# An Evaluation of the Prevalence of Respiratory and General Symptoms among Occupants of Households Affected by Flooding in Guyana: The Case of Cove & John

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**Abstract** This study attempted to determine the prevalence of respiratory symptoms amongst occupants of homes affected by flooding in Guyana focusing on the area of Cove & John, East Coast Demerara. A total of 130 households representing 460 participants completed the questionnaire. This corresponds to a participation rate of 70% of households (n=130/185) and 82% of persons (n=460/562). The prevalence of upper respiratory symptoms stuffy nose, runny nose, sore or dry throat and sneezing was 5% amongst respondents. A positive association was found between the presence of less than 50% and more than 50% of mould inside the home and upper respiratory symptoms. There was an increased risk of stuffy nose odds ratio (OR): 3.86(1.34 – 11.17), itchy nose OR: 4.28(1.31 – 14.04), and sore throat OR: 6.15(2.35 – 16.15) for persons dwelling in homes with more than 50% coverage of mould compared to homes with less than 50%. A similar association was found between mould and lower respiratory symptoms; wheeze OR: 5.87(2.56 – 13.47), chest tightness OR: 4.72(1.59 – 13.97), shortness of breath OR: 4.55(2.02 – 10.23), and cough OR: 2.92(1.39 – 6.14). This study demonstrates statistically significant associations between home dampness and general symptoms and the presence of mould and upper and lower respiratory symptoms.

Key words: Mould, Dampness, Respiratory symptoms

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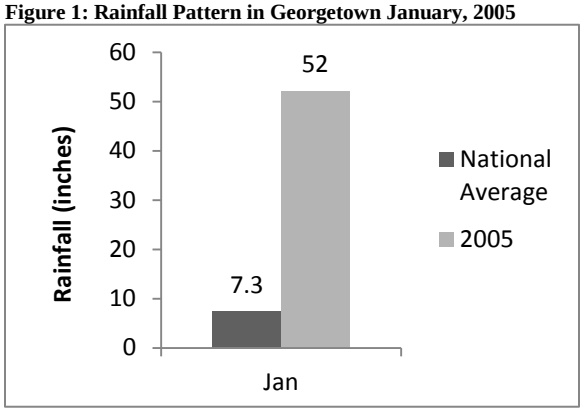
## 1. Introduction

The Institute of Medicine (IOM) defines home dampness as moisture damage arising from leaks or flooding that damages the home resulting in mould, material damage or microbial growth of variable extent and severity (IOM, 2004). Home dampness and mould are associated with upper and lower respiratory health problems. The IOM in a review of studies that investigated this relationship reported that there is sufficient evidence to conclude that there is an association between exposure to a damp indoor environment and upper respiratory tract symptoms and lower respiratory tract symptoms: cough and wheeze (IOM, 2004). Literature suggests that home dampness and mould and their associated health implications pose a problem of global proportions which is currently undiagnosed in many countries (Jaakkola et al., 2002). This may be the situation in Guyana although no published or unpublished documentation was found that highlights this as a health issue, even though home dampness is currently being experienced in

the country (GoG, 2000; GoG, 2005; MoH, 2008). Comparative literature on respiratory morbidity associated with home dampness in tropical climates is also limited, as much of the existing pool of literature investigates this relationship in temperate and subtropical climates.

Guyana experiences an equatorial climate with warm temperatures averaging at 29.6°C during the day and 24.0°C at night (Hydrometeorological 2006). Annual average rainfall totals range between 1778mm (70.0 inches) and 2800mm (110.2 inches). Relative humidity is generally above 70 percent (Hydrometeorological 2006). Guyana does not experience the extremes of hot and cold. The coastline of Guyana which is inhabited by approximately 90% of the population lies 1 to 1.5 metres below sea level at high tide (Beaie, 2007). This necessitates a network of elaborate drainage canals, sluices and pumps to remove water from the land after rainfall.

**Figure 1: Rainfall Pattern in Georgetown January, 2005**



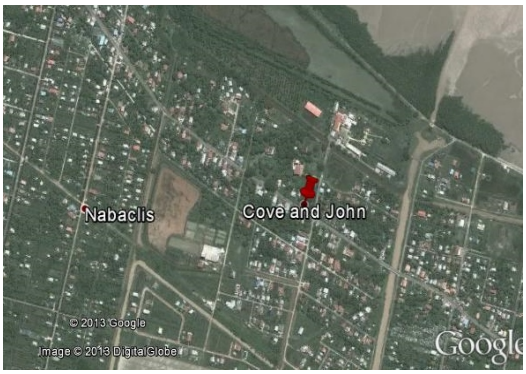

Given the current extremes in weather patterns, Guyana experiences excessive rainfall over short periods which overwhelm the drainage facilities inundating a significant proportion of residential communities. For example, in January, 2005, Guyana experienced 52 inches of rainfall compared to a national average of 7.3 inches for the month of January. This was the most severe flood in 100 years affecting nearly 200,000 people from 68 villages (GoG, 2006). Since then, while not of the same magnitude, villages are being affected by flooding annually. The focus of this study is the floods of December 2008 since during the period 1 – 18 December Guyana experienced 16.7 inches of rainfall compared to a national average of 10.3 inches which resulted in flooding of several of the coastal communities. Sanitary conditions and public health concerns are the major priority as flood waters overwhelm drinking and wastewater management systems (GoG, 2006). This study aimed to determine the prevalence of respiratory symptoms amongst occupants of homes affected by flooding in Guyana focusing on the area of Cove & John, East Coast Demerara.

## 2. Methodology

The study, conducted in 2009, aimed to determine the prevalence of respiratory symptoms among occupants of homes affected by flooding in Guyana. The target population were persons living in communities flooded in December 2008. Home dampness was defined as households flooded with a minimum of 6 inches of water for at least 3 consecutive days. There were twenty such communities affected by flooding in December, 2008. The criteria for the selection of the study population were that the community:

- ✓ Must have experienced flooding in December 2008 with at least 30% of the community flooded.

**Map of Cove and John, East Coast Demerara**




Source: "Guyana." 6°45′06.64″N and 57°58′17.98″W. Google Earth. 21 May 2013. 12 August 2013.

- ✓ Must have between a minimum of 100 and a maximum of 500 households;
- ✓ Must consist of a majority (75%) of wooden homes; and
- ✓ Must be a residential community.

The criteria yielded the community of Cove & John. A census of the community found 185 households reflecting a population of 562 persons.

The questionnaire utilised for the health assessment was a modified version of that designed by the US National Institute for Occupational Safety and Health (NIOSH). The questionnaire solicited information regarding upper and lower respiratory symptoms, using self-reports and self- reported physician diagnosis. It comprised questions regarding personal and environmental characteristics, and the presence of general symptoms. Questionnaires were administered to the female head of the household, as females tend to have more knowledge of the health problems of the family as a whole (Martin, Platt et al. 1987). Data was also collected for children under the age of 18 years with verbal parental consent. Analysis of the data elements was performed using Statistical Programme for the Social Sciences (SPSS). Prevalence was estimated including 95% confidence interval. A nonparametric test of significance, (chi-square) was used to estimate the probability that other factors account for the observed relationship other than chance. The odds ratio (OR) was also computed to determine the strength of the association between dampness and mould and respiratory symptoms. This study was approved by the Institutional Review Board of the St. George's University.

## 3. Results

A total of 130 households representing 460 participants completed the questionnaire. This corresponds to a participation rate of 70% of households (n=130/185) and 82% of persons (n=460/562). Eighteen (18) households declined to participate in the survey, thirteen (13) households were excluded due to no response after 3 home visits, twenty (20) households were vacant or abandoned, two (2) households were under construction and information solicited indicated that they were unoccupied during the flood, one (1) household had relocated to the area after the flood and the sole occupant of one (1) household was differently abled and as such could not communicate with the interviewers.

Females comprised 49% of the participants and nonsmokers 63.7% with a mean age of 34.3±21.6 years. The ethnic origin of 70% of the participants was East Indian and 65% of the respondents had primary education or less. Fifty percent (50%) of household survived on a income of less than G$50,000 (equivalent to US$250) (Table 2). Of the 77% of households affected by flooding 92% indicated less than 50% coverage of mould inside the home. Homes with no ceiling represented 76% of the housing stock surveyed. Ninety nine (99%) of the homes affected by flooding had zinc, aluminium or galvanized roofings (Table 3). Of the homes with zinc, aluminium, or galvanized roofing 75% had no ceiling and 51% indicated that water also came into the home because of roof or window damage.

During clean up 91% of the flood affected respondents indicated that they did not use a respirator during the cleanup of their homes. Of the respondents who did not use a respirator during clean

up 54% had primary or less education and survived on less than G$50,000. The relationship between the presence of mould and the use of a respirator during clean-up was statistically significant ($p<0.05$) (Fisher's Exact Test (FET): 0.007). A similar relationship was found for the presence of mould and the absence of a ceiling (FET: 0.000).

The prevalence of the most common symptoms respondents experienced during the flooding were fever and chills 33.3%; dry and itchy skin 32.2%; and headaches 22% (Table 4). The most common lower respiratory symptom was cough - 16%. The prevalence of upper respiratory

**Table 1:** Response to the Health Assessment Survey

| **Survey response** | **# of households** |
|---|---|
| Participated in survey | 130 |
| Declined to participate in the survey | 18 |
| No response after 3 home visits | 13 |
| Vacant and/or abandoned | 20 |
| Under construction (new) | 2 |
| Relocated from area | 1 |
| Unable to communicate | 1 |
| **Total** | **185** |

**Table 2:** Demographics and Personal Habits of the Participants

| **Variables** | **Participants %** |
|---|---|
| Female | 49.3 |
| Age | |
| ≤ 34 years | 52.4 |
| > 34 years | 47.6 |
| Ethnicity | |
| East Indian | 70.2 |
| African/Black | 23.7 |
| Other | 6 |
| Education | |
| < Primary | 24.3 |
| Primary | 42.6 |
| Secondary | 25.9 |
| Tertiary | 7.2 |
| Income | |
| < G$50,000 | 50.2 |
| > G$50,000 | 49.8 |
| Smoke | |
| Regularly | 16.5 |
| Never | 83.5 |

**Table 3**: Description of Households and Flooding Damage

| Description of households & flooding damage | # of households |
|---|---|
| Affected by flooding | 100 |
| Not affected by flooding | 30 |
| <50 mould in home following flooding | 92 |
| No ceiling in home | 76 |
| Zinc, aluminium, or galvanize roofing | 99 |

symptoms stuffy nose, runny nose, sore or dry throat and sneezing was 5% (Table 4). A statistically significant association ($p<0.05$) was found between flooded homes and fever and chills ($\lambda^2$:23.56). A similar association was also found between the current presence of mould and achy joints ($p<0.05$) and runny nose without cold ($p<0.05$). There was no association observed between home dampness and respiratory symptoms. However a positive association was found between the presence of less than 50% and more than 50% of mould inside the home and upper respiratory symptoms. There was an increased risk of stuffy nose OR: 3.86(1.34 – 11.17), itchy nose OR: 4.28(1.31 – 14.04), and sore throat OR: 6.15(2.35 – 16.15) for persons dwelling in homes with more than 50% coverage of mould compared to homes with less than 50% (Table 5). A similar association was found between mould and lower respiratory symptoms; wheeze OR: 5.87(2.56 – 13.47), chest tightness OR: 4.72(1.59 – 13.97), shortness of breath OR: 4.55(2.02 – 10.23), and cough OR: 2.92(1.39 – 6.14) (Table 6).

**Table 4:** The Prevalence of General & Respiratory Symptoms

| Symptoms | Prevalence (95% CI) |
|---|---|
| **General Symptoms** | |
| Fever and Chills | 0.33(0.29 - 0.37) |
| Achy Joints | 0.09(0.06 - 0.12) |
| Fatigue | 0.09(0.06 - 0.12) |
| Headaches | 0.22(0.19 - 0.26) |
| Dry or Itchy Skin | 0.32(0.28 - 0.37) |
| **Upper Respiratory Symptoms** | |
| Stuffy Nose without cold | 0.05(0.03 – 0.07) |
| Runny Nose without cold | 0.05(0.03 - 0.07) |
| Itchy Nose without cold | 0.03(0.02 - 0.05) |
| Sore or Dry Throat | 0.05(0.03 - 0.07) |
| Sneezing without cold | 0.05(0.03 - 0.06) |
| **Lower Respiratory Symptoms** | |
| Wheezing | 0.08(0.05 - 0.10) |
| Chest Tightness | 0.04(0.02 - 0.06) |
| Shortness of Breath | 0.09(0.07 - 0.12) |
| Coughing Attacks | 0.16(0.13 - 0.19) |
| Cough with Phlegm | 0.15(0.12 - 0.19) |

**Table 5**: The relationship between home dampness, mould and upper respiratory symptoms

| | Upper Respiratory Symptoms odds ratio (95% confidence interval) | |
|---|---|---|
| **Symptoms** | *Home dampness* | *Mould* |
| *Stuffy nose* | 0.63 (0.25 – 1.58) | 3.86 (1.34 – 11.17) |
| *Runny nose* | 1.42 (0.39 – 5.03) | 1.94 (0.55 – 6.89) |
| *Itchy nose* | 0.98 (0.94 – 1.03) | 4.28 (1.31 – 14.04) |
| *Sore Throat* | 1.08 (0.39 – 2.99) | 6.15 (2.35 – 16.15) |
| *Sneezing* | 0.47 (0.19 – 1.16) | 2.99 (0.95 – 9.42) |

**Table 6:** The relationship between home dampness, mould and lower respiratory symptoms

| | Lower Respiratory Symptoms odds ratio (95% confidence interval) | |
|---|---|---|
| **Symptoms** | *Home dampness* | *Mould* |
| *Wheeze* | 1.55 (0.63 – 3.84) | 5.87 ((2.35 – 16.15)) |
| *Chest Tightness* | 1.63 (0.47 – 5.70) | 4.72 (1.59 – 13.97) |
| *Shortness of Breath* | 0.86 (0.42 – 1.78) | 4.55 (2.02 – 10.23) |
| *Coughing Attacks* | 0.78 (0.44 – 1.37) | 2.92 (1.39 – 6.14) |
| *Cough with Phlegm* | 1.54 (0.79 – 2.99) | 0.48 (0.14 – 1.63) |

## 4. Discussion

The presence of mould was commonly reported by study participants. However the percentage present may have been underestimated since mould is not always visible to the naked eye (Koskinin et al., 1999; IOM, 2004). This underestimation may have contributed to the high prevalence (91%) of participants who did not use a respirator during the clean-up of their homes. This high prevalence may also be attributed in part to a lack of awareness of the dangers posed by mould as well as the level of education attained by respondents.

This study also identified statistically significant positive associations between the presence of mould and respiratory symptoms. The results found herein are similar to those found in other epidemiological studies (Koskinin et al., 1999; Norback et al., 1999; Bornehag et al., 2001; Engvall et al., 2001; Kilpenlainen et al., 2001; Engvall et al., 2002; Zock et al., 2002; Gunnbjornsdottir et al., 2003; Institute of Medicine (IOM), 2004) conducted in arctic, temperate and subtropical climates. The results indicate that despite the difference in climate and physical structure of homes mould presents a respiratory health problem for the community of Cove & John.

The significant relationship found between the presence of mould and the absence of a ceiling requires further investigation. The physical structure of homes within Cove & John indicated a high prevalence of zinc, aluminium or galvanizes roofing. It also indicated the entry of rainfall via roof or window damage, hence it was anticipated that the absence of a ceiling may have offered a protective effect against mould. Since ceilings are prone to rainfall leaks which are slow and may result in extensive mould growth unseen by the participants (IOM, 2004). However, perhaps the entry of water directly to the home via the roof may have resulted in moisture build up in walls, furnishings, and floors creating the ideal environment for the proliferation of mould.

The findings of this research indicate that home dampness and mould may present a respiratory health problem for the community of Cove and John. Given Guyana's vulnerability to flooding and the number of communities affected during these national disasters, it is imperative that a determination be made of whether or not this is indeed an undiagnosed National problem. Such that efforts can be put in place, if necessary, by the Ministry of Health and all of the relevant stakeholders to address this as a priority area as soon as possible.

It is important to note that Guyana's a total real GDP at factor cost of 847.9 million US dollars, per capita GDP was 1111$US in 2007, the lowest in the Caribbean Community (CARICOM) (MoF 2007). Thirty six percent of the Guyanese population experience absolute poverty and nineteen percent are critically poor (Thomas, 2000). As such the Guyanese population can ill afford additional expenses which can be prevented or ameliorated if this problem is diagnosed. Currently, during flood disasters, the cost attached to the adverse health consequences of home dampness are borne by the individual as it is not recognized as a priority area. In addition, dampness can cause structural damage to homes that is expensive to repair (Levin, 2005). Dampness could also cause increased emissions of some chemical pollutants from materials and surfaces that could also pose a threat to health (Fisk, Lei-Gomez et al. 2007). These are all cost that a struggling economy, such as Guyana's, can ill afford to leave unattended for much longer.

The strength of this research is in the methodology particularly the study population and the previously validated and tested research instrument. The study population is the entire community which makes the sample highly representative of what obtains within the community. However, this research suffers from several limitations. The small number of participants may have made it difficult to identify statistically significant relationships between home dampness and respiratory symptoms.

The time lag between the occurrence of the flooding and the survey may have affected the results of the health assessment. The time lag may have allowed for bias due to faulty memory of what took place in December 2008. The study sample lacks external validity since sample size is relatively small.

## 5. Conclusion

This study demonstrates statistically significant associations between home dampness and general symptoms and the presence of mould and upper and lower respiratory symptoms. These results add to the body of evidence of a relationship between home dampness and mould and respiratory symptoms. This study was conducted in a tropical climate and thus indicates further that irrespective of climate and physical structure of homes dampness and mould may present a respiratory health problem.

## Conflicts of Interest

The author declares no conflict of interest.

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