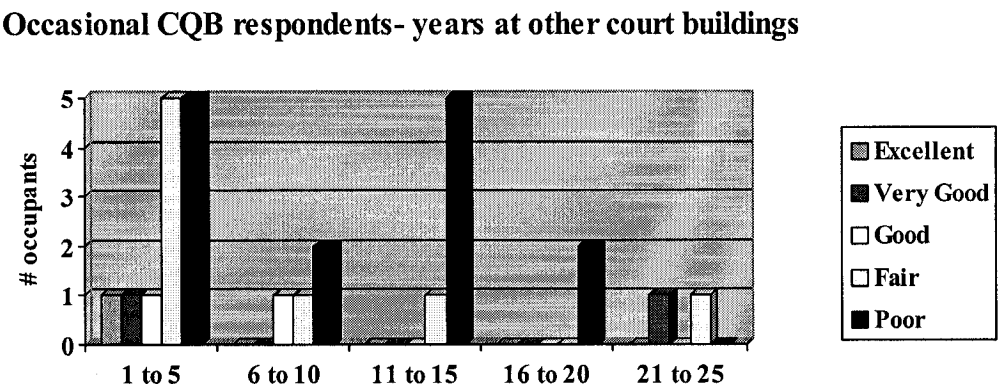


Chart 8: Occasional CQB Respondents rating of IAQ by years worked



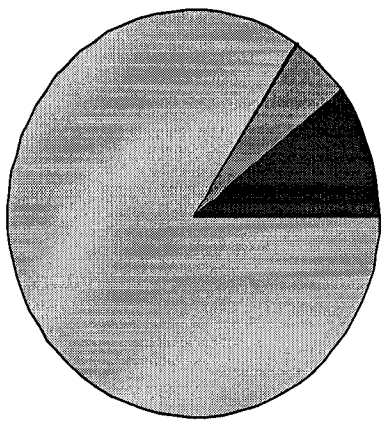
Overall, nearly 37% (n = 23) of respondents could attribute a timeframe when their rating was at least 2.0 ("somewhat" troubling) as occurring during the workweek, Monday to Friday. This is reflective of exposure relating to the building. 37% is more than reflective of the numbers of occupants who would be expected to be hypersusceptible, or even

susceptible to indoor air pollutants such as fungi. Occupants, who reported more severe symptoms, reported them as occurring all the time, not just Monday to Friday (See Appendix 7.11).

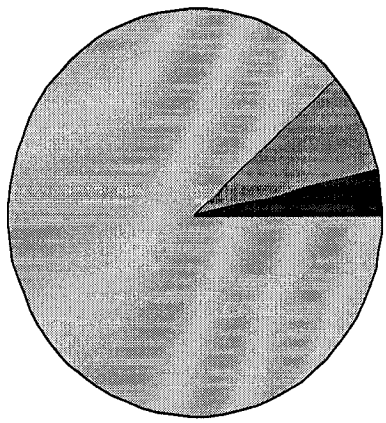
The analysis of the onset of symptoms for CQB occupants who work either above or below the Plus 15 level does not reveal significant patterns regarding a specific location, or the day of the week when symptoms emerge (Appendix 7.5). When compared with the control group however, slight differences emerge with patterns of onset as seen in Charts 9 and 10 below. These summaries reflect raw symptom numbers but do not include adjustments for response rates.

Respondents above Plus 15 level appear to be reporting slightly fewer morning onset symptoms, and slightly more afternoon onset symptoms than do the respondents below Plus 15 level. It is difficult to make any strong connections of the timing as relating exclusively to fungi, based on these data.

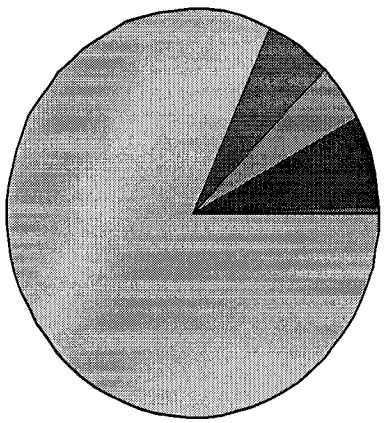
Chart 9: Symptomatic days by location



Above Plus 15 Level CQB Respondents



Below Plus 15 Level CQB Respondents



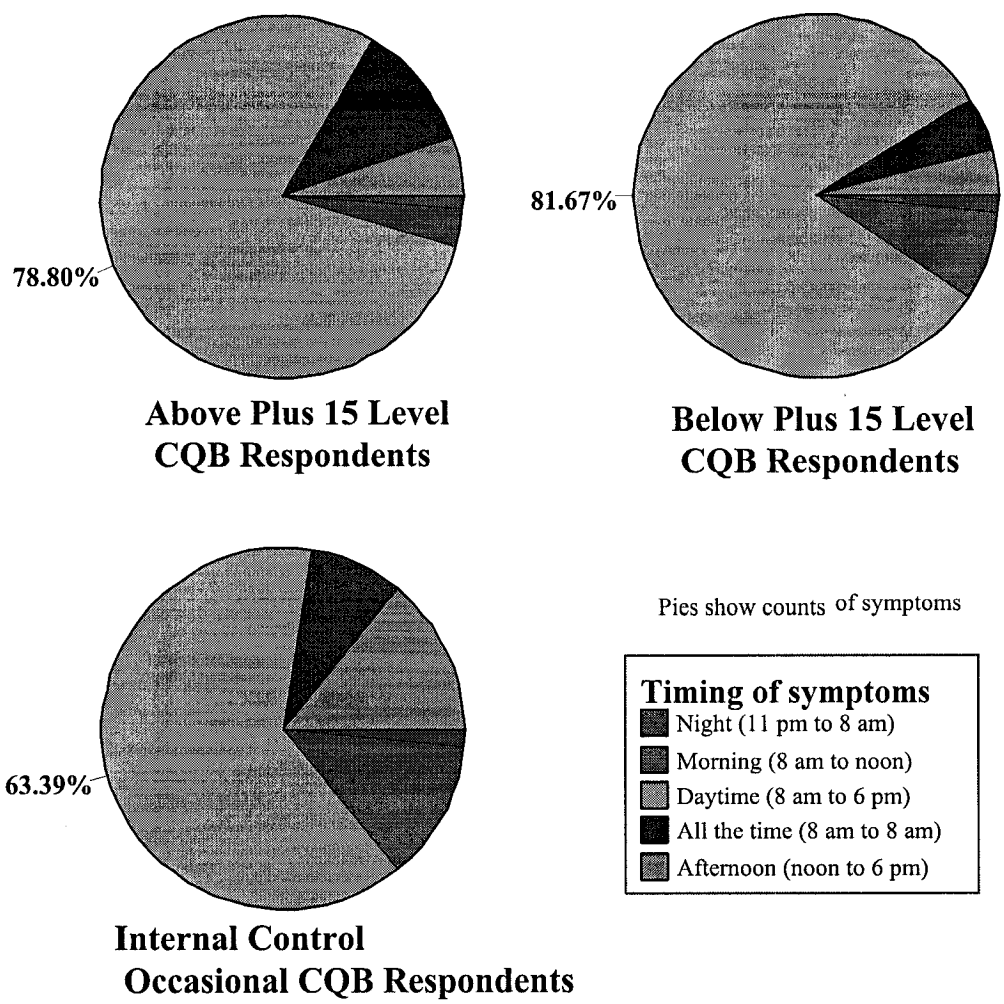
Internal Control Occasional CQB Respondents

Pies show counts

Symptomatic days

- Monday to Friday
- Weekend
- Days off / Vacation
- Every day, excluding vacation days off
- Every day
- No specific time

Chart 10: Timing of symptom onset by location



4.5 Courthouse respondents' symptom clusters

The questionnaires were coded upon receipt using a form developed with Microsoft Access (version 2000 9.0.3821 SR-1) and analyzed using SPSS for Windows (version 11.5.0 September 6 2002 updated with version 12.0 November 2003) and Microsoft Excel (version 2000) to extract descriptive and quantitative information about the results.

Coding assigned the lowest floor as the primary location if no clear primary location emerged in the questionnaire. Where occupants did not indicate a response to every question regarding their health in sections on the symptom/time matrix, then the response was coded "0" (Not at all troubled).

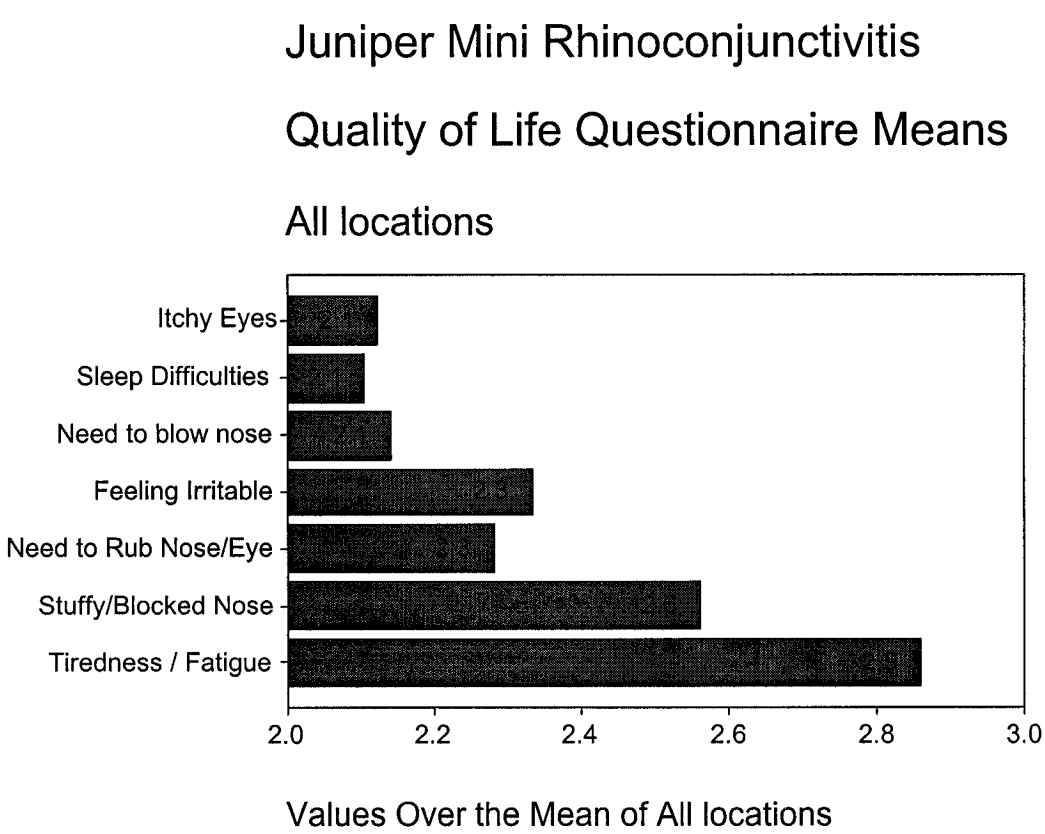
Three occasional Court of Queen's Bench occupants completed portions of the Juniper MiniRQLQ, but not the subsequent symptom matrix. One occupant (of unknown location) did not complete either the Juniper MiniRQLQ, or the symptom matrix, but did complete other sections of the survey.

Sixty-three surveys are included in the overall data analysis (of which 43 were from the CQB building) with 60 of those surveys including data regarding the relationship of symptoms to locations within the CQB building.

4.5.1 MiniRQLQ

From the Juniper MiniRQLQ, fatigue and stuffy noses are most prevalent among all courthouse workers surveyed, as seen in Chart 11 below:

Chart 11: Quality of Life MiniRQLQ



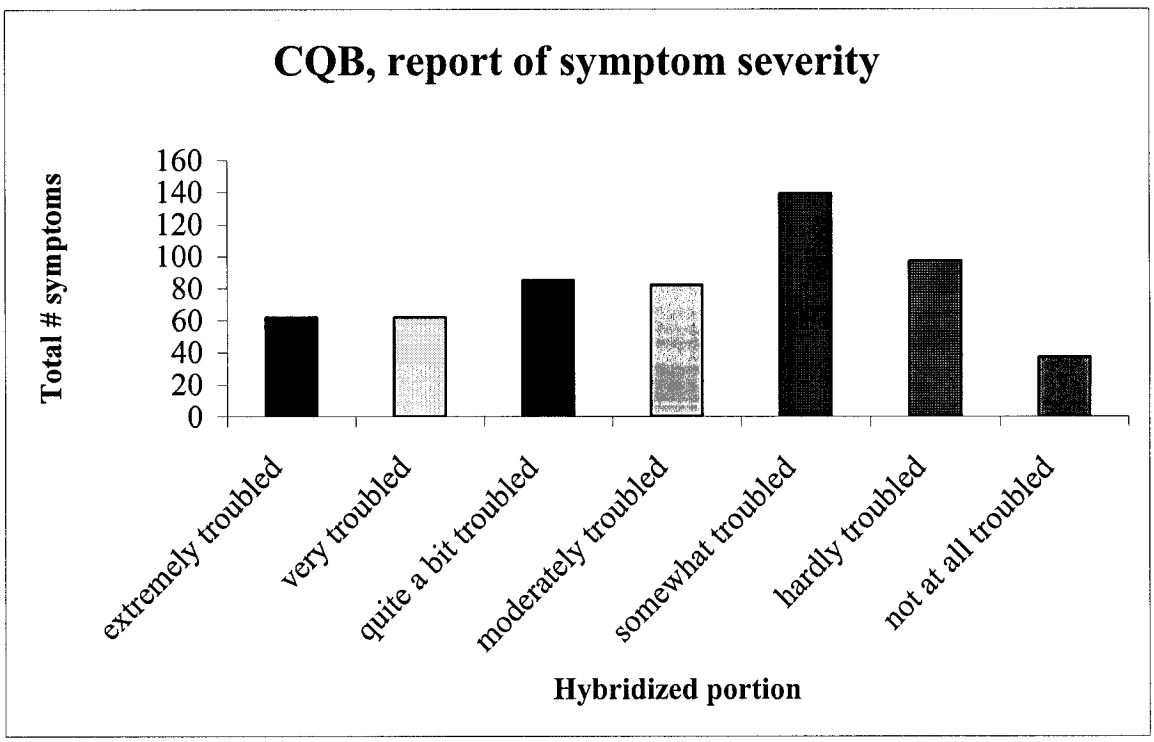
The mean of n= 63 respondents was 2.9 over all locations (Scale of two = somewhat troubled, and 3= moderately troubled by nose/eye symptoms). The high responses to "feeling irritable" and "needing to rub nose and eyes" may be an early signal of occupants' exposures to indoor air contaminants. Since the first administration of the instrument provides baseline information, this portion of the survey can only reflect changes for occupants if administered a second time. The validity of the results cannot be predicted on these results alone, since a post test was not planned. Summaries of individual items within the questionnaire across all locations is located in Appendix 7.14 and the summaries of mean MiniRQLQ scores by CQB occupants vs. occasional CQB occupants can be found in Appendix 7.13.

4.5.2 Hybridized survey

A Microsoft Access 2000 database was the tool used for the design of data coding and input. Microsoft Excel 2000 and SPSS - Version 12.0 are the tools used to extract the data and present the data. Recoding of locations was done where necessary, using the lowest level in the building as the primary building location. Location coding relied on supplementary comments or diagrams that respondents added to their survey, where necessary. Appendices 7.7 to 7.15 inclusive contain the data used to present these findings.

Chart 12 below provides a beginning summary of the overall pattern of severity for all symptoms reported. As can be seen, the ranking of "2" somewhat troubled" seemed to be a point of differentiation for respondents, where increased perception of health effects are reported more frequently.

Chart 12: CQB-Hybridized summary



The data was recoded across each domain and compared across locations, as follows:

Digestive-CQB/Hardly		Digestive-Location X CQB/Hardly
Abdominal Pain		1
Diarrhea		
Vomiting		1
Nausea		1
Total	**24**	**3**
n=43		n=4

- Possible of four symptoms under "digestive-hardly",
- Four occupants responded regarding Location X.

Therefore, sixteen potential scores are possible for this cell.

Actual score totals = 3.

$$\frac{3}{16} = \frac{X}{100}$$

Percent of respondents for this domain therefore is = 18.75%

See highlighted cell for that value in Appendix 7.8. The converted data from respondents is contained in Appendix 7.7.

The hybridized data was then averaged by symptom cluster (respiratory, rhinoconjunctivitis, vascular, endocrine/immune, dermal and digestive) and specific location/floor, then grouped by two locations as follows:

1. Data averaged from respondents who work only occasionally at the Court of Queen's Bench building (six other identified primary court operations locations),
2. Data averaged from all respondents of CQB building,
3. Data analyzed, then grouped across two sections of the CQB building:
    a) Below Plus 15 Level –This is an original section of the building (built 1962),
    b) At or above Plus 15 level - This includes floors two through five of the original section of the building (built 1962) and the top floors (6-9) of the "newer" section of the building (built 1974-6).

Appendix 7.10 contains the charts that visually summarize the data from the hybridized survey, by location. The six symptom domains include separate charts summarizing the internal control group compared with the CQB respondents. All respondents, not just full time respondents are included. Charts of the CQB responses by building location (above or below Plus 15 level) then summarize the symptom domains.

4.5.2.1 Rhinoconjunctivitis and Respiratory Symptoms

Table 20

Rhinoconjunctivitis Symptoms
Eye irritation
Watering eyes
Dry throat
Sore throat
Runny nose
Sinus congestion
Nasal irritation
Stuffy feeling
Dry eyes

Severe rhinoconjunctivitis symptoms were the most prevalent among full-time respondents of the CQB and reported with less severity by the internal control group respondents. Since the questionnaire included the cover page of the Juniper MiniRQLQ that clearly stated "Rhinoconjunctivitis" in large letters, (See Appendix 7.2) this may have been a factor affecting possible interpretation of the responses. Eight of the 180 CQB respondents report chronic allergic conditions compared with eight of the 310 control respondents (see Table 14). 13% of the occasional CQB respondents, indicated a mean score of "2" ("Somewhat troubled") or less.

Table 21 Rhinoconjunctivitis by Location

Rhino-conjunctivitis / Exposure	Symptom Cluster Severity			
Occasional Court of Queen's Bench building occupants	4-6	4-6	2.00-3.99	2.00-3.99
	n/a	0	n/a	87%
Court of Queen's Bench building occupants	26%	46%	26%	6%
	Above Plus 15 Level	Below Plus 15 Level	Above Plus 15 Level	Below Plus 15 Level

Respiratory symptoms are reported less overall than rhinoconjunctivitis symptoms, but appear to be more skewed in severity in the upper section of the building. Fifty percent of respondents occupying the upper floors of the Court of Queen's Bench building are "Quite a bit" to "Extremely troubled" by respiratory symptoms in that location while 22% of the respondents "Below +15" report these more severe symptoms. From Table 14, eight CQB respondents vs. three control respondents report asthma or respiratory illness such as bronchitis.

Table 22

Respiratory symptoms
Cough
Cold or flu like symptoms
Wheezing
Shortness of breath
Respiratory tract irritation
Asthma medication less effective
Cough at night
Hoarseness
Tightness in Chest♦

Table 23: Respiratory by Location

Respiratory / Exposure	Symptom Cluster Severity			
Occasional Court of Queen's Bench building occupants	4-6	4-6	2.00-3.99	2.00-3.99
	n/a	0	n/a	50%
Court of Queen's Bench building occupants	50%	18%	13%	15%
	Above Plus 15 Level	Below Plus 15 Level	Above Plus 15 Level	Below Plus 15 Level

♦ Occupants wrote in "other"

4.5.2.2 Dermal Symptoms

Similar to Rhinoconjunctivitis symptoms, dermal symptoms were slightly higher in severity in the older section of the building. 44% of respondents below Plus 15 level are "Quite a bit" to "extremely troubled" by their skin symptoms. One occupant who works in the older section of the building noted that other occupants "came up to ask about [the rash on occupants'] hands and compare"[symptoms]. Respondents below Plus 15 level reported more chronic dermal symptoms than other survey respondents did. This, in combination with the respiratory and rhinoconjunctivitis symptoms provides more support of an association with occupant exposures to fungi.

Table 24

Dermal Symptoms
Chapped lips
Skin rashes or sores
Itchy skin
Dry, flaking skin

Table 25: Dermal by Location

Dermal / Exposure	Symptom Cluster Severity			
Occasional Court of Queen's Bench building occupants	4-6	4-6	2.00-3.99	2.00-3.99
	n/a	0	n/a	100%
Court of Queen's Bench building occupants	38%	44%	25%	6%
	Above Plus 15 Level	Below Plus 15 Level	Above Plus 15 Level	Below Plus 15 Level

4.5.2.3 Vascular Symptoms

Table 26

Vascular symptoms
Headaches
Dizziness
Bleeding Nose
Migraine, Hypertension♦

Headache was the most common symptom that courthouse occupants reported within this symptom cluster. These responses were more frequent among respondents in the upper part of the CQB building. Six of the CQB respondents had blood pressure disorders (Table 14), with three of those respondents located above Plus 15 level and three below Plus 15 Level.

Table 27: Vascular by Location

Vascular / Exposure	Symptom Cluster Severity			
Occasional Court of Queen's Bench building occupants	4-6	4-6	2.00-3.99	2.00-3.99
	n/a	33%	n/a	0
Court of Queen's Bench building occupants	25%	8%	25%	25%
	Above Plus 15 Level	Below Plus 15 Level	Above Plus 15 Level	Below Plus 15 Level

♦ Occupants wrote in "other"

4.5.2.4 Endocrine/Immune Symptoms

Respondents from the upper section of the building report greater severity of fatigue, irritability and sleepiness, tiredness. Respondents below Plus 15 level experienced effects as "Not at troubling" to "Somewhat troubling" (n= 61%) but only 22 % of those above Plus 15 level were "untroubled" by symptoms in this domain. The MiniRQLQ incorporates fatigue and sleepiness/tiredness as coexisting elements of rhinoconjunctivitis. The results of these fatigue question are similar in dominance to the findings of Krushinsky's health interviews (Krushinsky 2002). Krushinsky interviewed twenty CQB building occupants and found that 70% of participants reported fatigue as a problem, while 25 % of this sample reported difficulty concentrating, and 45% reported sleeping difficulties.

Table 28

Endocrine/Immune Symptoms
Sleepiness, tiredness
Fatigue
Weight loss
Difficulty sleeping at night
Menstrual/menopausal problems
Irritability
Inability to concentrate
Joint pain/Swelling
Forgetting
Thyroid

Table 29: Endocrine/Immune by Location

Endocrine / Immune / Exposure	Symptom Cluster Severity			
Occasional Court of Queen's Bench building occupants	4-6	4-6	2.00-3.99	2.00-3.99
	n/a	22%	n/a	44%
Court of Queen's Bench building occupants	78%	33%	0	6%
	Above Plus 15 Level	Below Plus 15 Level	Above Plus 15 Level	Below Plus 15 Level

4.5.2.5 Digestive Symptoms

Digestive symptoms are not significant issues for an average of 96% to 100% of occupants (occasional or regular) excepting those persons working below Plus 15 level in the CQB building. That zone contained 25% of occupants who were "Somewhat", "Moderately" or "Extremely troubled" by a digestive symptom listed below:

Table 30

Digestive Symptoms
Nausea
Abdominal pain
Diarrhea
Vomiting

Table 31: Digestive by Location

Digestive / Exposure	Symptom Cluster Severity			
Occasional Court of Queen's Bench building occupants	4-6	4-6	2.00-3.99	2.00-3.99
	n/a	0	n/a	0
Court of Queen's Bench building occupants	0	6%	0	19%
	Above Plus 15 Level	Below Plus 15 Level	Above Plus 15 Level	Below Plus 15 Level

4.6 Limitations of This Study

Several limitations to this study arise from the methods and results.

Firstly, this study focuses disproportionately on the full-time Court of Queen's Bench occupants due to weaknesses in the internal control group design. The control population is an internal control, that is, courthouse occupants, who may occasionally frequent the Court of Queen's Bench building, but who do not have that building as their primary work location, as identified by the occupant. Since there were no healthy respondents of other buildings agreeing to an interview, questions remain regarding the applicability of these results to the occupants of the other six buildings that were not the subject of this study. In addition, access to other buildings to assess any building-related factors of significance was not available.

Secondly, the value of a hermeneutic approach is the utilization of numerous points of view to examine this complex problem. A hermeneutic approach as applied to the study of indoor air for these courthouse occupants has still "missed" several points of view including those of building maintenance staff, building managers, indoor air quality investigators and the internal control population with and without symptoms. Additionally, this researcher had limited access to the building. Occupants' self-reports and their perceptions of their health symptoms are only one type of measure of occupant health. Other "missed" points of view that could increase or decrease an assessment of risk would

be formalized, mandatory asthma screening or measurements of occupants' respiratory functioning for example. Utilization of a hermeneutic approach was critical to counterbalance this limitation.

Thirdly, whether the addition of the upper four floors to the courthouse in 1976 is truly a variable or not, cannot be determined without a full examination of the building envelope. The data do suggest a slight difference, when the responses from retired, ill or part time employees are included in the analysis. It is likely that the movement patterns of both air contaminants and building occupants' work patterns throughout the building confound each other in answering this question from this data alone. Again, in the absence of a full examination of the building envelope identifying just one area of the building as either hazardous or healthy would be imprudent.

Fourthly, the contaminant of interest in this study was fungi. The results however suggest that health effects resulting from other indoor air contaminants such as those commonly linked to inadequate or improper ventilation may be of further interest. Fungi are a relatively narrow focus when examining indoor air quality contaminants. Others include volatile organic compounds (VOC's) from building materials, other biocontaminants such as bacteria and viruses, particulate matter from indoor sources, and gases and particulate matter from outdoor or other indoor air sources. While the internal control assisted with counterbalancing this limitation, a comprehensive indoor air quality investigation would be required to definitively identify fungi as a sole source of concern.

Fifthly, this study cannot evaluate the significance of the air sampling methods; the mitigation steps, the "amount" of fungi found, nor makes recommendations for individuals' health based on this data alone. It is possible that this research did not stratify the results of the questionnaire sufficiently in order to draw conclusions about indoor air quality's effects on hypersusceptible occupants. For example, although three full-time CQB occupants reported mould, moisture or insufficient insulation in their homes, those respondents stayed in the sample for broader analysis. Since detailed exposure histories are not generally in the purview of building managers' expertise, other habitus variables such as smoking history and home environmental conditions would be better analyzed by survey tools such as described by Miller or Marshall (Miller 1997; Marshall 2000).

Lastly, risk assessment has two components in indoor air quality investigations -to identify any large indicators of immediate illnesses that may be occurring, and to assess whether the levels of discomfort may be reaching levels of broader risk of serious illness to occupants. Several occupants commented during interviews that they appreciated risk communication that was transparent, clear and factual. How can occupant experts contribute so that building owner and occupant priorities align (Tesh 1999)? Environment, health or safety committees with formalised minutes and written procedures assist in this regard, but generally flounder in the absence of a stable champion culture built from within an organization (Kirkland 2002). An ongoing indoor air quality management system that could be integrated with existing environmental management systems (Beaulieu 1998) would be beneficial in preventing poor indoor air quality, and assist with the ongoing

management of occupant health concerns or indoor air quality complaints. This study did not focus on risk management, but the principles of risk identification with clear, data driven risk communication strategies are a significant part of indoor air quality best practices.

5.0 Chapter Five: Summary

5.1 Discussion

Asking about sensory discomfort is critical to the collection of adequate indoor air quality data to determine risks to occupants exposed to bioaerosols such as fungi. Indoor air quality is primarily a construct of comfort (Cain 2002) but a construct with significant public health implications and effects on occupational productivity. This study utilized the analysis of six symptom matrices, drawn from public health and indoor air quality research to examine the experience of courthouse occupants' health using a hermeneutic examination. Information from a variety of sources assisted in understanding the similarities and differences of occupants' health issues working regularly or occasionally at the CQB building.

More occupants with health symptoms and chronic health conditions responded than would be expected if the surveys returned were drawn at random from all occupants. Since the survey self-selected respondents due to the nature of the design, the use of the internal control group and timing factors is critical to the analysis. Increased respiratory effects of CQB occupants may be due to exposure to fungi indoors, and the irritative/allergic effects that fungi can induce. There was insufficient evidence to comment about possible exposures to mycotoxins from the results of this study. Of the 36 full-time CQB occupants responding, ten people reported at least one chronic respiratory health condition.

Using a targeted, hermeneutic approach was also critical in capturing the concerns of those susceptible and hypersusceptible persons who are most at risk from indoor air pollutants such as fungi. Building assessments by external experts, or voluntary health interviews alone cannot capture the complexity of human diversity, experiences and exposures within their work environments. Each component of those investigations however is significant, but more as a set of pixels, that contributes to an understanding of an entire image.

The occupant interviews provided additional information; namely that the timing of some symptoms occurs at 8:00 a.m. and noon, and comments were received about car exhaust odours being drawn in from the parkade. This information was not as evident from the questionnaire data alone. An indoor air quality investigation that queries only one contaminant and its effects is unwise. It is reassuring that mitigation measures at the CQB building did start, in response to identified health concerns of many occupants.

This survey described the respondents' perception of risk to their quality of life and their understanding and reactions to the reporting of findings of fungi in their workplace. Implementation of a hermeneutic method for susceptible and hypersusceptible groups of office workers can be recommended as a way to capture both qualitative and quantitative data for this population. These overlapping themes acknowledge the inequities and real relationships in which people co-exist. A hermeneutic approach allows for incorporation of different horizons of opinion, and can more accurately reflect the imperfect structures that people actually live within - families, communities, workplaces, and governments.

5.2 Conclusions

Indoor air quality investigation at the CQB building identified fungi as a contaminant of interest and concern. Exposure to occupants would not be limited to the identified basement areas where fungi were speciated from air samples, but would also include other building locations due to migration of spores through ventilation, book and file materials transport or from other amplification sources that may have been present during 2001-2002. Full-time CQB occupants would have *similar* exposures regardless of their primary work location within the building.

Overall, courthouse respondents from all locations rating their symptoms as "Somewhat (or more) troubling" (2+) responded to the entire questionnaire in greater detail, rated air quality and ventilation less positively, and were experiencing more than one symptom, Monday to Friday. This is evidence that the survey reflects primarily those occupants who are feeling sick.

Due to the self-selective nature of this research, it is likely that all of the hypersusceptible courthouse occupants who occupy the Court of Queen's Bench building have responded, as well as many of the susceptible occupants and likely all hypersusceptible occupants of the six other court buildings. This study found that the relative risk of rhinoconjunctivitis is 2.12 times greater for full-time respondents from the Court of Queen's Bench than for occasional occupants of the building. The relative risk of sick building symptoms from the

hybridized survey responses was 3.05 times greater for CQB respondents than for occasional occupants of the building. Fatigue, respiratory illness, rhinoconjunctivitis and headache were predominant symptoms / groupings for CQB respondents. Higher respiratory, rhinoconjunctivitis and dermal symptoms were reported by CQB respondents as compared with the internal control group. Fungi's known allergic and irritative effects on the respiratory system could provoke such symptoms for occupants exposed chronically to this bioaerosol indoors.

However, other symptom patterns also appear to be present. Based on the timing data, the indoor air is likely contributing to occupants' distress but the timing of respondents' symptoms was not clear enough to determine if fungi alone, or in combination with other contaminants or factors is causing this.

These time indicators could also be suggestive that allergic or irritative mechanisms alone are occurring, rather than immediate toxic effects from the inhalation of fungi. Respondents had difficulty affixing a time of onset for symptoms they perceived as only "somewhat" or "moderately" troubling. It would follow that we have trouble remembering what does not bother us.

Proactive IAQ management and design practices that incorporate the needs of susceptible and hypersusceptible office workers would likely prevent health-related complaints. Inclusion of occupant participation through surveys is essential and contributes critical

information to guide integrated indoor air quality management systems. A hermeneutic approach assisted in the application of evidence-based research from many points of view in order to examine the risks from fungi indoors and the experiences of susceptible and hypersusceptible people. Poor indoor air quality most adversely affects this large (30%) group of office workers.

A hermeneutic indoor air quality survey method can be recommended to help occupants and building owners or managers understand health risks when our understanding of levels of exposure to fungi are unclear or while direct exposure analysis is unavailable.

5.3 Recommendations for Further Study

Inclusion of occupant participation through surveys and interviews is critical in guiding integrated indoor air quality assessments. Seeking regular discomfort information using IAQ complaint forms, interviews and survey screening methods from wellness and public health perspectives is recommended for occupants of courthouses, and would be beneficial for occupants of any office building. Occupants are able to provide information critical to their own, and future occupants' health and quality of life. Application of a hermeneutic analysis to examine the indoor air quality of public office buildings requires a champion and further study is required to effectively operationalize this in light of competing priorities. Alberta's *Clean Air Strategic Alliance* (CASA 2004), *Climate Change Central* (C3 2004) and the Canadian *Healthy Indoors Partnership* (Robinson 2003) are effective partnering models to consider.

The MiniRQLQ was a sensitive instrument that demonstrated more value for individual building locations, rather than for grouped overall means across buildings, where it lost some sensitivity in identifying trends. Confirmation of this could be administration of the MiniRQLQ paired with another similar health-related quality of life instrument designed and validated specifically for indoor air quality purposes. For determination of exposures to fungi, the MiniRQLQ deserves consideration as a paired instrument with a brief

occupant complaint form (possibly within a computerized IAQ management system) or as an adjunct to a hybridized survey when no IAQ management system exists.

Further deconstruction of the components and elements of sick building syndrome is required. This study presented only one researchers "re-clustering" of those elements through utilization of a hermeneutic approach. Opportunity exists to increase our understanding of "sick building syndrome" symptoms, and to proactively protect the health of courthouse and other office workers. Medically familiar (i.e., genetically caused) autoimmune diseases may continue to drive the publicly funded research, however the public health benefits of continued research in areas such as toxicant induced losses of tolerance and sick building syndrome are encouraged.

Further use of a hermeneutic approach is highly recommended as a way of focussing scarce and valuable research efforts on the needs of those people most directly affected by widespread public health issues such as indoor air quality.

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7.0 Appendices

Appendix 7.1: Microbiology results from the CQB building, Calgary AB

Two separate sets of airborne fungi were collected and each set of samples were examined by different laboratories.

Indoors observations of portions of non-public areas on the ground floor and basement during collection of fungal samples in the file rooms of the Court of Queen's Bench building on January 24, 2002 (accompanied by an authorized occupant). Photographs of the interior of the CQB building in this document were taken at that time. The microbiological laboratory report from samples taken that day is attached.

Previously another sampling team had conducted fungal sampling on September 5 and 6, 2001. The report of that team's laboratory findings follows.

Bio-Chem Consulting Services Ltd.

CERTIFICATE OF ANALYSIS
Environmental Microbiology Report

Client / Company :
Client Job Number :
B.C. Project No. :
Report No. :

Date Sampled: 24-Jan-02
Date Received: 25-Jan-02
Report Date : 05-Mar-02

Sample Description	Fungi (cfu/m3)	Fungi (cfu/cm2)	Fungi (cfu/swab)		Approx. No. of Unique Isolates
1: FR-1	81				7
2: FR-2, Control	<6				-
3: FR-3, COA fileroom	20				2
4: FR-4, Basement exhibit room storage	10				2
5: FR-5, Exhibit room vault	60				3
6: FR-6, QB fileroom	75				5
7: FR-7, Surrogate fileroom	140				11
8: FR-8, Swab, crack in floor	-		10		1
9: FR-9/10, File moving section/DA F.R.	300				8
10: FR-11, F.R. near exhibit vault	60				7
11: FR-12, DA fileroom	10				1
12: FR-13, DA Fileroom, sponge		<1			-
13: FR-14, Tunnel in boxes	86				7
14: FR-15, Tunnel ambient	62				5
15: FR-16, Outdoors control	200				10

Fungal Preliminary Identification			
Isolate	Probable Genus	Isolate	Probable Genus
1A	Yeast	9H	*
1B	*	9I	Yeast
1C	*	10A	*Scytalidium*
1D	*Cladosporium*	10B	*
1E	Yeast	10C	*Penicillium*
1F	Yeast	10D	*
1G	*Scytalidium*	10E	*Penicillium*
3A	*Scytalidium*	10F	*Cladosporium*
3B	*Aspergillus*	11A	*Stachybotrys*
4A	*	13A	*Stachybotrys*
4B	*	13B	Yeast
5A	*Sepedonium*	13C	*Cladosporium*
5B	*Aspergillus*	13D	*Penicillium*
6A	*Penicillium*	13E	*Penicillium*
6B	*	13F	*Cladosporium*
6C	*Stachybotrys*	13G	*
6D	*Penicillium*	14A	*Scytalidium*
6E	*Cladosporium*	14B	*Cladosporium*
7A	*	14C	*Sporothrix*
7B	*	14D	*Chrysosporium/Sporotrichum*
7C	*	14E	Yeast
7D	*	14F	*Cladosporium*
7E	*	15A	*
7F	*Penicillium*	15B	*Cladosporium*
7G	*Cladosporium*	15C	*Aspergillus*
7H	*Penicillium*	15D	*
8A	*Cladosporium*	15E	*
9A	*Stachybotrys*	15F	*
9B	*Stachybotrys*	15G	*
9C	*Ulocladium*	15H	*
9D	*Penicillium*	15I	Yeast
9E	*Penicillium*	15J	*
9F	*		
9G	*		

* Requires slide culturing and/or subculture onto alternate media

Fungal Identification		
Isolate	Identity	Comments
3B	*Aspergillus versicolor*	This species is known to elicit Type III (delayed) allergenic responses, and is also a known producer of mycotoxins (potentially toxigenic).
5B	*Aspergillus versicolor*	See 3B
6A	*Pen. aurantiogriseum*	This species is a known producer of mycotoxins and should be considered potentially toxigenic.
6C	*Stachybotrys chartarum*	Known to cause Type I (immediate) allergic responses, and is known to be potentially toxigenic (known to produce mycotoxins). The propensity of an isolate to produce mycotoxins indoors, however, is unknown.
6D	*Pen. aurantiogriseum*	See 6A
7F	*Pen. aurantiogriseum*	See 6A
7H	*Pen. aurantiogriseum*	See 6A
9A	*Stachybotrys chartarum*	See 6C
9B	*Stachybotrys chartarum*	See 6C
9D	*Pen. aurantiogriseum*	See 6A
9E	*Pen. aurantiogriseum*	See 6A
10C	*Penicillium solitum*	No health-related issues observed within available literature.
10E	*Penicillium sclerotiorum*	No health-related issues observed within available literature.
11A	*Stachybotrys chartarum*	See 6C
13A	*Stachybotrys chartarum*	See 6C
13D	*Pen. aurantiogriseum*	See 6A
13E	*Pen. aurantiogriseum*	See 6A
15C	*Eurotium amstelodami*	This species is a known producer of mycotoxins and should be considered potentially toxigenic.

Paracel Laboratories Ltd.
300-2319 St. Laurent Blvd., Ottawa, Ontario Canada K1G 4K6
Tel: (613) 731-9577
Fax: (613) 731-906

To:

Calgary, AB

Attn:

Tel: 403-
Fax:403-

Project: AB-Infrastructure-Court of Q.B.
Sample Date: Sept 5 & 6, 2001
Report Date: Sept. 17, 2001
Paracel Ref No: W5233

*calculation based on : 150L sampling volume

Sample I.D.	Total Cts/m3	Microscopic Identification	Background Debris	*Cts/m3	% of Total	Cts on slide
Air-O-Cell:						
1 Building Exterior-W side	601	Cladosporium spores	Low	221	37	7
		Ascospores		127	21	4
		Basidiospores		127	21	4
		Aspergillus/Penicillium spores		32	5	1
		Epicoccum spores		32	5	1
		unknown		32	5	1
		yeast		32	5	1
2 Chambers	190	Ascospores	Moderate	158	83	5
		pigmented mycelial fragments		32	17	1
3 Ground Floor- Judges Private	32	Ascospores	Moderate	32	100	1
4 9th Fl- Justice Assistants Office	63	Aspergillus/Penicillium spores	Moderate	32	50	1
		Cladosporium spores		32	50	1
5 Court Rm 504	ND		Moderate	ND	ND	ND
6 Court Rm 605	ND		Low	ND	ND	ND
7 Chambers	63	Ascospores	Moderate	63	100	2
8 Divorce Court Office	32	Cladosporium spores	High	32	100	1
9 Civil Clerks Office	32	Cladosporium spores	High	32	14	1
10 File storage rm	63	Cladosporium spores	Moderate	32	50	1
		Stachybotrys (?) spores		32	50	1
11 Registrars office for court	ND		Moderate	ND	ND	ND
12 -9th	ND		Moderate	ND	ND	ND
13 Court rm 203	ND		Low	ND	ND	ND
14 Court rm 402	32	Cladosporium spores	Moderate	32	100	1
15 8th - Justice	95	Cladosporium spores	Moderate	63	67	2
		Aspergillus/Penicillium spores		32	33	1
16 Court rm 304	63	Botrytis spores	Low	32	50	1

		Cladosporium spores		32	50	1

17 7th Fl -Judge's Library	32	Aspergillus/Penicillium spores	Moderate	32	14	1
18 8th Fl.	ND		Low	ND	ND	ND
19 Court Rm 204	ND		Low	ND	ND	ND
20 Court Rm 501	ND		Moderate	ND	ND	ND
21 Roof-E side	380	Ascospores	Low	253	67	8
		Aspergillus/Penicillium spores		32	8	1
		Basidiospores		32	8	1
		Cladosporium spores		32	8	1
		Rust spores		32	8	1
22 Court Rm 404	475	Ascospores	Low	285	60	9
		Cladosporium spores		95	20	3
		Basidiospores		63	13	2
		Rust spores		32	7	1
23 7th Fl- Reference	ND		Low	ND	ND	ND
24 Exhibit Rom Storage area	32	Cladosporium spores	Low	32	100	1
25 Exhibit Rm Office	32	Cladosporium spores	Moderate	32	50	1
26 6th Fl.	ND		Moderate	ND	ND	ND

ND - no fungal isolates recovered

Background debris : rating of 'L' = occupying 10% or less of microscope field area, 'M' = 10%-30% field area, 'H' = greater than 30% of field area.

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To:

Calgary, AB

Attn:

Tel:
Fax:

Project: AB Infrastructure- Court of Q.B.
Sample Date: Sept 5 & 6, 2001
Report Date: Sept 25, 2001
Paracel Ref No: W5202

*calculation based on 4 min. (160L) sampling time.

Sample I.D.	Total CFU/m3*	Species Identification	CFU on strip
Fungi RCS:			
1 1st- Civil Clerks Office	6	Alternaria alternata	1
2 Court rm 605	ND		ND
3 Master's chamber recpt	6	Epicoccum nigrum	1
4 Court rm 501	ND		ND
5 Exhibit Room-storage area	6	Cladosporium sphaerospermum	1
6 Court rm 404	ND		ND
7 Court rm 204	ND		ND
8 Court rm 504	ND		ND
9 Court rm 304	ND		ND
10 Mr Justice	31	non-sporulating isolates-pink	2
		Alternaria alternata	1
		Ulocladium chartarum	1
		yeast	1
11 Court Rm 402	6	non-sporulating isolates-pink	1
12 Court Rm 203	ND		ND
13 Grnd fl -Judge's chambers recpt	6	non-sporulating isolates-pink	1
14 Exhibit Rm off	19	non-sporulating isolates-pink	2
		Alternaria alternata	1
15 Registrar's office	ND		ND
16 File storage Rm	6	Cladosporium sphaerospermum	1
17 Divorce Court Recpt	25	Alternaria alternata	2
		pink yeast	2
18 8th Fl- Mr Justice	19	Alternaria alternata	2
		non-sporulating isolates-pink	1
19 7th Fl- Judge's Library	ND		ND
20 Bldg Exterior- W side	125	Cladosporium sphaerospermum	8
		non-sporulating isolates-pink	5
		non-sporulating isolates-gold	3
		non-sporulating isolates-orange	3
		yeast	1
21 7th Fl- Reference	6	non-sporulating isolates-pink	1
22 8th Fl-	6	Ulocladium chartarum	1
23 Roof- E side	56	Cladosporium sphaerospermum	4
		non-sporulating isolates with clamp connections	2
		non-sporulating isolates-gold	1
		Talaromyces flavus	1
		yeast	1
24 9th Fl-	6	non-sporulating isolates-pink	1
25 9th Fl-	6	pink yeast	1
26 Mast	6	non-sporulating isolates-pink	1

Appendix 7.2: Occupant Survey

See Appendix 7.3 for the supporting documentation surrounding this questionnaire including certification of institutional ethics review, cover letters, informed consent forms, and interview guides for occupants and key informants.

MINI RHINOCONJUNCTIVITIS QUALITY OF LIFE QUESTIONNAIRE SELF-ADMINISTERED

PATIENT ID _____

DATE _____

Please complete **all** questions by circling the number that best describes how **troubled** you have been during the **last week as a result of your nose/eye symptoms.**

	Not troubled	Hardly troubled at all	Somewhat troubled	Moderately troubled	Quite a bit troubled	Very troubled	Extremely troubled
ACTIVITIES							
1. REGULAR ACTIVITIES AT HOME AND AT WORK (your occupation or tasks that you have to do regularly around your home and/or garden)	0	1	2	3	4	5	6
2. RECREATIONAL ACTIVITIES (indoor and outdoor activities with friends and family, sports, social activities, hobbies)	0	1	2	3	4	5	6
3. SLEEP (difficulties getting a good night's sleep and/or getting to sleep at night)	0	1	2	3	4	5	6
PRACTICAL PROBLEMS							
4. NEED TO RUB NOSE/ EYES	0	1	2	3	4	5	6
5. NEED TO BLOW NOSE REPEATEDLY	0	1	2	3	4	5	6

MINI RHINOCONJUNCTIVITIS
QUALITY OF LIFE QUESTIONNAIRE
SELF-ADMINISTERED

PATIENT ID _____

DATE _____

How **troubled** have you been during the ***last week*** as a result of these symptoms?

	Not troubled	Hardly troubled at all	Somewhat troubled	Moderately troubled	Quite a bit troubled	Very troubled	Extremely troubled
NOSE SYMPTOMS							
6. SNEEZING	0	1	2	3	4	5	6
7. STUFFY/BLOCKED NOSE	0	1	2	3	4	5	6
8. RUNNY NOSE	0	1	2	3	4	5	6
EYE SYMPTOMS							
9. ITCHY EYES	0	1	2	3	4	5	6
10. SORE EYES	0	1	2	3	4	5	6
11. WATERY EYES	0	1	2	3	4	5	6
OTHER SYMPTOMS							
12. TIREDNESS AND/OR FATIGUE	0	1	2	3	4	5	6
13. THIRST	0	1	2	3	4	5	6
14. FEELING IRRITABLE	0	1	2	3	4	5	6

Appendix 7.3: Supporting Documentation

- Cover letter with survey to Court of Queen's Bench, AUPE occupants
- Letter of permission to distribute surveys to Court of Queen's Bench occupants
- Letter of permission to distribute survey to former Court of Appeal, Calgary building occupants
- Informed consent form- Survey
- Informed consent form –Interview
- Informed consent form –Key informant interview
- Interview guide- Key informant
- Interview guide-Occupant
- E-mail Correspondence re permission to use MiniRQLQ
- E-mail Correspondence re permission to use "How small is PM?" diagram
- E-mail Correspondence re permission to use "Respiratory System" diagram

UNIVERSITY OF CALGARY

CONJOINT FACULTIES RESEARCH BOARD

CONSENT FORM

Dear Courthouse Occupant,

Research Project Title: **Health of Courthouse Occupants: Indoor Air Quality Baseline Survey**

Researcher: Troy Stooke
Supervisors: Professor Tang Lee

Please **return** completed surveys by **September 23, 2002.**

This consent form, which is your copy to keep, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

This project is examining how health surveys of occupants can be used in a standard way to investigate indoor air quality concerns in courthouses or other provincial government buildings. While use of instruments or laboratory identification of building problems continue to be ways of determining possible levels of exposure to contaminants for occupants, at some point those steps provide less success when human health information is also available.

This questionnaire is being offered to current and former occupants of the Court of Queen's Bench and Court of Appeal buildings in Calgary.

Your answers will be anonymous - you are not required to provide your name, unless you choose to be considered for selection for interviews.

- You may choose to complete the floor plan section or questions that identifies the work area(s) where you spend the most time in this building. Your completion of the floor plan part of the survey would then make your participation less anonymous, however, all information you provide will still remain confidential. In any situation, your name will not be used or associated with building locations.

- A possible consequence of this is that the occupants of certain areas of the building may be found to have health issues of significance, and will be identified as such. Statistical methods such as presenting grouped results will be used to protect from disclosing such identifying information for small work areas.

This survey will require about 20-30 minutes to complete. If you are chosen for a follow up interview, the interview will require about 45 to 60 minutes of your time. You will not be identified for choosing to not participate in any aspects of this study.

UNIVERSITY OF CALGARY

CONJOINT FACULTIES RESEARCH ETHICS BOARD

CONSENT FORM / INTERVIEW

Research Project Title: **Health of Courthouse Occupants: Indoor Air Quality Baseline Survey**

Researcher: Troy Stooke
Supervisor: Professor Tang Lee

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

This project is examining how health surveys of occupants can be used as a standard tool for the investigation of indoor air quality concerns in courthouses or other provincial government buildings. While use of instruments or laboratory identification of building problems continue to be ways of determining possible levels of exposure, at some point those steps provide less success when human health information is also available. A questionnaire was offered to all occupants of the Court of Queen's Bench and former occupants of the Court of Appeal buildings in Calgary. You indicated on that questionnaire your willingness to be considered for an interview.

From the individuals who returned the survey, a sample of those experiencing symptoms, and those individuals who identify themselves as symptom-free have been selected for interviews. You are free to decline to participate at any time. If you choose to withdraw, you are free to withdraw any written information you have provided up until this time as well. There are no risks to participating in this study either by completing the questionnaire or by participating in a follow up interview. This interview will require about 45 to 60 minutes of your time. An audio tape recording of this interview will be made, with your permission, simply for the researcher's assistance in recalling information that you provide. You will not be identified if you choose to not participate in any aspects of this study.

Possible consequences of this interview are that there may be increased attention on the state of indoor air quality at your building after the study is complete. A possible consequence of this is that the occupants of certain areas of the building may be found to have health issues of significance, and will be identified as such. Your confidentiality will be maintained in that your name will not be published, nor will discussion occur regarding your interview with anyone other than my supervisory committee.

The information you provide will be available to Tang Lee, Architect, for his professional reference for up to two years after completion of this study. Within that time, this data will only be available for him for the purposes of an indoor air quality investigation that he may be requested to conduct as applicable to this group of occupants.

After the study is made available, there is a slight potential for an increase in media attention on the building in general. This survey does not incur any financial costs to the respondents nor offer any compensation for participation. Completed questionnaires and the recording of the interview will be securely stored whether on paper, audiotape or electronically. After two years all records and data will be destroyed.

A copy of this consent form has been given to you to keep for your records and reference.

Key informant interview guide DATE

INTRODUCTION

My name is Troy Stooke, and I am a Master's Student in Environmental Science at the University of Calgary in Alberta. I am conducting research to identify the extent to which occupant health surveys can be used as a standard tool for the investigation of indoor air quality concerns in courthouses or other provincial buildings.

Would you be interested in participating in this research as a key informant?

INFORMED CONSENT
If so, {read informed consent script} if by telephone. Fax consent form if interested. If not, thank person and hang up.

SIX QUESTIONS

1. Do you currently use occupant surveys for indoor air quality investigations?

2. What challenges do you experience in interpreting health survey information (if used)?

3. How valuable do you feel that this method of indoor air quality investigation is?

4. May I have a copy of the survey information that you use for reference and development of my research instrument?

5. Do you know who the author(s) of the occupant survey(s) that you use are?

6. Do you have any other sources of information about health surveys that you could refer me to?

Thank you very much for your help.

Occupant interview guide **11/23/03**

Hello: _____Name of participant)
Date_____Time_____Location_____
Have you had a chance to read the consent form? If yes- is there anything else that I can explain? If no? Do you wish to continue? If yes, give/read/sign my copy of consent forms. If no, thank the person and leave. If yes: continue:

I am researching a method of collecting indoor air quality information as one way to help determine the effects of indoor air on people. I will be speaking with occupants of the Court of Queen's Bench building who have been to the doctor for their symptoms, and comparing their experience with people who have said that they have few symptoms. I chose you because of being in one of those two groups. I would like to tape-record our interview to help me remember better what is important about indoor air quality for you (and this tape will be erased after afterwards). Is that ok? (Explain confidentiality again if needed).

1. Can you describe what good indoor air quality means to you?

2. When you feel healthy, can you describe what that is like? (What does feeling good and healthy mean for you?)

3. When you are feeling sick, can you describe what that is like for you? (What does feeling bad or not healthy mean for you?)

4. You wrote that you have worked in this building for ___ years (confirm if all in CQB). What areas do you work in? (Get details of floor, movements on floors/between floors).

5. What kind of work activities do you do? Where are the other activities located in reference to where you spend most of your day? How much contact with other people/ public occurs in those areas? (How many people?)

6. Has your immediate work area had any water leaks? Do you know of any water leaks, moisture or dryness in the building?
    - This building has had many renovations. Which renovations can you describe or recall while working in this building?

Occupant interview guide **11/23/03**

7. I am interested in smells that you notice at work. Can you describe? Do you think that you have a good (or a poor) sense of smell? How long has your workspace been smoke free? Have you started (or stopped) smoking since September 2002 (when questionnaire sent to you).

8. When was the last time you went to the doctor (clinic/hospital/other health practitioner)? Can you tell me why you went?

9. What is it like for you if you have to stay home from work because you don't feel well?

10. How much time do you spend outdoors during a typical workday? What are the longest and shortest amounts of time that you spend outdoors?

11. How do you rate your health, symptoms now as compared to where you worked before?

12. Do you have any photos of your work area or can I take any photos that I can use in my research document? (No identifying sections or people in a photo will be used).

13. Do you have anything you would like to add since completing the questionnaire and after talking about this today?

(Note observations of participant_____)
(i.e. rashes, colouring of face (redness in face, eyes – any redness, shadows), neck, perspiration, twitching, breathing difficulty, weight estimate, eye blinking, etc)

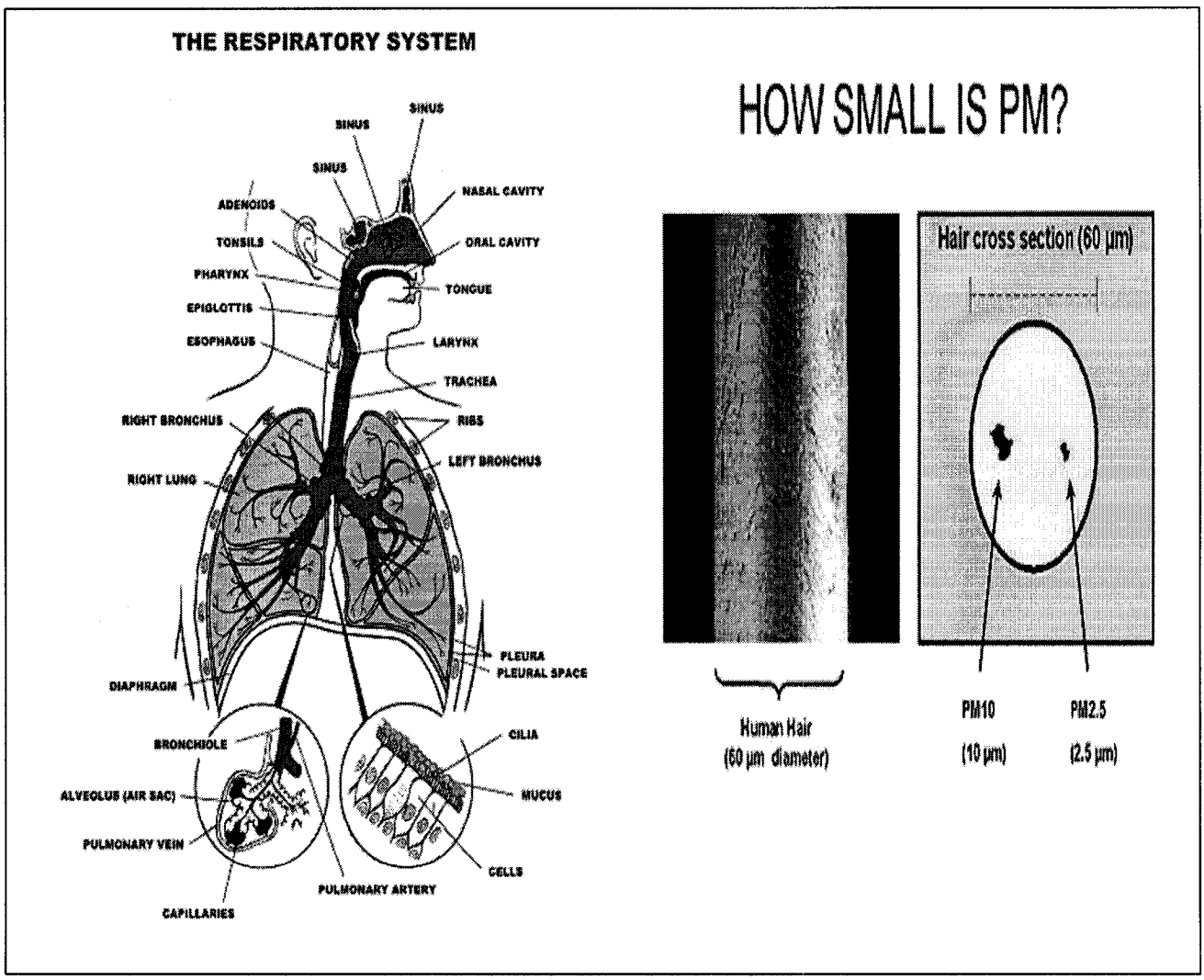
14. I may need to talk to you again another day to make sure that I understand everything you explained to me and. Is that ok for me to call you again if I need to do that? [Give copy of consent to respondent.] Thank person.

Appendix 7.4 Inhalation of Particles into the Respiratory System

Figure 5: The respiratory system
Sources:
(Canada's Digital Collections 2003)
(Canadian Lung Association 2003) ♥

Figure 6: How small is particulate matter?
Source: (Bode 2003) ♦

Fungi or fungal fragments with diameters ranging from 2.5 -10 μm are easily inhaled into the smallest regions of our lungs, the alveoli.



♦ http://www.arb.ca.gov/research/aaqs/pm/pm.htm#top

♥ http://www.lung.ca/children/grades7_12/respiratory/respiratory_system.html, www.sk.lung.ca

Appendix 7.5 Length of time until onset of symptoms in a day (by CQB bldg location)

How long are you at work when your symptoms emerge?	Do your symptoms go away?	When do your symptoms go away?	CQB Building Location coded	When are symptoms worse?
Several hours	YES	One hour	♦	Tuesday to Thursday
Several hours	NO	Away from bldg 1 week or +	♦	Monday to Friday
30 minutes	NO	Away from bldg 1 week or +	♠	Do not go away
30 to 60 min.	NO	Away from bldg 1 week or +	♠	Monday to Friday
Several hours	YES	Several hours		Monday to Friday
Several hours	YES	On weekends		Wednesday
30 to 60 min.	YES	One hour	♣	Monday
Immediately	YES	Away from bldg 1 week or +	Δ	Tuesday to Friday
Immediately	YES	Several hours	Δ	Monday to Friday
One hour	YES	On weekends	Δ	Friday
30 to 60 min.	NO	Do not go away	Δ	Tuesday to Friday
Immediately	NO	Away from bldg 1 week or +	Δ	Friday
One hour	NO	Away from bldg 1 week or +	Δ	Thursday and Friday
30 minutes	NO	Away from bldg 1 week or +	Δ	Do not go away
10 minutes	NO	Do not go away	φ	Monday to Friday
One hour	NO	Do not go away	Ω	Do not go away
Several hours	YES	One hour	•	Do not go away
30 to 60 min.	NO	Do not go away	•	Wed. and Thursday
Immediately	NO	Away from bldg 1 week or +	•	Friday
		Do not go away	•	Do not go away
One hour	NO	Do not go away	∞	Monday to Friday
30 to 60 minutes	NO	Do not go away	♥	Mon., Thurs., Friday
Immediately	NO	Do not go away	♥	Monday to Saturday
One hour	YES	One hour	♥	Monday to Friday
30 to 60 min.	YES	Immediately	♥	N/a
One hour	YES	Several hours	♥	N/a
Several hours	YES	One hour	♥	Monday to Friday
Noon to 6 pm	YES	On weekends	∀	No specific time
30 minutes	YES	One hour	∀	Mon., Tuesday, Friday
Several hours	YES	On weekends	∀	Monday to Friday
All the time	NO	Do not go away	∀	Do not go away
All the time	NO	Do not go away	∀	Do not go away
Several hours	NO	Do not go away	∀	Monday to Friday

Appendix 7.6: Whom do you tell?

Who have you discussed your health symptoms with?	**Number of Respondents**	**IF FEW PEOPLE KNOW, WHY?**	**Number of respondents**
Joint OHS committee	3	Not a problem	12
Family Doctor	39	Would affect my job	9
Family/friends	44	No time to follow up	7
Walk-in clinic	8	Don't have regular DR	1
Co-workers	40	Use meds (OTC)-over the counter	12
Medical specialist	10	Use diet/exercise	14
Supervisor at work	21	Have meds prescription	14
Manager at work	12	Was told not serious	9
Facilities staff or manager	4	Doctor said I was fine	9
Union	9	Worried bldg closure	8
Personnel Office	0	Don't know who to go to	8
No One	11	Comments: (See next page)	
Checked on the Internet	9		
IAQ Specialist	8		
Comments Re " Others-Who have you discussed your health symptoms with? " • We had a provincial health nurse prior to 1992 • Discussed with family only-no one at work • Eye doctor • Lawyer			

Comments Re:
"If few people know about your health symptoms or indoor air quality questions, please check ✔ all the reasons why"

- You will see on the next page that I have high blood pressure and XXX. These are bigger concerns for me. I do not place indoor air quality as a priority.
- Diagnosis 3 times in 8 years with atopic lung disease.
- Whenever the air was tested etc we were told it was okay even when we felt sick. Only this year we were tested for other things and guess what, we are not in there anymore.
- I was sick almost my whole first year as a judge-got colds which I could not recover from, sore throat, laryngitis. I have been healthy since, so not sure of the cause-stress? travel? building? (Although I worked at XXX for the previous X years and was never sick).
- Told by supervisor when I expressed my concern about the [X building location] "you have to be careful what you say as you could be held accountable"!
- Never seriously looked into [X building location]. Had sewer backup, mouldy carpet, mice found. I am sure after time you think this is normal, stuffy etc. Home-nose is clear after 2 days. Rash for several months also.
- After some time it is hard to decide whether these symptoms occur due to age or air quality!
- This never happens after a vacation- usually clears up with lots of rest and medication-steroids. Pretty hard to prove causation, isn't it?
- Period of extreme distress-multiple inhalers in someone without asthma.
- Dr. told me there is a concern, but there is no way to find out. It's very difficult to do tests for this kind of mould-Results won't come 100%.
- Doctor was unsure about mould found and what could be done and what symptoms, if any, were related.
- Management in the Justice department have an internal "competition" to see who has the fewest people off sick. I don't think they WANT to know. Also, there are bonuses of THOUSANDS of dollars given to management, based on how much they save in their budget.

Appendix 7.7: Converted Data (from SPSS data table for hybridized portion of survey by **CQB** location and severity)
-Figures are percentages (based on raw scores, divided by the number of occupants in that location).

Symptom	Severity	Location in CQB	Base-ment	Ground	Main	One	Two	Three	Six	Seven	Eight	Nine
1	0	Rhinoconjunctivitis Not at all	41	34	33	17	25	42	35	13	31	27
2	0	Respiratory Not at all	50	59	54	41	25	46	58	13	58	56
3	0	Dermal Not at all	50	44	33	22	25	42	60	25	50	41
4	0	Vascular Not at all	50	58	56	25	33	56	53	67	44	50
5	0	Endocrine/Immune Not at all	43	55	40	34	20	40	52	40	57	50
6	0	Digestive Not at all	56	69	67	50	100	67	90	100	58	81
1	1	Rhinoconjunctivitis Hardly	6	16	21	9	25	29	10	38	2	19
2	1	Respiratory Hardly	16	16	21	20	13	25	8	25	10	25
3	1	Dermal Hardly	0	25	25	13	25	42	5	25	8	22
4	1	Vascular Hardly	17	25	0	13	33	33	7	0	0	25
5	1	Endocrine/Immune Hardly	13	13	3	10	0	17	4	30	10	10
6	1	Digestive Hardly	19	13	8	19	0	25	25	0	17	13
1	2	Rhinoconjunctivitis Somewhat	6	22	13	25	13	17	23	50	8	19
2	2	Respiratory Somewhat	6	19	8	11	13	0	18	38	8	8
3	2	Dermal Somewhat	6	6	17	19	25	8	0	0	4	13
4	2	Vascular Somewhat	17	42	11	25	0	11	0	0	17	4
5	2	Endocrine/Immune Somewhat	5	15	17	26	0	3	14	30	7	13
6	2	Digestive Somewhat	6	13	8	13	0	0	5	0	8	9
1	3	Rhinoconjunctivitis Moderately	0	9	8	11	13	13	5	0	19	8
2	3	Respiratory Moderately	9	3	0	8	0	13	5	25	6	3

Symptom	Severity	Location in CQB	Base-ment	Ground	Main	One	Two	Three	Six	Seven	Eight	Nine
3	3	Dermal Moderately	0	0	0	16	0	0	15	50	17	9
4	3	Vascular Moderately	8	0	0	13	33	0	7	33	6	4
5	3	Endocrine/Immune Moderately	0	10	0	3	0	10	6	0	12	10
6	3	Digestive Moderately	13	6	0	9	0	0	0	0	0	0
1	4	Rhinoconjunctivitis Quite a bit	13	6	13	16	0	0	10	0	15	9
2	4	Respiratory Quite a bit	6	3	4	5	13	4	3	0	6	3
3	4	Dermal Quite a bit	25	25	8	6	25	8	15	0	4	16
4	4	Vascular Quite a bit	8	0	22	8	0	0	20	0	11	4
5	4	Endocrine/Immune Quite a bit	10	0	13	11	10	7	0	0	8	5
6	4	Digestive Quite a bit	0	0	8	3	0	0	0	0	0	0
1	5	Rhinoconjunctivitis Very	22	3	17	5	13	0	8	0	8	11
2	5	Respiratory Very	9	0	13	3	13	0	0	0	2	2
3	5	Dermal Very	19	0	8	9	0	0	0	0	13	0
4	5	Vascular Very	0	0	11	0	33	0	0	0	6	8
5	5	Endocrine/Immune Very	13	0	27	4	20	7	10	0	2	3
6	5	Digestive Very	0	0	8	0	0	0	0	0	4	0
1	6	Rhinoconjunctivitis Extremely	13	0	0	16	13	0	3	0	6	5
2	6	Respiratory Extremely	3	0	0	5	25	4	3	0	4	0
3	6	Dermal Extremely	0	0	0	16	0	0	0	0	4	3
4	6	Vascular Extremely	0	0	0	16	0	0	0	0	11	0
5	6	Endocrine/Immune Extremely	8	3	0	6	40	13	2	0	2	4
6	6	Digestive Extremely	6	0	0	0	0	8	0	0	8	0

Appendix 7.8: Sample Data Calculation Method for Appendix 7.9

Symptom score calculation example from raw data:

Digestive-CQB/Hardly		Digestive-Location X CQB/Hardly
Abdominal Pain		1
Diarrhea		
Vomiting		1
Nausea		1
Total	**24**	**3**
n=43		n=4

Calculation method for each domain is as follows:

Possible of four symptoms under "digestive-hardly" and four occupants at Location X.

Sixteen potential scores are possible for this cell.

Actual scores = 3.

$$\frac{3}{16} = \frac{X}{100}$$

Percent of occupants responding to this domain therefore = 18.75%

See highlighted cell for that value in Appendix 7.9 below.

APPENDIX 7.9 CQB Location by Severity (n=43)	Below + 15 Level N=19				Above + 15 Level N=24					
Rhinoconjunctivitis Not at all	40.63	34.38	33.33	17.19	25	41.67	35	12.5	31.25	26.56
Respiratory Not at all	50	59.38	54.17	40.63	25	45.83	57.5	12.5	58.33	56.25
Dermal Not at all	50	43.75	33.33	21.88	25	41.67	60	25	50	40.63
Vascular Not at all	50	58.33	55.56	25	33.33	55.56	53.33	66.67	44.44	50
Endocrine/Immune Not at all	42.5	55	40	33.75	20	40	52	40	56.67	50
Digestive Not at all	56.25	68.75	66.67	50	100	66.67	90	100	58.33	81.25
Rhinoconjunctivitis Hardly	6.25	15.63	20.83	9.38	25	29.17	10	37.5	2.08	18.75
Respiratory Hardly	15.63	15.63	20.83	20.31	12.5	25	7.5	25	10.42	25
Dermal Hardly	0	25	25	12.5	25	41.67	5	25	8.33	21.88
Vascular Hardly	16.67	25	0	12.5	33.33	33.33	6.67	0	0	25
Endocrine/Immune Hardly	12.5	12.5	3.33	10	0	16.67	4	30	10	10
Digestive Hardly	18.75	12.5	8.33	18.75	0	25	25	0	16.67	12.5
Rhinoconjunctivitis Somewhat	6.25	21.88	12.5	25	12.5	16.67	22.5	50	8.33	18.75
Respiratory Somewhat	6.25	18.75	8.33	10.94	12.5	0	17.5	37.5	8.33	7.81
Dermal Somewhat	6.25	6.25	16.67	18.75	25	8.33	0	0	4.17	12.5
Vascular Somewhat	16.67	41.67	11.11	25	0	11.11	0	0	16.67	4.17
Endocrine/Immune Somewhat	5	15	16.66	26.25	0	3.33	14	30	6.67	12.5
Digestive Somewhat	6.25	12.5	8.33	12.5	0	0	5	0	8.33	9.38
Rhinoconjunctivitis Moderately	0	9.38	8.33	10.94	12.5	12.5	5	0	18.75	7.81
Respiratory Moderately	9.38	3.13	0	7.81	0	12.5	5	25	6.25	3.13
Dermal Moderately	0	0	0	15.62	0	0	15	50	16.67	9.38
Vascular Moderately	8.33	0	0	12.5	33.33	0	6.67	33.33	5.56	4.17
Endocrine/Immune Moderately	0	10	0	2.5	0	10	6	0	11.67	10
Digestive Moderately	12.5	6.25	0	9.38	0	0	0	0	0	0
Rhinoconjunctivitis Quite a bit	12.5	6.25	12.5	15.63	0	0	10	0	14.58	9.38
Respiratory Quite a bit	6.25	3.13	4.17	4.69	12.5	4.17	2.5	0	6.25	3.13
Dermal Quite a bit	25	25	8.33	6.25	25	8.33	15	0	4.17	15.63
Vascular Quite a bit	8.33	0	22.22	8.33	0	0	20	0	11.11	4.17
Endocrine/Immune Quite a bit	10	0	13.33	11.25	10	6.67	0	0	8.33	5
Digestive Quite a bit	0	0	8.33	3.13	0	0	0	0	0	0

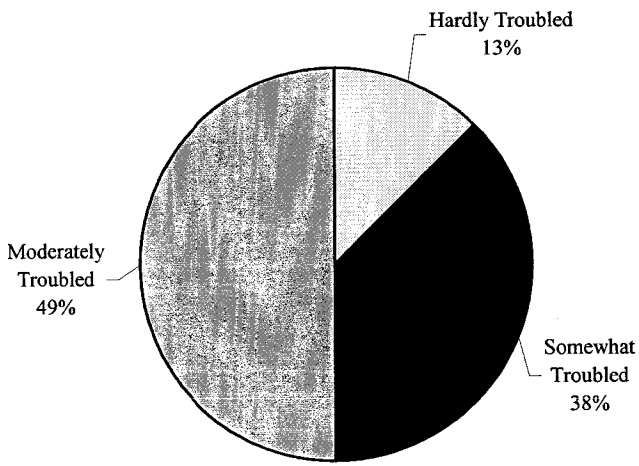
CQB Location by Severity cont'd (n=43)	Below + 15 Level N=19				Above + 15 Level N=24					
Rhinoconjunctivitis Very	21.88	3.13	16.67	4.69	12.5	0	7.5	0	8.33	10.94
Respiratory Very	9.38	0	12.5	3.13	12.5	0	0	0	2.08	1.56
Dermal Very	18.75	0	8.33	9.38	0	0	0	0	12.5	0
Vascular Very	0	0	11.11	0	33.33	0	0	0	5.56	8.33
Endocrine/Immune Very	12.5	0	26.67	3.75	20	6.67	10	0	1.67	2.5
Digestive Very	0	0	8.33	0	0	0	0	0	4.17	0
Rhinoconjunctivitis Extremely	12.5	0	0	15.63	12.5	0	2.5	0	6.25	5
Respiratory Extremely	3.13	0	0	4.69	25	4.17	2.5	0	4.17	0
Dermal Extremely	0	0	0	15.63	0	0	0	0	4.17	2.5
Vascular Extremely	0	0	0	15.63	0	0	0	0	11.11	0
Endocrine/Immune Extremely	7.5	2.5	0	6.25	40	13.33	2	0	1.67	3.75
Digestive Extremely	6.25	0	0	0	0	8.33	0	0	8.33	0
Non CQB Location by Severity (n=17)					N=17					
Rhinoconjunctivitis - Not at all	0	0	29.17	4.17	4.17	43.75	62.5	187.5	12.5	100
Respiratory - Not at all	37.5	62.5	50	29.17	20.83	31.25	100	175	25	100
Dermal - Not at all	0	25	58.33	0	8.33	12.5	62.5	175	50	100
Vascular - Not at all	33.33	66.67	66.67	11.11	22.22	16.67	100	133.33	66.67	100
Endocrine/Immune - Not at all	30	70	40	40	3.33	35	100	110	10	100
Digestive - Not at all	100	100	66.67	58.33	16.67	62.5	75	175	100	100
Rhinoconjunctivitis - Hardly	12.5	0	8.33	33.33	0	0	0	0	25	0
Respiratory - Hardly	12.5	25	8.33	12.5	8.33	6.25	0	12.5	25	0
Dermal - Hardly	0	25	0	33.33	0	0	0	0	12.5	0
Vascular - Hardly	33.33	0	11.11	44.44	22.22	0	0	0	0	0
Endocrine/Immune - Hardly	0	0	10	26.67	13.33	5	0	0	20	0
Digestive - Hardly	0	0	25	25	50	16.67	0	0	0	0
Rhinoconjunctivitis - Somewhat	37.5	37.5	33.33	20.83	12.5	12.5	0	25	62.5	0
Respiratory- Somewhat	37.5	0	16.67	37.5	20.83	6.25	0	25	37.5	0
Dermal - Somewhat	25	50	33.33	33.33	25	25	0	0	25	0
Vascular - Somewhat	0	0	11.11	22.22	0	0	0	33.33	0	0
Endocrine/Immune - Somewhat	20	10	13.33	6.67	3.33	5	0	50	60	0
Digestive - Somewhat	0	0	8.33	0	8.33	25	25	0	0	0

Non CQB Location by Severity cont'd (n=17)	N=17									
Rhinoconjunctivitis - Moderately	50	25	0	16.67	12.5	6.25	25	0	0	0
Respiratory - Moderately	12.5	12.5	4.17	4.17	8.33	18.75	0	0	0	0
Dermal- Moderately	75	0	0	8.33	16.67	25	0	0	0	0
Vascular- Moderately	0	33.33	0	11.11	0	16.67	0	0	33.33	0
Endocrine/Immune- Moderately	20	20	20	16.67	10	5	0	10	10	0
Digestive- Moderately	0	0	0	16.67	8.33	12.5	0	0	0	0
Rhinoconjunctivitis - Quite a bit	0	25	8.33	20.83	25	18.75	12.5	0	0	0
Respiratory- Quite a bit	0	0	4.17	4.17	25	18.75	0	0	0	0
Dermal- Quite a bit	0	0	8.33	8.33	33.33	25	75	0	0	0
Vascular- Quite a bit	33.33	0	11.11	11.11	22.22	66.67	0	33.33	0	0
Endocrine/Immune - Quite a bit	20	0	10	6.67	23.33	5	0	10	0	0
Digestive - Quite a bit	0	0	0	0	8.33	12.5	0	0	0	0
Rhinoconjunctivitis - Very	0	12.5	8.33	8.33	29.16	43.75	0	0	0	0
Respiratory- Very	0	0	4.17	8.33	4.17	37.5	0	0	0	0
Dermal- Very	0	0	0	8.33	16.67	50	0	0	0	0
Vascular- Very	0	0	0	0	22.22	16.67	0	0	0	0
Endocrine/Immune- Very	0	0	6.67	0	33.33	40	0	10	0	0
Digestive- Very	0	0	0	0	8.33	12.5	0	0	0	0
Rhinoconjunctivitis - Extremely	0	0	12.5	0	16.67	18.75	0	0	0	0
Respiratory- Extremely	0	0	12.5	4.17	8.33	12.5	0	0	0	0
Dermal - Extremely	0	0	0	0	0	12.5	0	0	0	0
Vascular - Extremely	0	0	0	11.11	11.11	0	0	0	0	0
Endocrine/Immune - Extremely	0	0	0	0	10	20	0	0	0	0
Digestive - Extremely	0	0	0	0	0	0	0	0	0	0

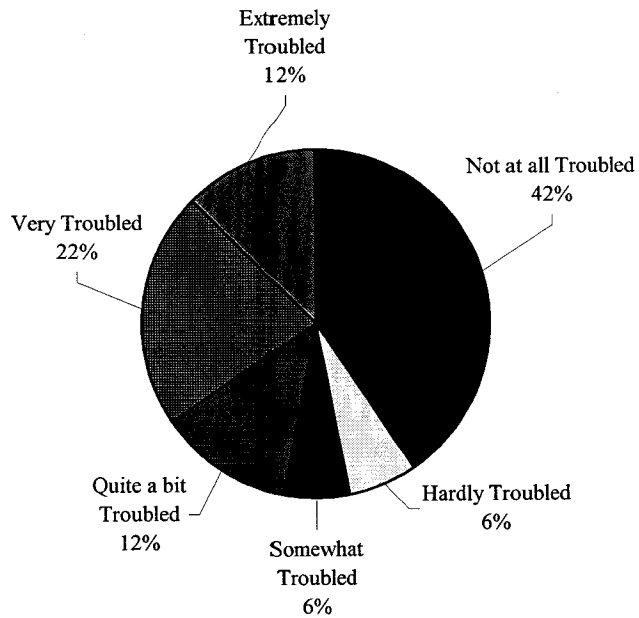
Appendix7.10: Symptom Cluster Severity by location (24 data charts from hybridized survey)

Charts 7.10.1 Rhinoconjunctivitis Symptom Clusters across Locations

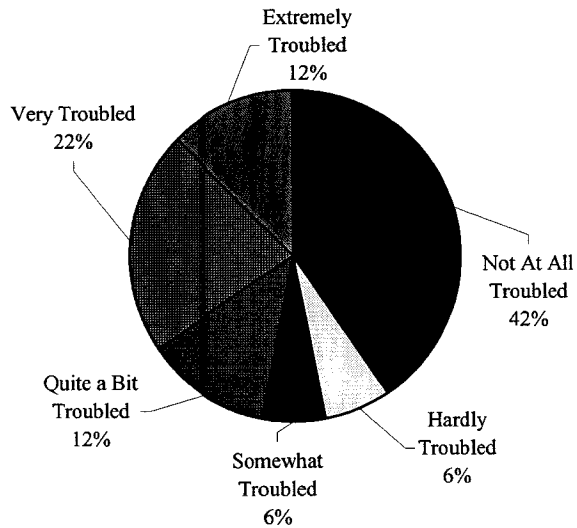
Rhinoconjunctivitis,
Occasional CQB Respondents
(n = 17)



Rhinoconjunctivitis,
CQB Respondents
(n=43)



Rhinoconjunctivitis, CQB Respondents
Below Plus 15 Level
(n=19)



Rhinoconjunctivitis, CQB Respondents
Above Plus 15 Level
(n = 24)

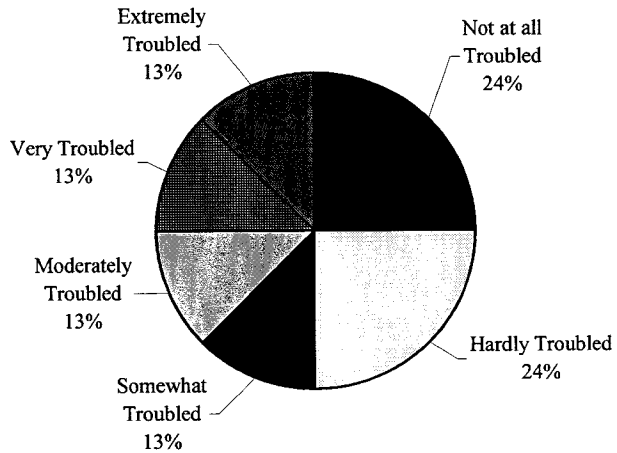
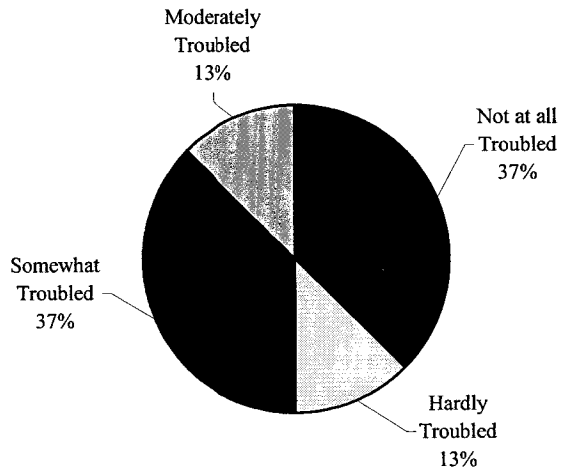
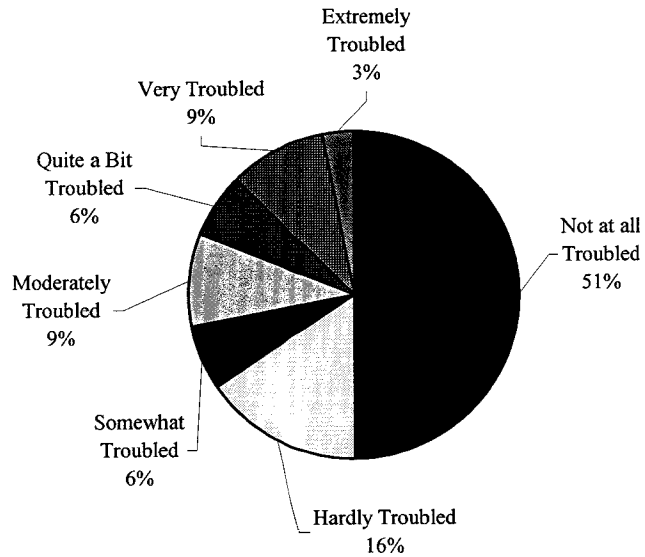


Chart 7.10.2 Respiratory Symptom Clusters across Locations

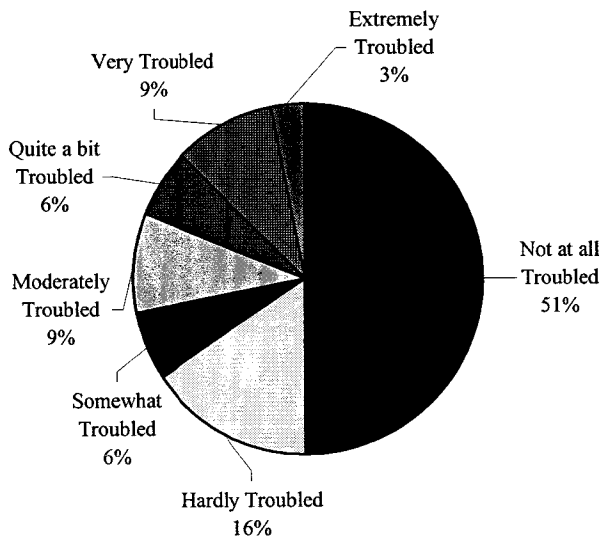
Respiratory,
Occasional CQB Respondents
(n = 17)



Respiratory,
All CQB Respondents
(n =43)



Respiratory, CQB Respondents
Below Plus 15 Level
(n=19)



Respiratory, CQB Respondents
Above Plus 15 Level
(n=24)

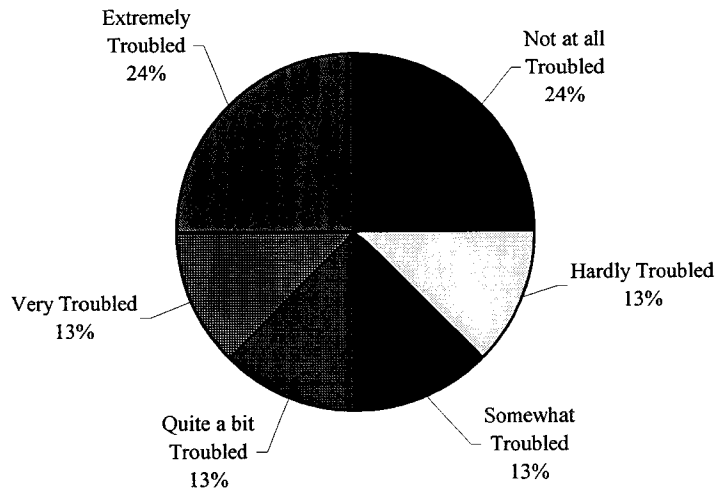
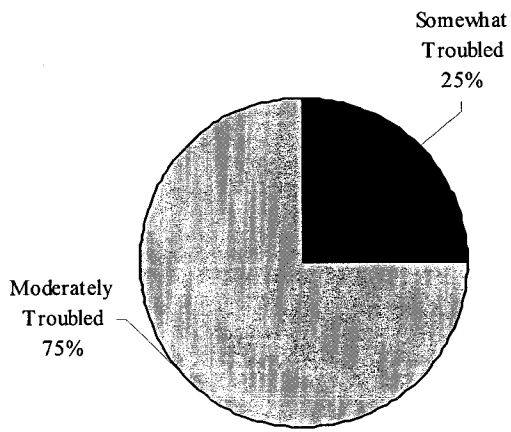
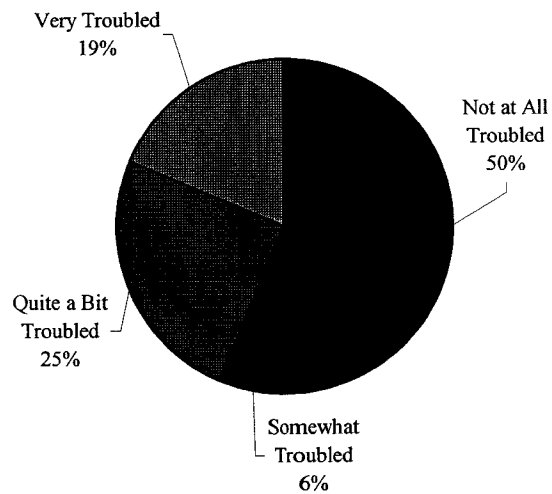


Chart 7.10.3 Dermal Symptom Clusters across Locations

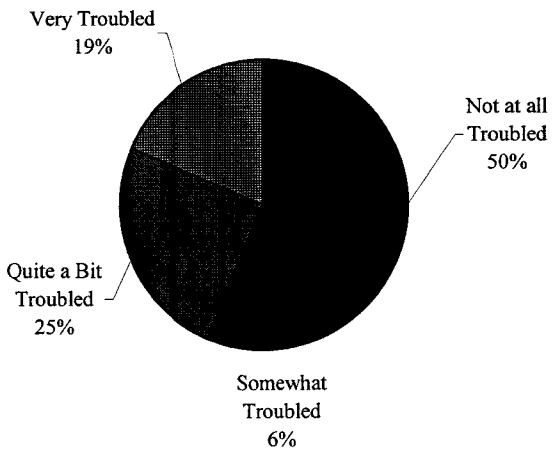
Dermal,
Occasional CQB Respondents
(n = 17)



Dermal,
All CQB Respondents
(n=43)



Dermal, CQB Respondents
Below Plus 15 Level
(n=19)



Dermal, CQB Respondents
Above Plus 15 Level
(n=24)

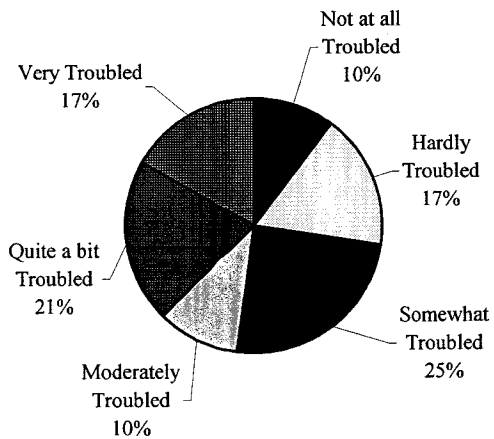
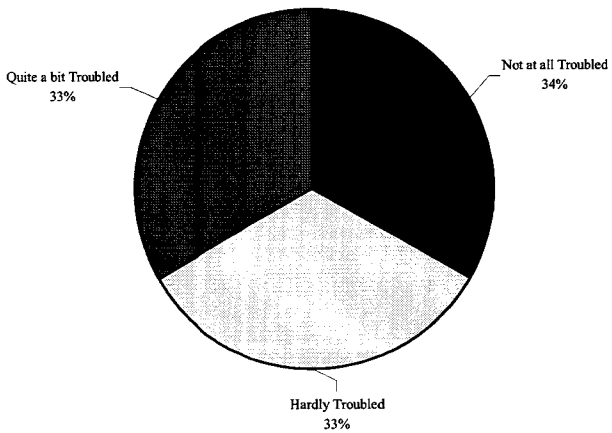
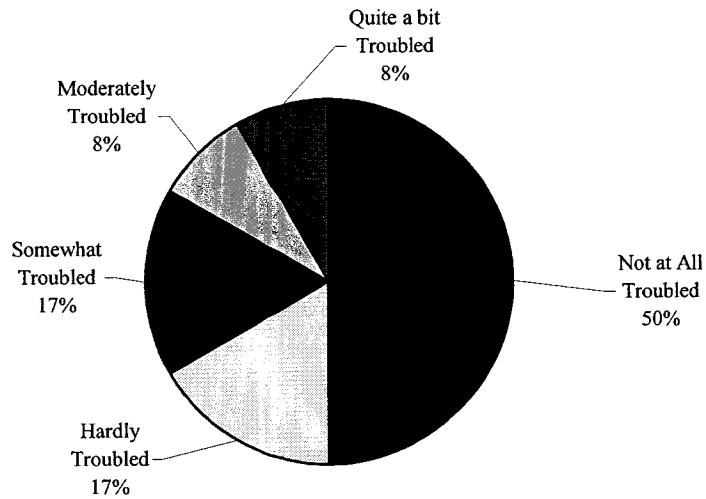


Chart 7.10.4 Vascular Symptom Clusters across Locations

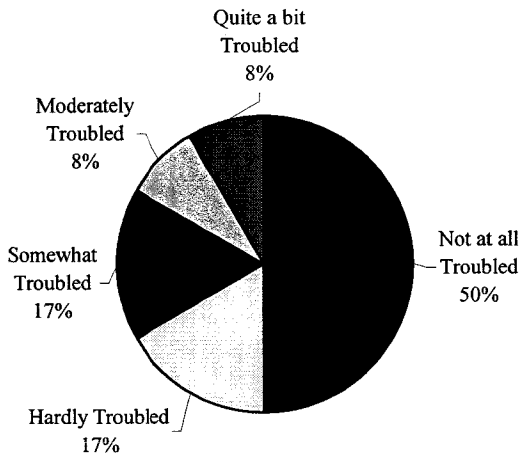
Vascular,
Occasional CQB Respondents
(n = 17)



Vascular,
All CQB Respondents
(n=43)



Vascular, CQB Respondents
Below Plus 15 Level
(n=19)



Vascular, CQB Respondents
Above Plus 15 Level
(n=24)

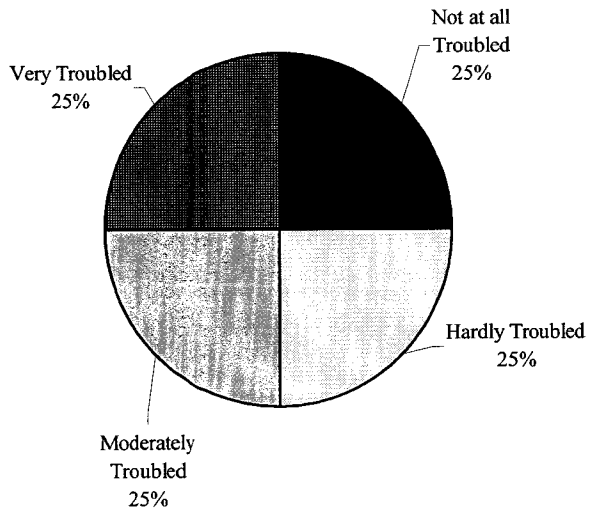
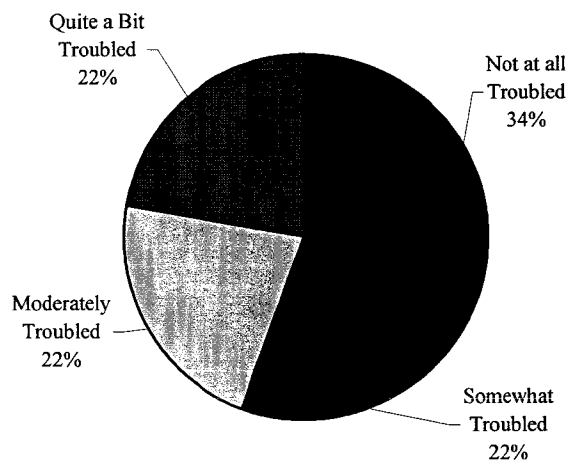
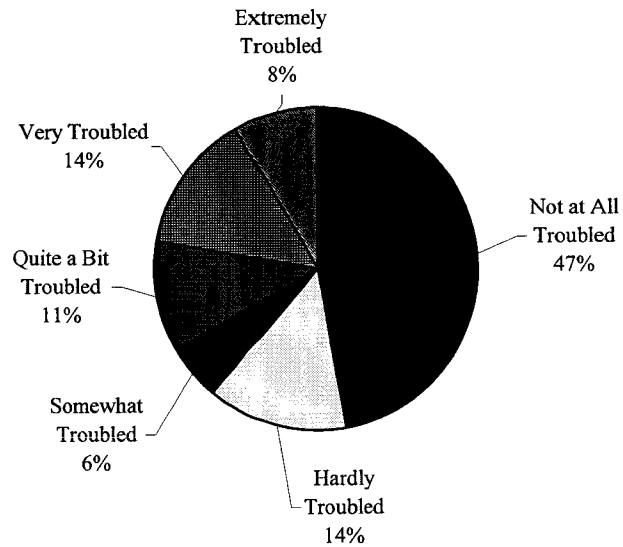


Chart 7.10.5 Endocrine/Immune Symptom Clusters across Locations

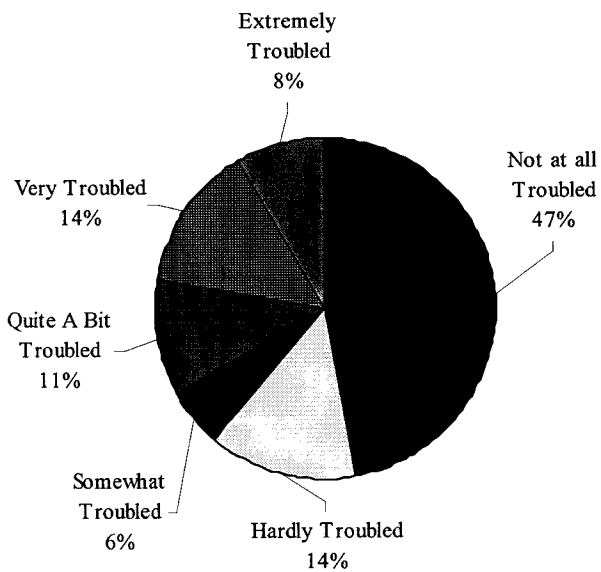
Endocrine/Immune,
Occasional CQB Respondents
(n = 17)



Endocrine/Immune,
All CQB Respondents
(n=43)



Endocrine/Immune,
CQB Respondents
Below Plus 15 Level
(n=19)



Endocrine/Immune,
CQB Respondents
Above Plus 15 Level
(n=24)

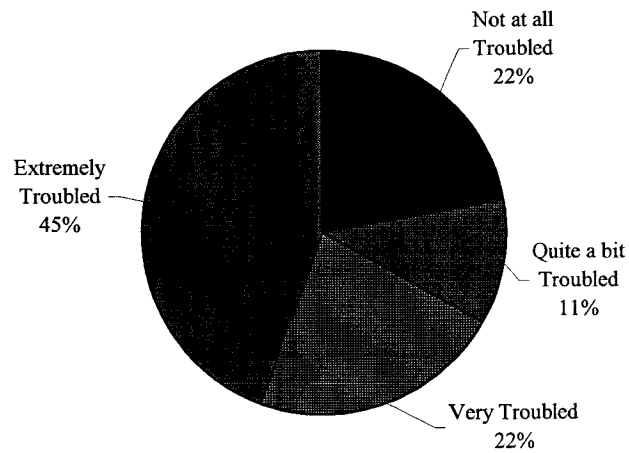
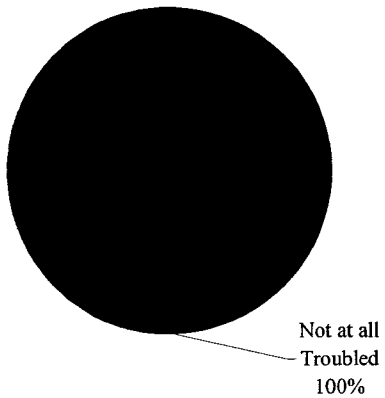
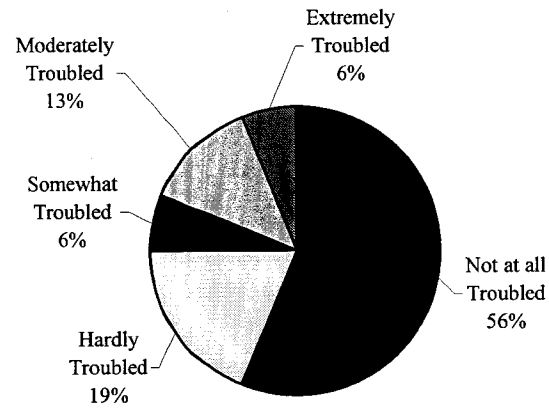


Chart 7.10.6 Digestive Symptom Clusters across Locations

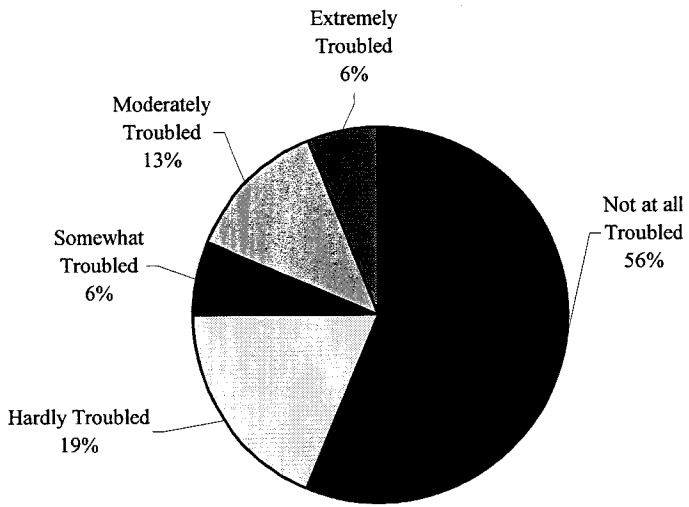
Digestive, Occasional CQB Respondents
(n = 17)



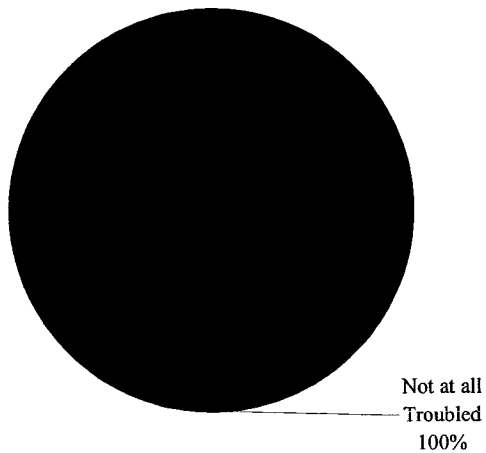
Digestive, CQB Respondents
(n=43)



Digestive,
CQB Respondents
Below Plus 15 Level
(n=19)



Digestive,
CQB Respondents
Above Plus 15 Level
(n=24)



Appendix 7.11: Severity and Timing, Hybridized Survey

Chart 7.11.1: Severity and timing of symptoms that are "most troubling" for all occupants

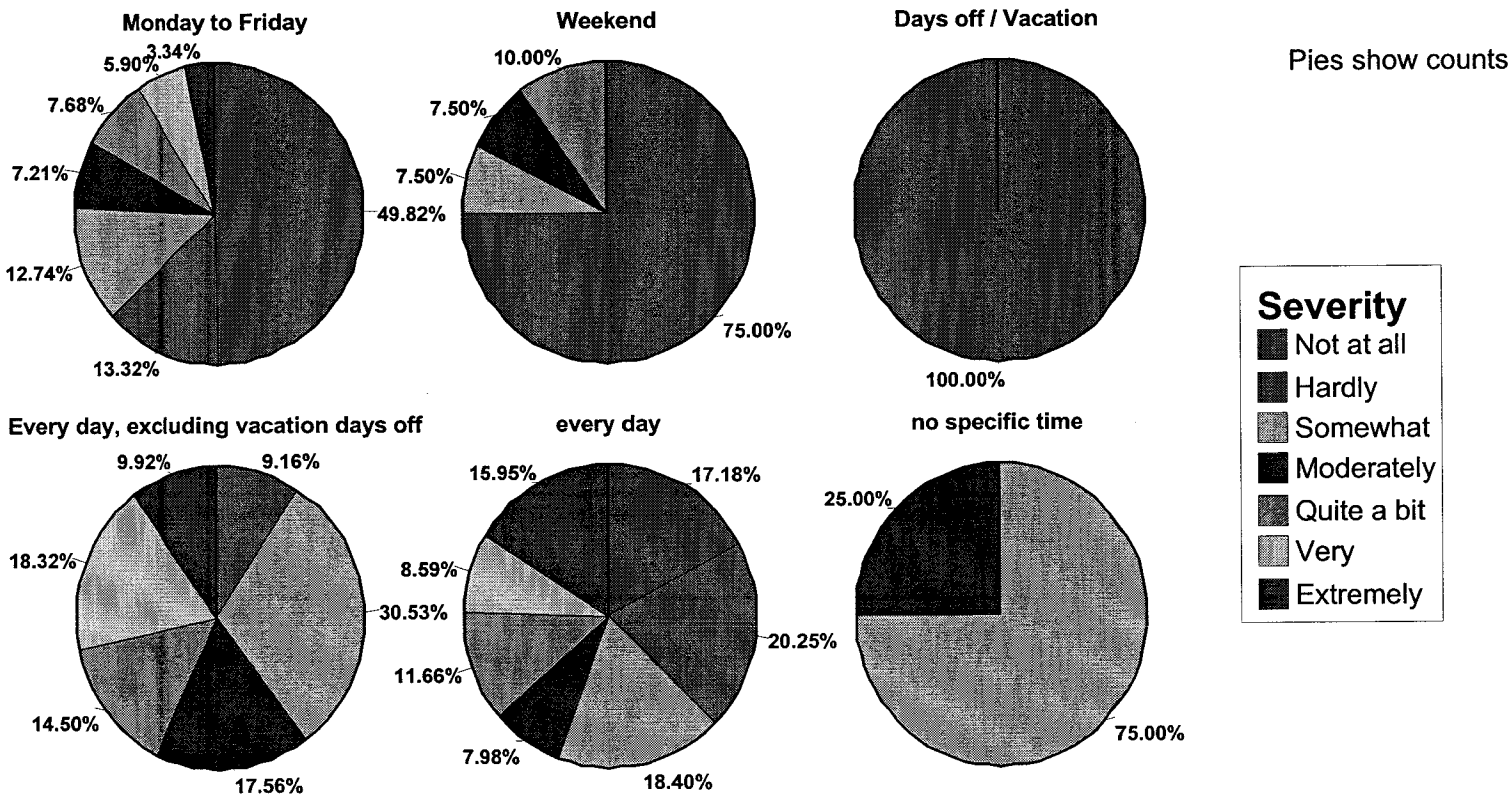
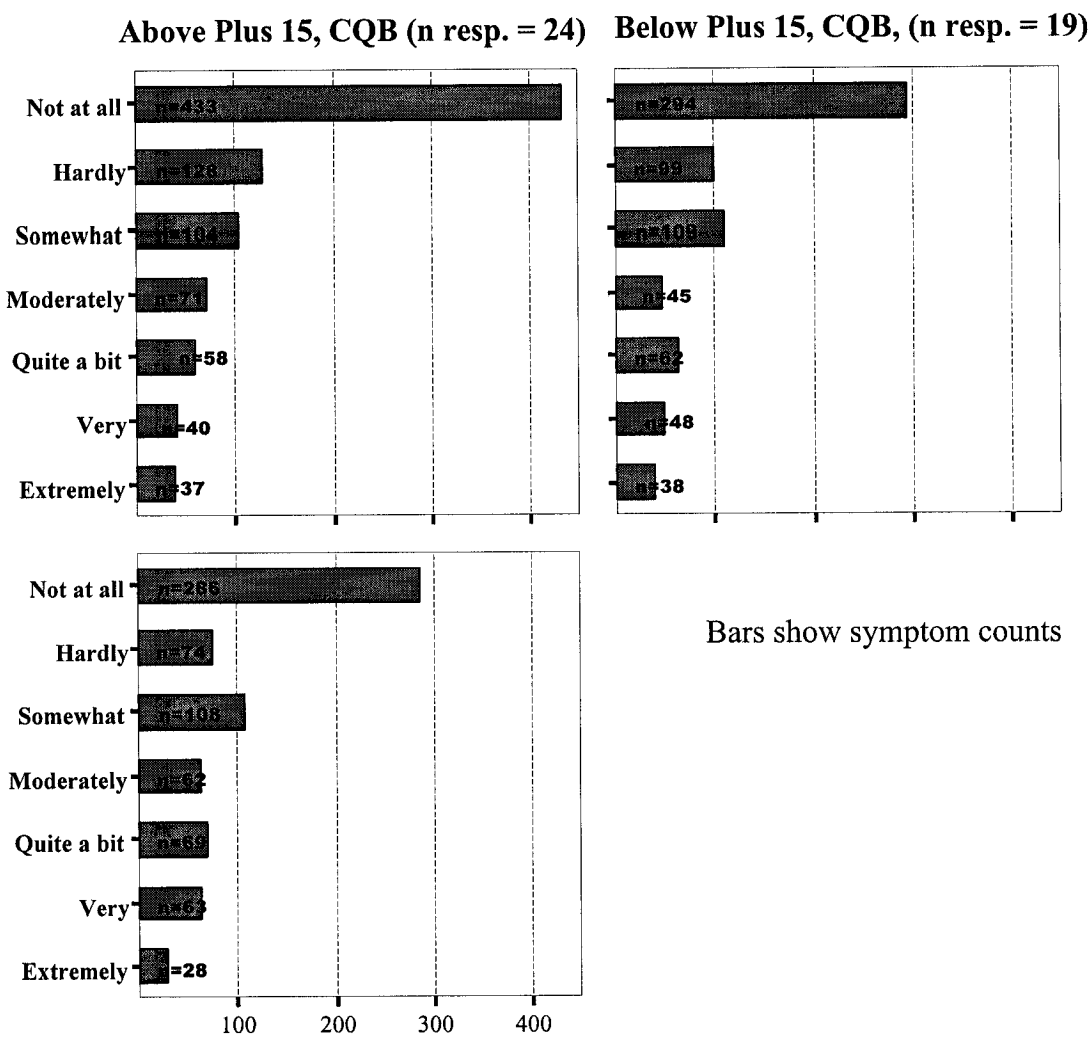


Chart 7.11.2 Symptom Severity by Location



Appendix 7.12: MiniRQLQ Data

CQB Occupant CODE	N	Minimum	Maximum	Mean
CAS10	13	0	0	0.00
CAS13	14	0	1	0.07
CAS14 / not full time occupant	14	0	2	0.14
CAS17	14	0	1	0.14
CAS19 / not full time occupant	14	0	2	0.29
CAS01	14	0	2	0.50
CAS20	14	0	2	0.50
CAS21	14	0	2	0.57
CAS22	14	0	2	Interviewed 0.57
CAS23	13	0	2	0.62
CAS24	14	0	2	0.70
CAS26	14	0	3	Interviewed 0.71
CAS29	14	0	2	0.86
CAS02 / not full time occupant	14	0	2	0.86
CAS30 / not full time occupant	14	0	2	0.86
CAS31	14	0	2	1.07
CAS32	11	0	4	1.36
CAS33	14	0	3	1.43
CAS34 / not full time occupant	12	0	4	1.50
CAS35	14	0	5	1.57
CAS37	12	0	5	1.58
CAS38	14	1	2	1.64
CAS39	14	1	4	1.93
CAS40	14	0	3	2.00
CAS41	14	1	5	2.14
CAS43 / not full time occupant	14	1	4	2.21
CAS46	14	0	4	2.29
CAS47	14	0	5	2.29
CAS48	14	1	4	2.29
CAS50	14	1	4	Interviewed 2.36
CAS51	12	1	4	2.42
CAS52	12	0	4	2.42
CAS53	14	0	6	2.43
CAS54	14	0	5	2.50
CAS55	14	2	3	2.71
CAS56 / not full time occupant	14	0	6	2.86
CAS59	14	1	6	3.07
CAS05	14	1	5	3.15
CAS62	14	2	5	3.64
CAS63	14	3	6	Interviewed 4.50
CAS06	14	3	6	Interviewed 4.64
CAS07	14	4	6	5.79
CAS08	14	4	6	5.86

CQB Occasional Occupant CODE	N	Minimum	Maximum	Mean
Cas11	14	1	6	3.43
Cas12	14	0	6	2.43
Cas16	14	0	2	0.86
Cas18	14	1	5	3.36
Cas25	14	3	6	4.57
Cas28	14	0	5	1.71
Cas36	14	0	0	0.00
Cas42	14	2	6	4.00
Cas44	14	3	5	4.00
Cas45	14	0	3	1.57
Cas49	0	n/a		
Cas4	14	0	2	1.00
Cas57 / not full time occupant	14	0	3	1.50
Cas58 / not full time occupant	14	0	4	0.29
Cas60	14	1	4	3.0
Cas61	14	0	0	0.0
Cas64 / not full time occupant	14	0	6	2.43
Cas65 / not full time occupant	14	0	0	0.0
Cas66	14	1	6	4.43
Cas67	14	0	5	2.71
Cas9	14	1	4	2.36

Appendix 7.13: MiniRQLQ Mean Scores (in ascending order by location)

Occasional CQB occupants full time (n=16)	CQB full time occupants (n=36)	Below Plus 15 full time (n=17)	Above Plus15 full time (n=19)
0	0	0.07	0
0	0.07	0.14	0.5
0.86	0.14	0.5	0.57
1	0.5	0.7	0.57
1.57	0.5	1.07	0.62
1.71	0.57	1.43	0.71
2.36	0.57	1.57	0.86
2.43	0.62	1.64	1.36
2.71	0.7	2.29	1.58
3	0.71	2.29	1.93
3.36	0.86	2.36	2
3.43	1.07	2.42	2.14
4	1.36	2.71	2.29
4	1.43	3.15	2.42
4.43	1.57	4.5	2.43
4.57	1.58	4.64	2.5
	1.64	5.79	3.07
	1.93		3.64
	2		5.86
	2.14		
	2.29		
	2.29		
	2.29		
	2.36		
	2.42		
	2.42		
	2.43		
	2.5		
	2.71		
	3.07		
	3.15		
	3.64		
	4.5		
	4.64		
	5.79		
	5.86		

Occasional CQB occupants (n=20)*	CQB occupants (n=43)*	Below Plus 15 (n=19)	Above Plus15 (n=24)
0	0	0.07	0
0	0.07	0.14	**0.14**
0	0.14	**0.29**	0.5
0.29	**0.14**	0.5	0.57
0.86	**0.29**	0.7	0.57
1	0.5	**0.86**	0.62
1.5	0.5	1.07	0.71
1.57	0.57	1.43	0.86
1.71	0.57	1.57	**0.86**
2.36	0.62	1.64	1.36
2.43	0.7	2.29	**1.5**
2.43	0.71	2.29	1.58
2.71	**0.86**	2.36	1.93
3	**0.86**	2.42	2
3.36	0.86	2.71	2.14
3.43	1.07	3.15	**2.21**
4	1.36	4.5	2.29
4	1.43	4.64	2.42
4.43	**1.5**	5.79	2.43
4.57	1.57		2.5
	1.58		**2.86**
	1.64		3.07
	1.93		3.64
	2		5.86
	2.14		
	2.21		
	2.29		
	2.29		
	2.29		
	2.36		
	2.42		
	2.42		
	2.43		
	2.5		
	2.71		
	2.86		
	3.07		
	3.15		
	3.64		
	4.5		
	4.64		
	5.79		
	5.86		

*Bold scores indicate non-full time occupant of a courthouse building.

Chart 7.13.1: Mini RQLQ Severity-Court of Queen's Bench Occupants

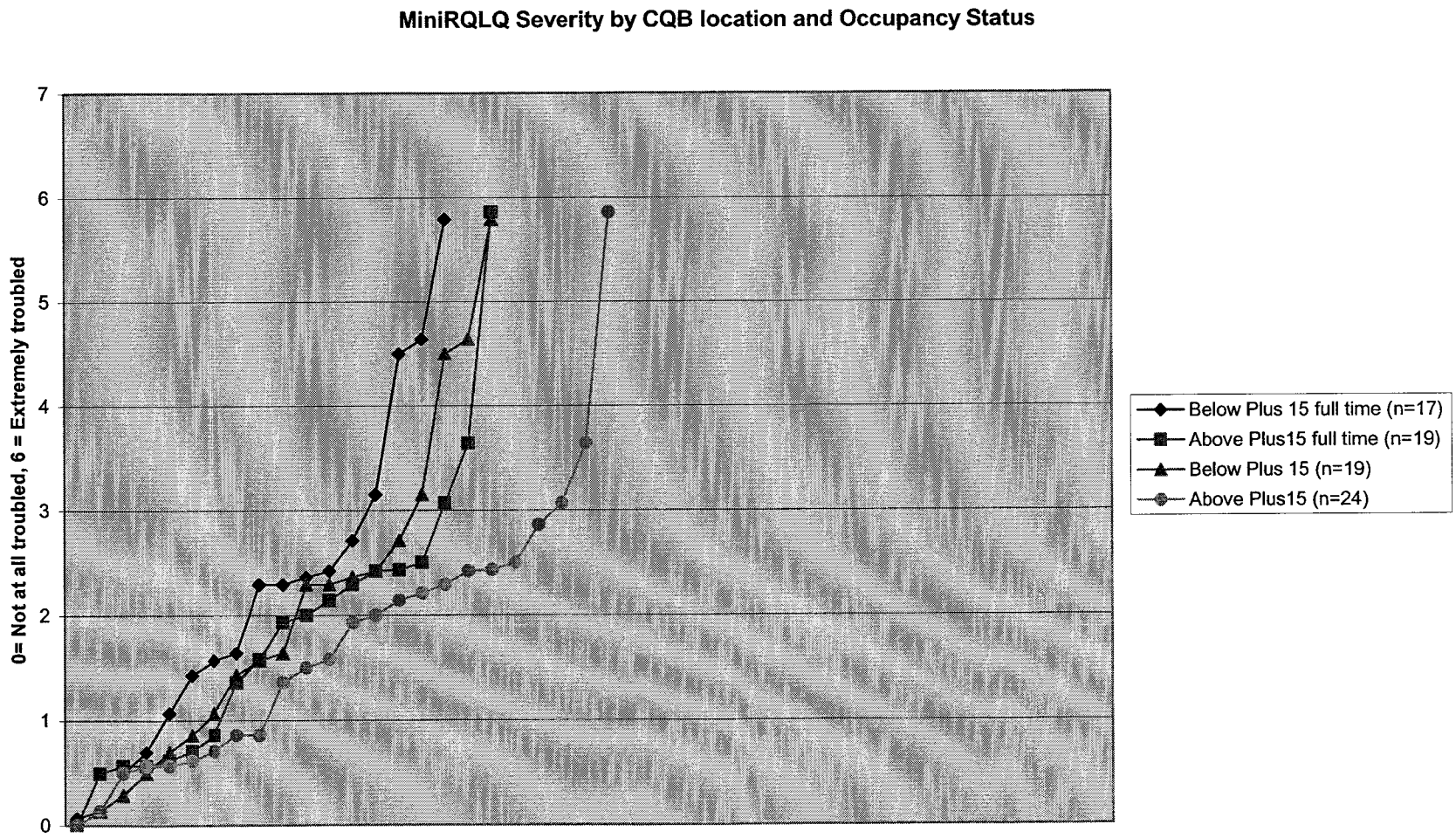
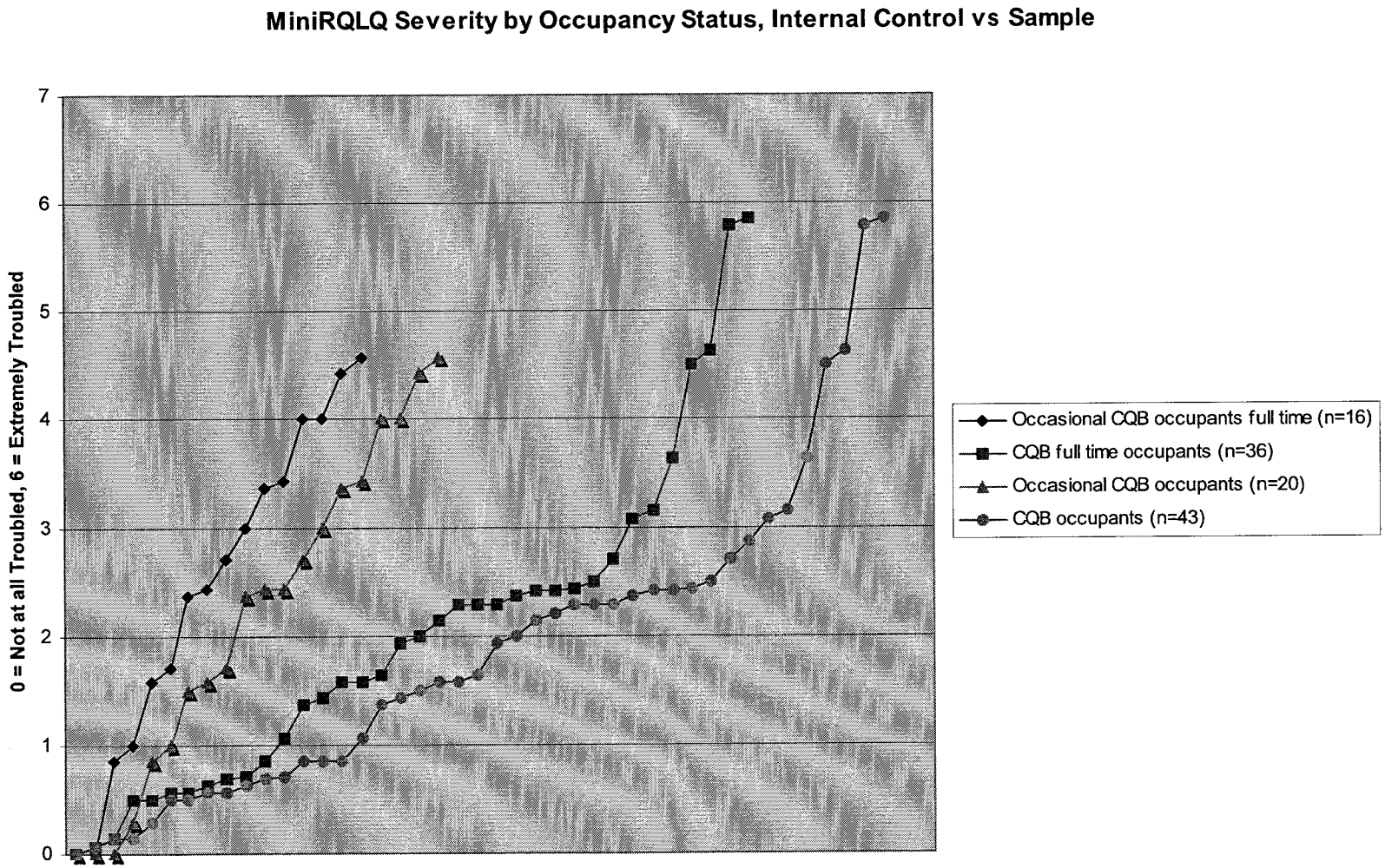


Chart 7.13.2: Mini RQLQ Severity-Court of Queen's Bench Occupants and Internal Control group



Appendix 7.14

MiniRQLQ Raw Data

survey_id	activities_1	activities_2	activities_3	practical_problems_4	practical_problems_5	nose_symptom_6	nose_symptoms_7	nose_symptoms_8	eye_symptoms_9	eye_symptoms_10	eye_symptoms_11	other_symptoms_12	other_symptoms_13	other_symptoms_14
10yc912	1	2	0	0	2	0	3	2	0	0	0	0	0	0
11nc912	3	1	5	3	3	4	4	1	3	4	2	6	3	6
12nqf912	0	0	1	2	6	4	5	4	1	1	3	2	4	1
13nqc912	2	2	1	2	3	2	3	4	1	1	1	2	1	2
14nqc912	0	0	0	0	0	1	0	0	0	0	0	0	0	0
15nf913														
16nqc913	2	1	1	1	1	0	1	0	1	0	0	2	0	2
17nqc913	1	1	2	1	0	1	1	1	1	1	1	1	2	1
18nc913	2	2	3	5	2	2	4	1	5	3	5	4	5	4
19nqc913	0	0	2	1	0	1	1	0	1	0	0	1	0	0
1yqc911	0	0	0	0	0	0	0	0	0	0	0		0	0
20nqc913	5	4	6	6	6	6	6	6	6	6	6	6	6	6
21yqc913	1	1	1	6	6	1	3	6	4	4	4	2	2	2
22nqc916	1	0	2	1	1	0	0	1	0	1	0	0	0	0
23yqc916	1	0	3	3	1	1	3	0	1			4	1	0
24yqf917	4	5	6	3	3	1	4	0	1	1	1	5	3	3
25nc917	3	3	4	6	6	3	6	6	5	5	5	4	3	5
26nqc917	0	0	0	0	0	0	2	0	0	0	0	0	0	0
28nc918	0	1	2	3	0	0	0	2	4	2	5	3	0	2
29nqc918	1	1	5	1	1	1	4	2	1	1	1	5	1	5
2nqc912		1	1	4	4		4	3	4	0	0	3	2	3
30nqc918	3	2	3	3	2	1	3	2	4	4	2	2	0	1
31yqc919	3	3	3	4	4	2	4	3	4	4	4	5	4	4
32yqc919	0	0	2	2	2	3	3	0	4	4	0	5	4	3

33nqc919	0	0	0	2	2	2		2	0	0	0	0	0	0
34nqf919	2	2	1	2	2	1	4	2	4	4	2	2	2	1
35yqc920	0	0	1	0	0	0	0	0	0	0	0	1	0	0
36nqc920	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37nqc920	0	0	2	0	0	0	0	0	0	0	0	2	0	0
38yqc925	4	4	3	5	5	4	5	5	5	5	4	6	5	5
39yqc925	5	5	4	4	5	4	6	4	4	4	3	5	4	6
40nqc925	1	1	1	0	0		2				1	1	0	0
41yqc925	2	2	1	3	4	1	3	4	3	3	1	3	1	2
42npc925	4	3	2	4	6	5	5	5	3	3	2	4	4	6
43yqac925	1	0	0	2	2	1	1	2	2	3	2	2	1	1
44yc926	3	3	4	4	4	3	4	4	4	4	4	5	5	5
45nac926	1	1	2	1	0	2	1	1	1	2	1	3	3	3
46nqc926	0	0	1	1	2	2	2	1	0	1	0	1	1	0
47yqc926	1	1	2		2	0	2	2		4		1	0	0
48yqc926	3	2	3	3	3	2	3	2	3	3	2	3	3	3
49nac926														
4nc912	1	0	1	2	1	1	2	1	2	1	1	1	0	0
50nqc926	1	1	2	2	1	2	2	1	2	2	1	2	2	2
51nqc926	1	1	5	1	1	1	2	1	1	0	0	4	1	3
52nqc926	2	2	1	3	4			4	2	1	1	4	3	2
53yqac926	4	6	6	6	6	6	6	6	6	6	6	6	6	6
54yqc926	2	2	4	2	2	2	2	2	1	3	1	4	2	3
55nqc926	3	3	0	3	2	2	0	3	3	3	3	3	0	0
56yqf926	1	1	2	0	1	1	1	0	0	1	0	2	1	1
57naf927	1	1	3	1	2	2	2	2	1	0	0	2	2	2
58nc927	0	0	0	0	0	0	0	0	0	0	0	0	4	0
59nqc930	0	0	0	0	2	2	2	2	0	0	0	0	0	0
5yqc912	0	0	2	4	0	0	6	0	2	5	0	6	6	3
60nc930	3	4	3	3	3	2	4	1	2	3	3	4	3	4

61yac101	0	0	0	0	0	0	0	0	0	0	0	0	0	0
62nqc102	1	1	1	4	1	3	5	4	3	3		5	5	5
63yqc103	0	0	5			1	3	0	0	1	1	3	2	3
64yqaf108	6	6	6	0	0	0	0	0	0	0	0	6	4	6
65naf108	0	0	0	0	0	0	0	0	0	0	0	0	0	0
66npc108	2	1	4	5	5	6	6	3	6	5	6	6	1	6
67yac108	4	1	0	5	2	1	4	2	4	0	4	3	5	3
6nqc912	0	0	0	2	2	1	1	2	5	5	5	5	3	4
7yqc912	1	1	0	0	0	1	0	0	0	2	2	1	0	0
8nq912	2	0	0	2	2	2	0	2	2	0	0	0	0	0
9nqc912	1	2	4	2	3	1	3	2	1	2	1	4	4	3

Appendix 7.15: MiniRQLQ All Locations

For all locations, the summary of all respondents is grouped by the 14 questions of the MiniRQLQ.

Chart 7.15.1

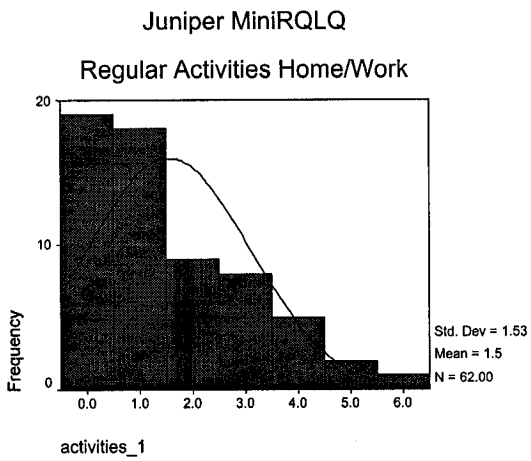


Chart 7.15.2

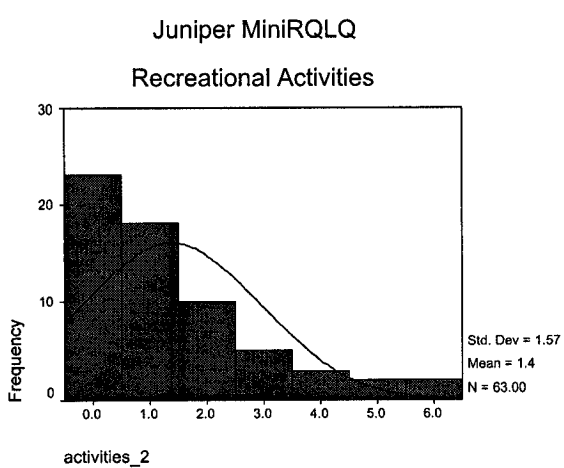


Chart 7.15.3

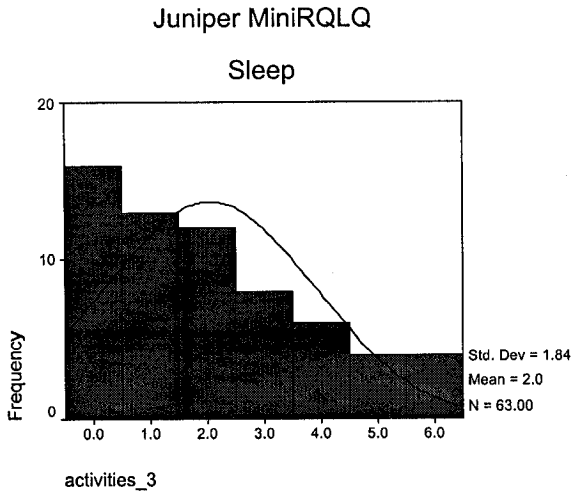


Chart 7.15.4

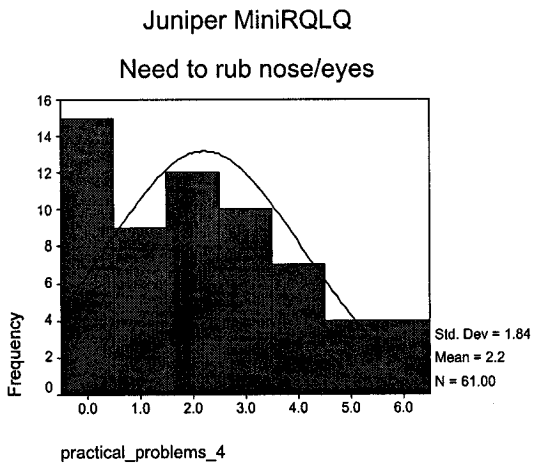


Chart 7.15.5

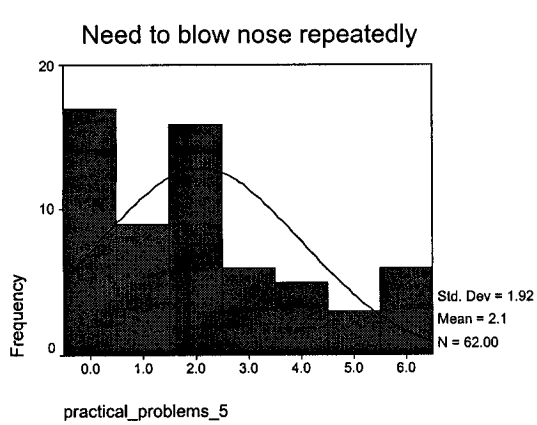


Chart 7.15.6

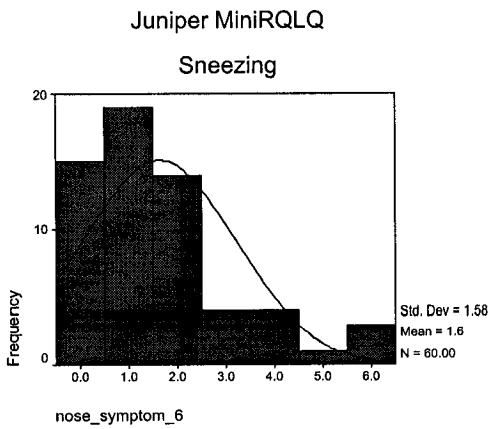


Chart 7.15.7

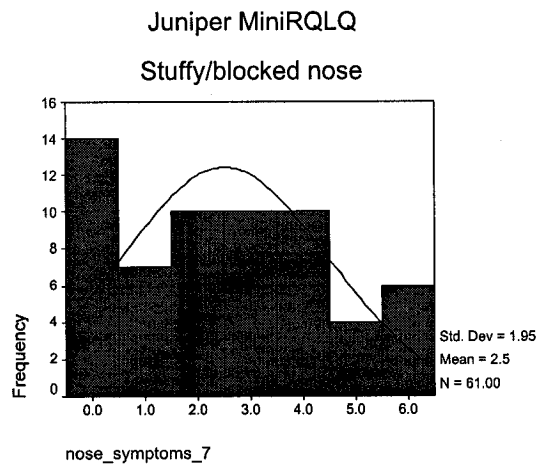


Chart 7.15.8

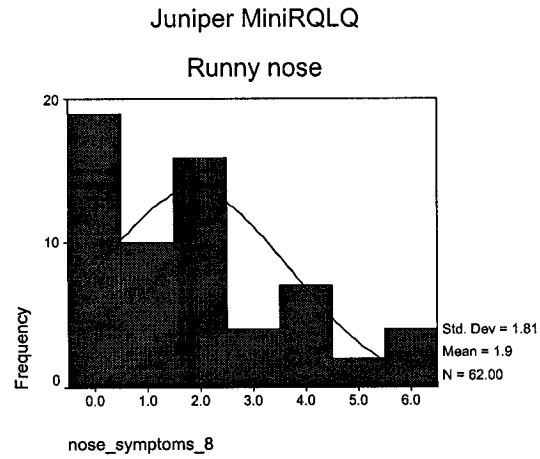


Chart 7.15.9

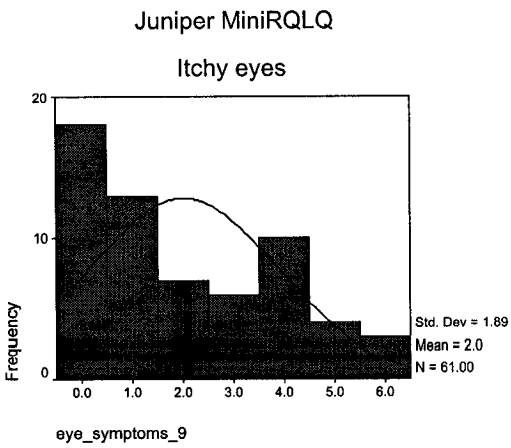


Chart 7.15.10

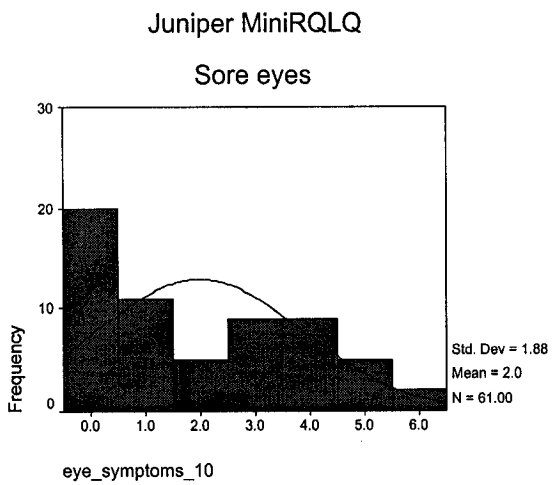


Chart 7.15.11

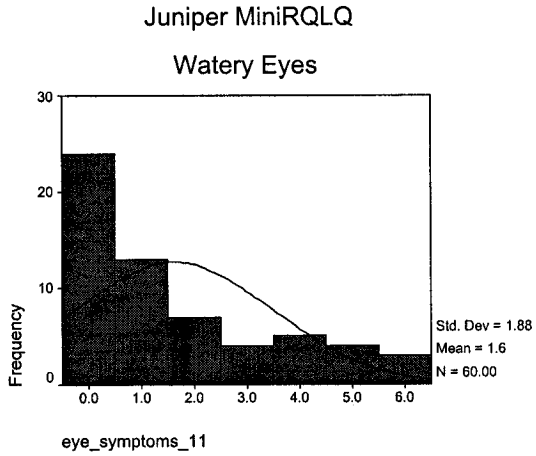


Chart 7.15.12

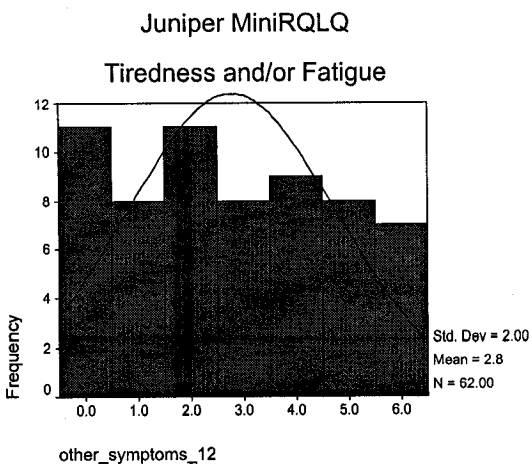


Chart 7.15.13

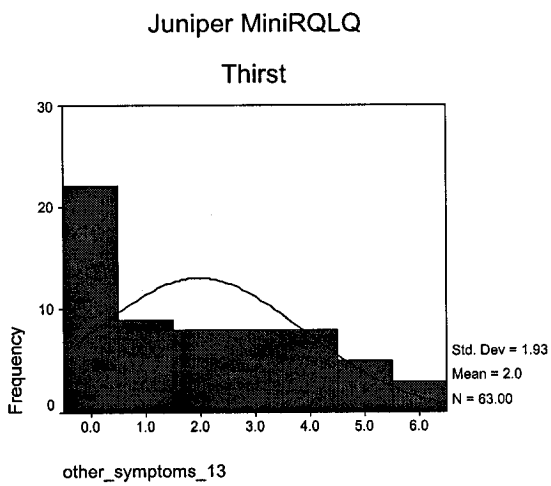


Chart 7.15.14