

How the July and August 2017 Wildfire Smoke Events Affected Health and Quality of Life in Kamloops, BC

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Introduction

This report examines the results of an online survey of the general population in Kamloops BC during the period from August 7 to September 4, 2017. In the interval from early July to early September, British Columbia had the most hectares of forest ever burned in recorded history and Kamloops experienced the highest PM_{2.5} (fine particulate concentrations) for the months of July and August since records began in 1998 (Tsigaris and Schemenauer, 2017). This occurred despite the major forest fires being 60 km or more from Kamloops.¹

The crisis was palpable and real time data was insufficient for the public to modify health habits and protect themselves. There are limitations to the averaged data available from the BC Ministry of the Environment monitors, which include one-hour averages of PM_{2.5} concentrations in the air. The three prior one-hour-average values are averaged and used by Environment Canada in the calculation of the Air Quality Health Index (AQHI), which in turn is used to

¹ Moeltner et al. (2013) examining smoke from numerous wildfires affecting the Reno/Sparks area of Northern Nevada over a 4-year period, found that hospital admissions can be linked to fires as far as 200–300 miles from the impact area.

describe the air quality to the public. This index also factors in the previous three hourly averages of NO₂ and O₃ and when PM_{2.5} is at such an important level, the AQHI became less useful in alerting the public. There was also a lack of Government guidelines for the extraordinary circumstance, and no alert protocol for the population. Reassurances by health representatives were given to the public about the risks being “transient” and “unlikely to cause harm” contrary to the findings of the literature on the health impact of wildfire smoke (Liu, J.C. et al. 2015; Reid et. al. 2016, Black, C. et al., 2017).² There was an opportunity to examine the impact of the smoke on the Kamloops population in real time, but this was not a focus of the Interior Health Authority. In that the physicians within the KPHES were experiencing challenges in service delivery to the population, a survey was undertaken to examine in broad terms the subjective symptoms the public was experiencing.

The Online Survey

A SurveyMonkey® questionnaire was developed and a link sent out to the public via several group emails, websites, Facebook pages, and picked up by the local media. The online survey was available from August 7th until September 4th 2017. The month of August was the worst air quality in Kamloops in 20 years of measurements (Tsigaris and Schemenauer, 2017). The worst day was August 3rd 2017 with the 24-hour average PM_{2.5} at 274.4 ug/m³. On August 7th the 24 hour average PM_{2.5} stood at 187.5 ug/m³ and remained over 100 ug/m³ until August 11th. As with all surveys (online or otherwise) the response rate is highest when it is first launched and then drops as illustrated in Figure 1 below.

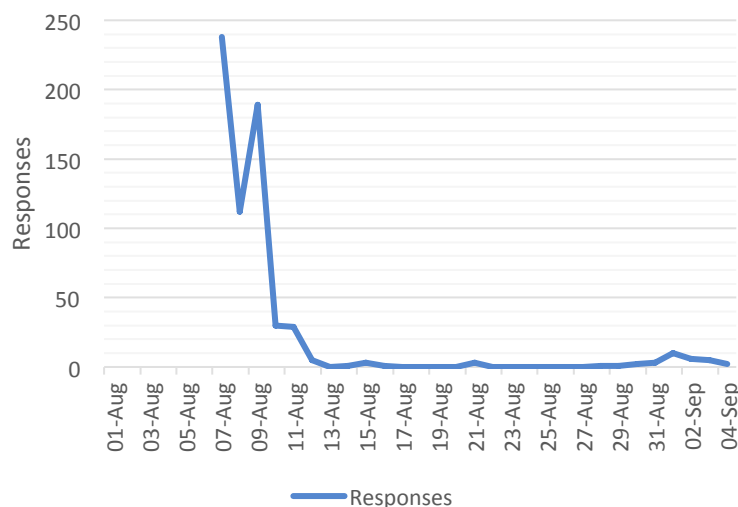


Figure 1: Survey response rate

² Liu et. al. (2015) examined 61 epidemiological studies and found that the majority showed that there was increased risk of respiratory and cardiovascular diseases from wildfire smoke. Similar findings are reported in Reid et al. (2016). More recently Black et al. (2017) examining the literature reconfirmed the association of wildfire smoke on respiratory illness.

There are advantages and disadvantages associated with online surveys. Advantages include cost of delivering, timeliness in that it coincides with the event, and accessibility (Evans and Mathur, 2005). Online surveys suffer from under-coverage of the population without access to the internet and it is not a random sample causing a bias due to self selection (Bethlehem, 2010). Even though these problems do not allow for generalizations, the analysis in this case still provides valuable information as it involves 641 members of the public. It can be assumed many more people would have been affected, given a population of 103,811³, but the exact number affected cannot be known.

There were nine question areas in total. These questions covered changes in lifestyle, symptom spectrum, utilization of the health care system, change in work or other duties, change in exercise and outdoor leisure, exercise and chores. Questions also addressed protective measures adopted, and whether the public understood the AQHI or PM_{2.5} data generated by the public and private monitors in use. The public was also polled for suggestions on management of their air. There was space for subjective suggestions, which were collated for common themes.

Impact on Lifestyle

With such severe smoky conditions one would expect an immediate impact on people’s lifestyle. Indeed this is what the survey results indicate. As Figure 2 illustrates, there were 349 of 641 respondents (54.5%) categorizing their lifestyle as severely affected by the wildfire smoke. A further 201 (31.4%) categorized the lifestyle impact as moderately affected. Only 15 (2.3%) felt the smoke did not affect them. at all.

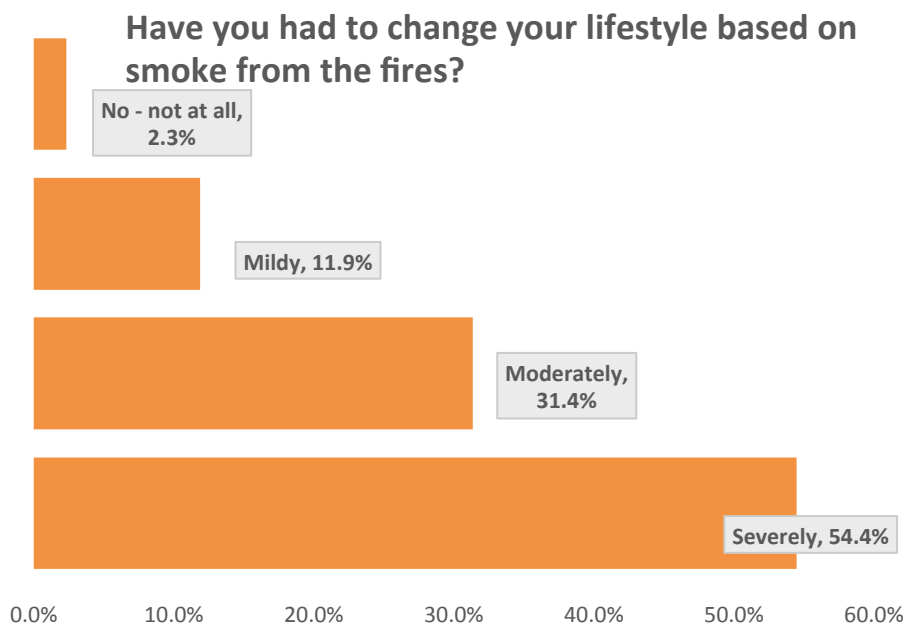


Figure 2: Impact on lifestyle

³ 2016 Canada Census for Kamloops [Census agglomeration].

Symptoms from smoky conditions

Symptoms were extensive, with the most common being eye and throat irritation, headache/irritability and fatigue/malaise. This was followed by cough/phlegm/asthma, and nose irritation. A smaller but still significant response was for anxiety/mood change, sleep disruption, and stomach upset/nausea. This survey finds that the symptoms were not only respiratory. People also reported headaches and felt tired. There were also psychological impacts such as anxiety/mood change and sleep disruption. Table 1 ranks the symptoms from highest responses to lowest.

Table 1: What Symptoms have you had that you feel is from the wildfire smoke? (choose all that apply)

Symptoms	Responses	(% from 632 responses)
Throat irritation (sore throat, hoarse voice)	502	79
Eye irritation	501	79
Headache, irritability	474	75
Fatigue, malaise	391	62
Airways irritation (cough, phlegm, asthma)	371	59
Nose irritation	346	55
Anxiety, mood change	274	43
Sleep disruption	237	38
Stomach upset, nausea	210	33
Other (please specify)	61	10

Behaviour and reactions to smoky conditions

One respondent had to be admitted to hospital, 5 used the emergency room, 13 (2%) had to go to a community health provider. 147 (23%) were using more of their usual medications such as inhalers, sinus tablets, or other pills. The majority (416, 65.2%) of respondents fell into the category of having symptoms that they “just toughed out”, and 56 (8.8%) reported that they did not have symptoms that made them use the medical system or interventions at all. Moeltner et al. (2013) studied the impact of numerous wildfires on hospital related costs for the Reno/Sparks area of Northern Nevada over a 4 year period. One of the findings was that the 2008 fire season had a smoke-induced inpatient costs in Reno/Sparks close to \$2.2 million.

Have you used the health care system for any of your symptoms?

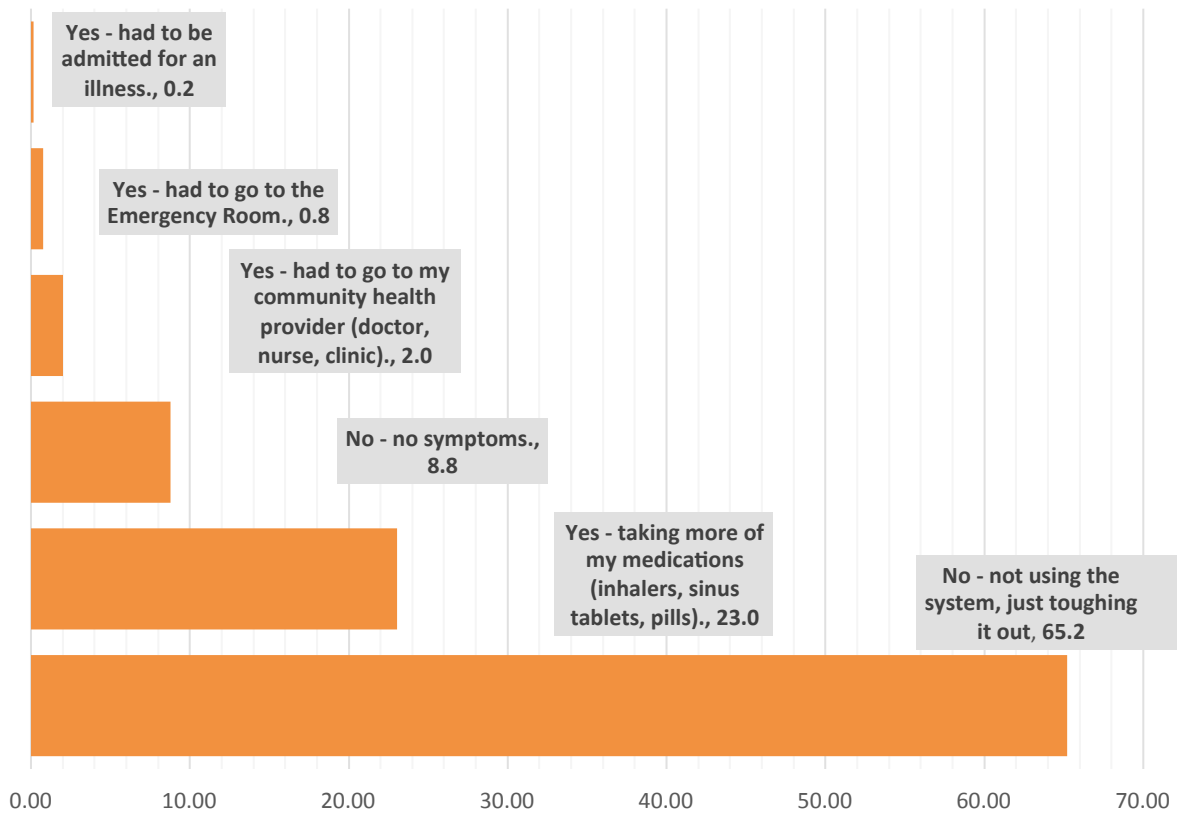


Figure 3: Reaction to smoky conditions. % of 638 responses

Impact on work

Kochi et. al. (2010) found that the cost of illness from wildfire smoke in terms of work days lost and restricted-activity days contributed significantly to total morbidity (illness) related expenditures. Studies reviewed indicated that workdays lost or restricted activity on some days and accounted for 36 to 74% of total estimated morbidity healthcare costs. Our survey results indicate a significant disruption of work activity along with adjustments and accommodations. Of respondents that were working (405 responses), there were 227 (56%) working despite symptoms, and had not made any accommodations.⁴ However, 97 (24%) were responding to mild symptoms by reducing work hours, or working from home. Another 47 (11.6%) had symptoms significant enough to be absent from work or suffered a disrupted schedule. Of those working, 23 (5.7%) were having severe symptoms and resorted to wearing a mask, taking increased breaks, or having shifts markedly disturbed. Finally, 11 people (2.7%) were unable to work due to severe symptoms. These results reconfirm the findings of Kochi et. al. (2010).

⁴ There were a number of people that were not working and hence this question was not applicable (207 out of 638). These are excluded from the percentages reported.

Have you changed your work or duties?

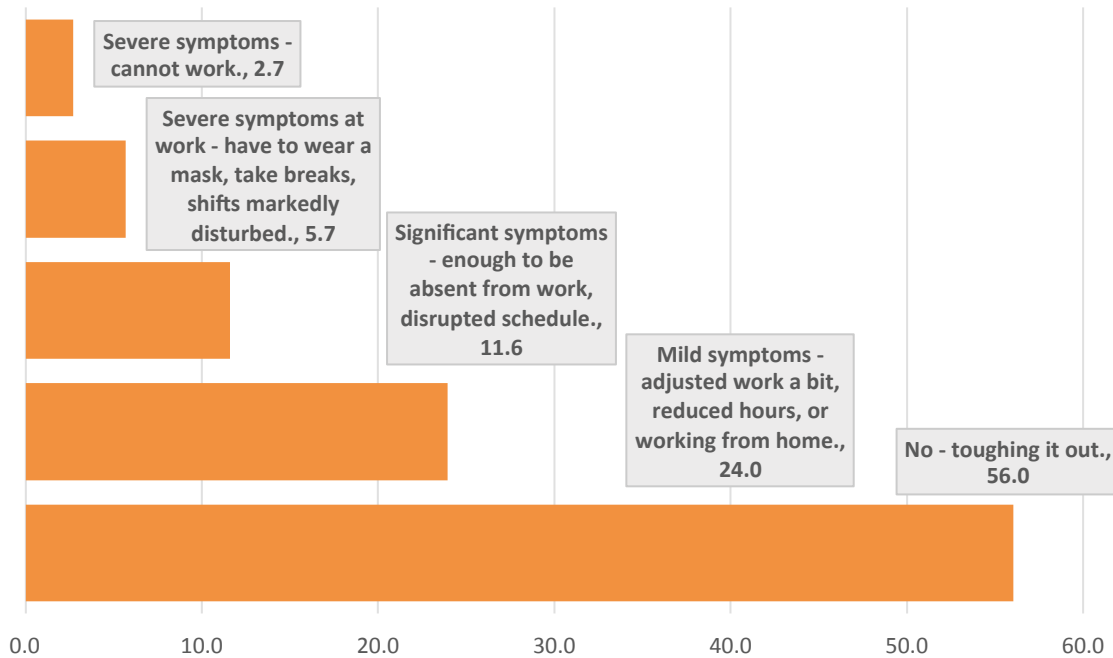


Figure 4: Impact on work or duties. % of 405 responses who were working

Impact on outdoor activities

There is evidence that air pollution and wildfire smoke impacted outdoor activities. For example, many soccer teams cancelled their participation in the long August weekend soccer tournament. Multiple sports associations made the difficult decision to postpone, cancel, or move events indoors.⁵ These are costly preventive measures in order to reduce the likelihood of a health impact. This is further discussed in the section on measures of protection. Furthermore, the Kamloops referee association implemented a policy that allowed referees to cancel the game if the AQHI index was in the high-risk category. Many recreational games were cancelled as a result of this new policy.

Exercise outdoors was severely affected in 346 (54.8%) of respondents. They were unable to do outdoor exercise and did not feel their indoor substitutes were adequate. 58 (9.1%) were wearing a mask to exercise outdoors at all. 153 (24.1%) were substituting indoor activities and trying to keep their healthy exercise activities up. 54 (8.5%) were reducing the time they spent in outdoor exercise. A minority (12, 1.9%) reported that they were just putting up with their symptoms and

⁵ See editorial by Marty Hastings in KTW entitled: “Smoke, air quality hurting Kamloops sports scene” on August 10, 2017. Access at: <https://www.kamloopsthisweek.com/smoke-air-quality-hurting-kamloops-sports-scene/>

had not changed their outdoor activities, and even fewer (10, 1.6%) were not having symptoms or changes in routines outdoors.

How much has your exercise and outdoor leisure physical activity been affected? (Running, biking, hiking, walking, water sports)

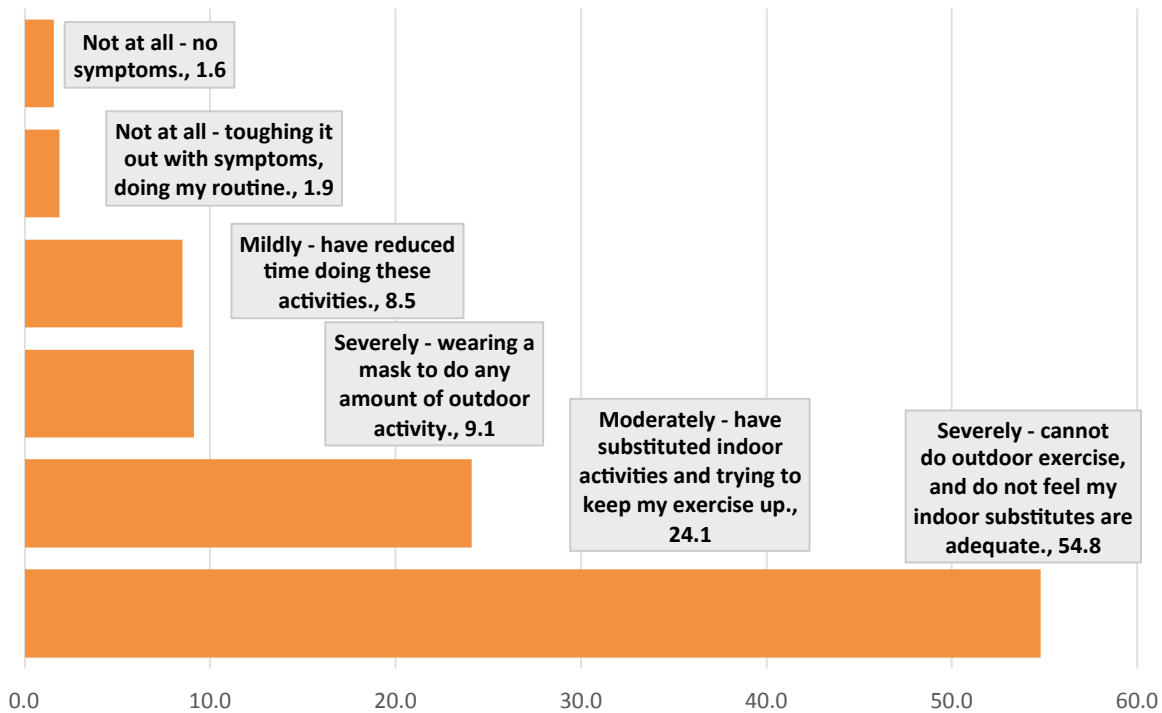


Figure 5: Impact on exercise and outdoor leisure physical activity

The survey questioned respondents on outdoor chores being affected (gardening, yard maintenance, home maintenance). A number (45, 7.0%) were living in circumstances where others keep the grounds. Most (252, 45.7%) were postponing these duties until conditions changed. Many (213, 38.7%) were targeting essential duties only and /or using specialized equipment such as a mask. Some (97, 17.6%) were reducing their time at these activities. A minority (23, 4.2%) were persisting at these activities, or reporting no symptoms (11, 2%).

How much have your outdoor chores been affected? (gardening, yard maintenance, home maintenance)

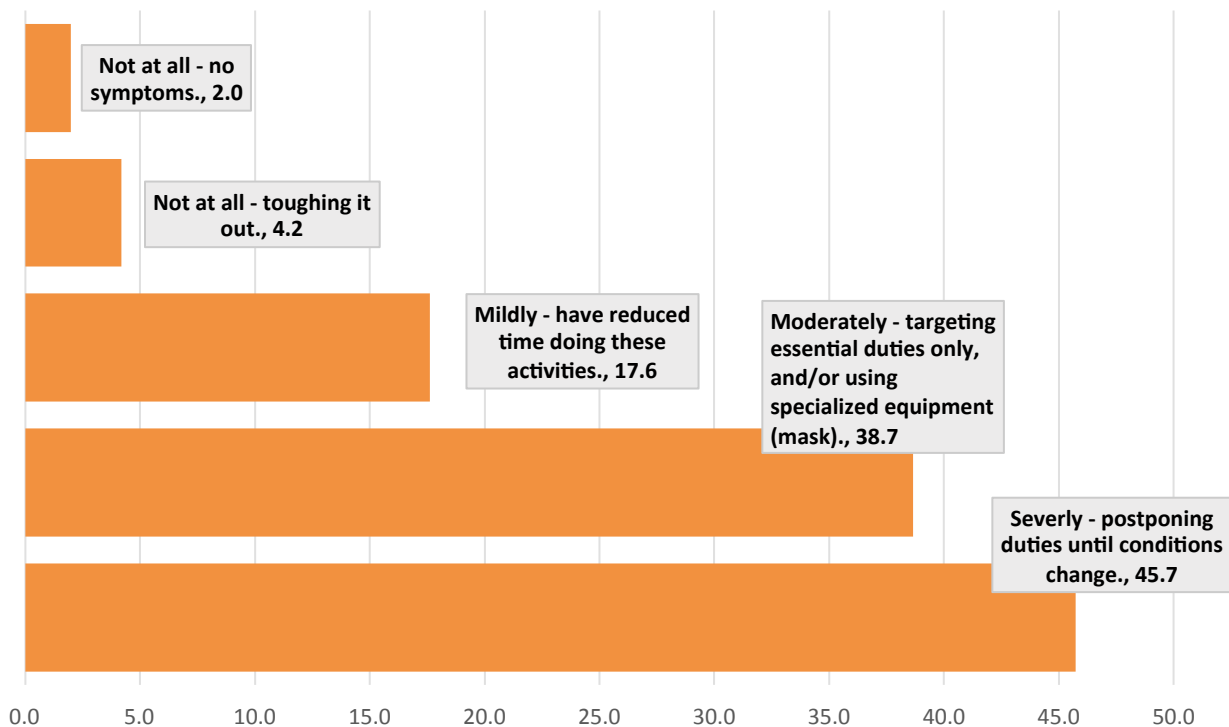


Figure 6: Impact on outdoor chores

Measures for protection

People may or may not react by reducing activities, work or otherwise. Many also do not require medical attention, but a significant number take costly protective measures to avoid or reduce the impact that smoke has on them. For example, Kunzli et al. (2006) found that it was more likely that asthmatic children were wearing masks and staying indoors during the 2003 Southern California wildfires. Richardson et al. (2012) conducted a survey and found that 89% of the respondents undertook some defensive (avoidance) measures in order to reduce their exposure to smoke from the 2009 largest wildfire in Los Angeles County's modern history. The measures taken are costly in terms of time and money. They found defensive measures to cost \$84.42 per exposed person per day. Dix-Cooper et. al. (2014) explored the evidence on reducing time outdoors during wildfire smoke events and advice to stay indoors, reduce outdoor physical activity and cancelling events. To this extent School District 73 in Kamloops took action and required students to stay indoors during recess and lunch time if air quality was bad⁶.

⁶ See Kamloops this Week article on Sept 7, 2017 titled: "Kamloops elementary students will be kept inside on bad-air days." Accessed at: <https://www.kamloopsthisweek.com/kamloops-elementary-students-will-kept-inside-bad-air-days/>

In the KPHEs survey, a high percentage (97.5%) of the respondents took some protective measures.⁷ Protective measures ranged from increased furnace air blower filter exchanges (305, 47.6%), mild lifestyle adjustments (286, 44.6%), increased use of medications (182, 28.4%), N95 masks or equivalents (142, 22.2%), air purifier units (125, 19.5%) and less specialized masks (58, 9%). Very few respondents reported no symptoms (16, 2.5%).

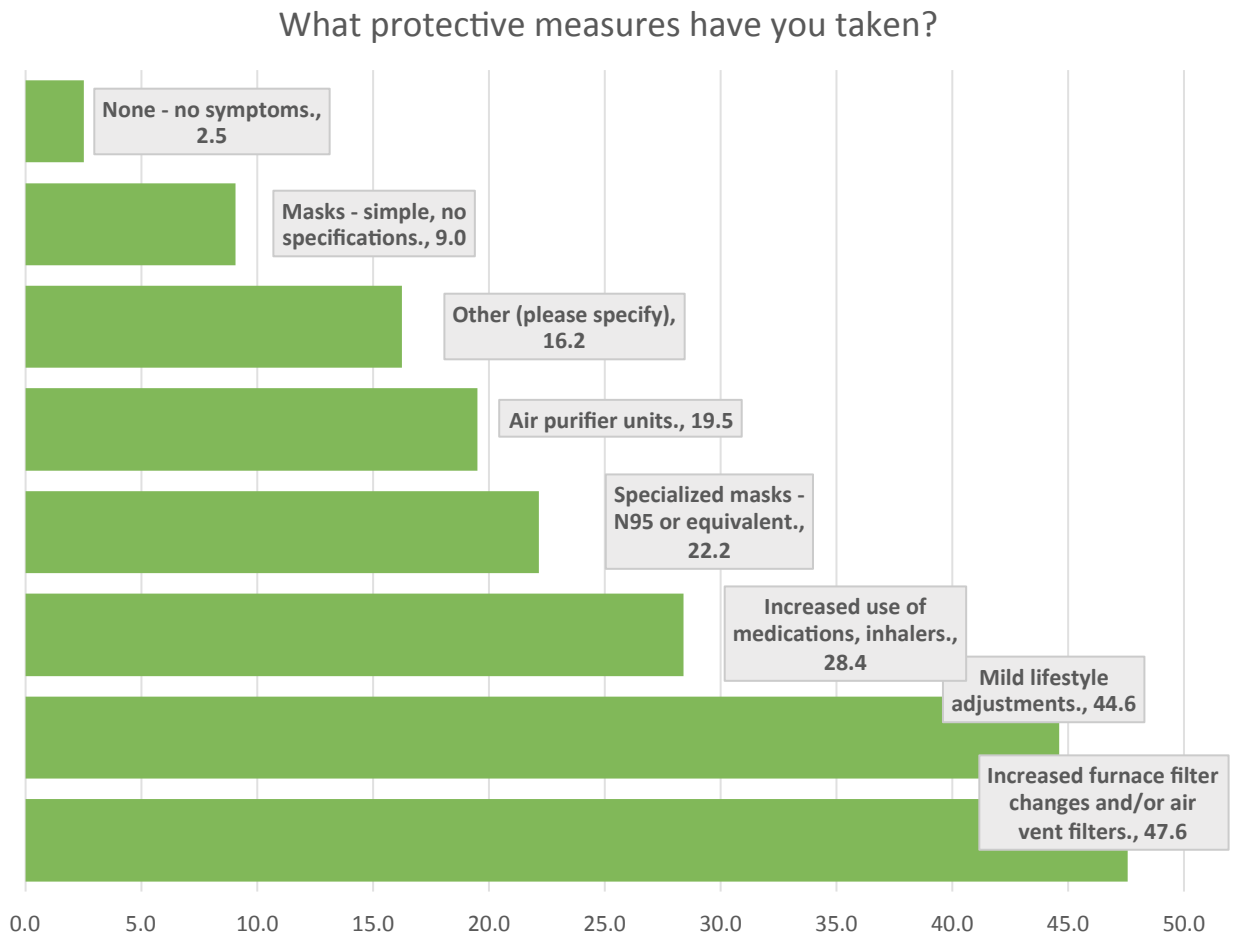


Figure 7: Costly defensive (avoidance) measures

Extreme measures for protection

The comments made by respondents identified some extreme accommodations that were not formally surveyed. Respondents described going from the Kamloops area to other areas in BC specifically to escape the air quality. Several cited vacation plans changing. Several cited changing their residence to that of a family member or friend who had an air conditioner, and capacity to filter their indoor air. Other challenges for those intending to travel in and out of Kamloops were significant flight cancellations and re-routings. The costs of ground travel and rebooking to an alternate airport fell to the consumer unless they had booked with a

⁷ The higher percent is probably due to the selectivity bias but the 89 percent found in Richardson et al (2012) is still clear evidence that the majority or 9 out of 10 people took measures.

comprehensive insurance plan for travel interruption. Vacation destinations and businesses in the region suffered severe losses which are still being estimated, an economic disaster for many.

Knowledge about air quality indicators

The respondents were asked if they understood the index produced by Environment Canada and the particulate concentrations being generated by the BC Ministry of the Environment monitors. The majority (446, 70.4%) felt that the numbers were helpful in planning activities and protective measures. Nearly one quarter (153, 24.1%) did not feel they understood these indexes and PM_{2.5} level data and would like information that would be helpful to them. A minority (35, 5.5%) did not understand the numbers and indices but were not worried about them. Six respondents commented specifically on the private monitors prevalent in Kamloops (purpleair.com). These monitors generate measurements in real time, without delay or averaging.

Air quality management recommendations

When asked what they felt would be helpful in the management of the air quality there was an even response amongst a list of choices. The respondents could pick more than one and make their own comments. The most frequent recommendation was to have a Provincial review of wildfire strategies 369 (63%). Comments from multiple respondents cited the natural cycle of wildfires and did not feel “prevention” was the best wording for this survey question. The respondents had a good command of literature and science regarding wildfire management techniques and were quick to point this out in the comments for this question. Logging practices around slash burning, controlled burns, and fuel management were cited both as concerns and as strategies.

Second on the list with 348 (59.39%) respondents were those who wanted more understandable data in “real time” for air quality alerts. Next with 303 (51.7%) were respondents agreeing there should be an active air shed management program for the region. Finally, 274 (46.8%) felt there should be collaboration between public and private sectors for monitoring air quality. Several suggestions were made that the pulp mill and other industries should be “turned off” during periods when air quality is so severely affected. Comments also clustered about concern regarding issues of further resource development near the City of Kamloops, especially extraction industries adding fine particulates to the air shed.

Table 2: Air management

What do you feel would be helpful in management of your air?	Responses	Percent
Provincial review of wildfire prevention strategies.	369	63.0
More understandable data in "real time" for air quality alerts.	348	59.4
An active air shed management program for your region.	303	51.7
Collaboration between public and private sectors for monitoring air quality.	274	46.8
Total	586	100

Comments were expressed around a lack of support during this crisis. Funded high quality masks, air filter subsidies, more air monitors, and air quality alerts were suggestions repeated through the comments sections of the survey. There were comments suggesting the air quality requirements of WorkSafeBC be employed as a standard. The exact standards used by WorkSafeBC were not quoted. There were comments supporting work leaves, both funded and unfunded.

A few respondents wanted better surveillance, fines, and actions taken against those starting fires through careless human activity.

Some of the smaller towns around Kamloops had respondents comment that the air quality monitors in Kamloops do not help them too much as they were outside of that catchment. They wished for more monitors in towns and villages in their areas.

Some comments were pointing in a different direction, with suggestions that “nature happens” and suggestions that wildfire smoke would be negligible if compared to industrial pollution.

Wood burning as a source of fuel and heat, and of course the family summer event of a bonfire, is in conflict with the data correlating particulates from burned wood as a carcinogen. The literature making the association between wood smoke and cancer is becoming quite clear. The BC Lung Association has a major initiative to reduce wood-burning stoves for this reason. Trying to reduce this risk, while at the same time doing controlled burns to reduce sources of fuel before the next fire season, makes it all the more confusing as to how to manage the air shed AND reduce fire risk.

All these concerns are in line with the recommendation of Black et. al (2017) in terms of direction of future research, which is improving air quality monitoring, predicting and reporting. Effectiveness of public health messaging and communication channels during wildfires has recently been examined by Fish et. al. (2017) but was mainly observational and descriptive in nature, thus rendering it insufficient to answer questions regarding effectiveness.

Conclusions

We conclude that the wildfire smoke of July and August 2017 impacted health and healthy lifestyles of Kamloops and region significantly. The air quality during these unprecedented wildfires had direct physical, psychological, social, and economic impacts to citizens.

We encourage the Health Authorities to develop a system of monitoring the health of the population in BC for both short term and long term health impacts.

We suggest the Ministry of Health partner with the Ministry of the Environment to develop alerts with a timescale suitable to describe short-term fluctuations in the smoke produced by wildfires and which utilize all relevant measurements available in a community such as Kamloops.

During extreme smoke events such as the summer of 2017, the Province should supply facemasks of the proper quality to adequately filter out the fine particles produced by wildfires. Filters for furnace-fans and other prevention equipment may need emergency planning as demand may outstrip supply. In the most extreme of circumstances, a disaster response plan

should include industrial sized filters installed in strategic public buildings to act as air-shelters for those who do not have homes with air-conditioners or furnace fans.

The Province should develop guidelines for those who work outside and enforce protection measures or work-cessation legislation for employers. Disaster planning should include designation of essential services and a protection plan for those workers who are required to fill these essential services.

The value of the survey and of the report, is not that we have found the nature of the responses from the public to the survey to be necessarily unexpected but rather, that they have been quantified so that they can be discussed and addressed. It is valuable to have looked at the responses from the public and compared them to effects experienced by other people, as reported in the medical and scientific literature, in other locations, during extreme forest fire events.

Furthermore, not too many surveys are done concurrently when the event is happening and to such a detail. It is also meant for future generations to read and be aware of the impact of the worst smoke episode in Kamloops. Finally it suggests further study is needed to determine if there was a significant impact on respiratory disease exacerbation, cardiovascular or stroke incidence rates relative to calmer periods, and to determine the economic cost of the impact of high levels of smoke in Kamloops and region.

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