

Original Research

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Abbreviations:

DALYs, Disability Adjusted Life Years; MDD, Major Depressive Disorder; PHQ-9, Patient Health Questionnaire-9; PTSD, Posttraumatic Stress Disorder; SPSS, Statistical Package for the Social Sciences

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Evaluating the Prevalence and Correlates of Major Depressive Disorder Among Residents of Fort McMurray, Canada, One Year After a Devastating Flood

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Abstract

Objective: This study assessed the prevalence and correlates of depression following the April 2020 flooding in Fort McMurray.

Methodology: A cross-sectional study design. Questionnaires were self-administered through an anonymous, online survey. Data collected included sociodemographics, flooding-related variables, clinical information, and likely major depressive disorder (MDD) using PHQ-9 scoring. Data were analyzed using descriptive statistics, the chi-square test, and logistic regression at $P = < 0.05$.

Results: Of the 186 respondents who completed the survey, 85.5% (159) of the respondents were females, 14.5% (27) were males, 52.7% (98) were above 40 years of age, and 94% (175) were employed. The prevalence of mild to severe depression among the respondents was 53.7% (75). Respondents who reported that they are unemployed are 12 times more likely to have a moderate to severe depression (OR = 12.16; 95% CI: 1.08–136.26). Respondents who had previously received a mental health diagnosis of MDD are five times more likely to have moderate to severe depression (OR = 5.306; 95% CI: 1.84–15.27).

Conclusion: This study suggests that flooding could impact the psychosocial and mental health of affected people. There is a need to reassess the existing guidelines on emergency planning for flooding to reduce its impacts on mental health and identify where research can support future evidence-based guidelines.

Flooding can have a serious effect on people's health and well-being, both psychological and physical. In common with other types of major disasters, the effects on people's health, relationships, and welfare can be affected by flooding. Floods are one of the most common types of global natural disasters responsible for almost 53 000 deaths in the last decade.¹ Flooding can cause substantial social and welfare problems that may linger over extended periods because of not only being flooded (the primary stressor), but also because of the secondary stressors (those stressors that are indirectly related to the initial extreme event, ie, economic stress associated with re-building) that arise as people try to recover their lives, property, and relationships. Flooding can challenge the psychosocial resilience of the hardest of people who are affected.² Psychosocial impacts of flood events suggest that they can have significant adverse effects on people's well-being, relationships, and mental health.³

Climate change has contributed to an increase in the intensity and frequency of floods. It will also worsen hurricanes, heat waves, droughts, wildfires, dust storms, and tornadoes.² This is because climate change entails changes in precipitation, along with temperature, wind patterns, atmospheric pressure, cloudiness, and humidity.

In their 2005 review on the global health impacts of flooding, Ahern *et al.*⁴ reported several epidemiological studies that assessed the effects of flooding on common mental disorders (including anxiety and depression), posttraumatic stress disorder (PTSD), and suicide. Most studies examining the effects of flooding on common mental disorders are from high or middle-income countries, and results revealed significant increases in depression, anxiety, and psychological distress among flood-affected adults. This means that experiencing a flood effect can lead to long-term negative psychological effects, long after the flooding itself has abated. Long-term health problems, in particular, adverse mental health outcomes, have been

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linked to the experience of flooding, including elevated levels of depression, anxiety, and PTSD in affected populations.^{5–7} Several factors are known to be associated with the likelihood of experiencing adverse mental health outcomes post-flooding. These include sociodemographic characteristics such as age, gender, socioeconomic and education statuses, and factors related to the nature of flooding (eg, depth and duration).⁸ Secondary stressors, including problems with relationships, loss of sentimental items, and difficulties with insurance or compensation, have also been associated with poor psychological outcomes.

Fort McMurray located in Alberta, Canada, has experienced several major natural disasters over the past 5 years. These include wildfires associated with an evacuation order in 2016, flooding in 2020, and also the COVID-19 pandemic in 2020.

These traumatizing experiences are believed to have adversely impacted the mental health and general well-being of survivors.^{6,9} On April 27, 2020, a major ice jam and melting waters caused massive flooding in downtown Fort McMurray. This forced over 15 000 people to be evacuated according to media reports.¹⁰ At the individual level, experiencing an episode of flooding may trigger memories of previous flooding episodes, intensifying the distress experienced.⁹ Multiple factors associated with flooding could trigger psychological distress, including fears and actions taken to protect family or belongings, experience of flooding, and long-term uncertainties concerning insurance.^{11–13} Additionally, it is plausible that the act of evacuation itself would also trigger stressful memories. Those who have been previously affected by flooding may also experience anticipatory anxiety and stress about the prospect of future flooding.^{14,15} This study assessed the clinical correlates of Major Depressive Disorder (MDD) following a flooding incident at Fort McMurray.

Methods

Study Setting

The study was conducted in Fort McMurray, Alberta, Canada. Fort McMurray is the urban service area of the Northern Alberta Regional Municipality of Wood Buffalo, with a diverse population of 111 687 as of the 2018 census,¹⁶ mainly in temporary accommodations (hotels, motels, and boarding house) and in adjoining rural communities. Fort McMurray is a multicultural community, attracting people from all corners of Canada and the world. Generally, moves to Fort McMurray have increased in the last decade. The ethnic groups include 65.8% white, 22.1% Aboriginal, 3.8% South Asian, 2.5% Filipino, 1.9% black, and 1.2% Arab. The total number of dwelling units in the Municipality in 2020 is 28 281. This represents an 8.4% decrease from the total number of dwelling units in 2015. The decrease is largely attributed to dwelling units that were destroyed by the 2016 Horse River Wildfire.¹⁷ The study site is considered the heart of one of Alberta's (and Canada's) hubs of petroleum production, located near the Athabasca oil sands. Besides the oil sands, the economy also relies on natural gas and pipeline transport, forestry, and tourism. People typically move to the Fort McMurray area to work in the oil sands industry.¹⁷ The major employers of labor in Fort McMurray are oil companies, which made Fort McMurray a thriving industrial center that attracted an influx of oil-industry workers who took up both permanent and temporary residences.

Study Design

This study adopted a descriptive cross-sectional study design. The study was carried out between April 24 and June 2, 2021, through a self-administered questionnaire that was sent to residents of FMM via REDCap.¹⁸

Ethical Consideration

Study approval was granted by the Research Ethics Board at the University of Alberta (Pro00066054). This study was also conducted in accordance with the Declaration of Helsinki (Hong Kong Amendment).

Data Collection

Data collection tools for this study were developed based on published literature and questions from previously validated instruments. The general constructs of interest included relevant demographic information, flood-related questions, and the mental health status of respondents. A standardized measure for likely MDD included in the survey was the Patient Health Questionnaire-9.¹⁹

REDCap is a secure web application for building and managing online surveys and databases. It is also used to collect virtually any type of data in any environment. It is specifically geared to support online and offline data capture for research studies and operations.¹⁸ The questionnaire was distributed randomly via email using government, school, occupational, and community platforms. Consent was implied, by completing the survey. Links to self-administered questionnaires were distributed randomly via email using intermediary agencies such as government, schools, and occupational and community platforms.

Statistical Analysis

A data analysis was undertaken using SPSS Statistics for Windows (Version 26; IBM Corp, Armonk, NY).²⁰ Demographic characteristics, flooding-related variables, as well as responses to questions related to MDD were summarized by absolute numbers and percentages. Only completed responses were reported, with no data imputation. The chi-square test and Fisher's exact analysis with 2-tailed significance ($P \leq 0.05$) were performed to assess the association between the demographic characteristics and responses to questions related to flooding and MDD, as measured using the Patient Health Questionnaire (PHQ-9) index. The PHQ-9 (included in appendix) is a multipurpose instrument used for screening, diagnosing, monitoring, and measuring the severity of depression, and it is a reliable and valid measure of depression severity.¹⁹ The PHQ-9 scale is half the length of many other depression measures, has comparable sensitivity and specificity, and consists of 9 criteria upon which the diagnosis of Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), fourth edition, depressive disorders is based. The PHQ-9 scoring was done using the standard recommendation with the threshold for likely moderate to high depression being met if 5 of the 9 items were checked and the total score was ≥ 10 .

Variables with statistically significant or near-significant association ($P \leq 0.1$) for each of the sociodemographic and flooding domains and MDD were entered into a logistic regression model. Before performing the logistic regression analysis, correlational diagnostics were performed to identify any strong intercorrelations

(Spearman's correlation coefficient of 0.7 to 1.0 or -0.7 to -1.0) among predictor variables. Odds ratios from the binary logistic regression analysis were calculated to determine the association between the predictor variables and the presence of MDD controlling for the other variables in each model.

Results

Out of the total of 249 persons who accessed the survey, there were 186 responses received, giving an effective response rate of 74.7% (see Table 1). Of the 186 respondents who completed the survey, 85.5% (159) of the respondents were female while 14.5% (27) were male, 52.7% (98) were above 40 years of age, 40.3% (75) were between the ages of 26 and 40 years, and the lowest proportion (7.0%; 13) was less than 25 years of age. Also, 94.1% (175) were employed and 5.9% (11) were unemployed. The majority (71%; 132) of the respondents were married or partnered, 19.4% (36) were single, and 9.7% (18) were either divorced or separated at the time of this study.

A larger percentage of the respondents, 94.6% (176), resided in Fort McMurray during the year 2020 flood while 5.4% (10) of the respondents were temporary residents in Fort McMurray during the flood. The majority, 75.8% (144), own a home, 24.2% (45) were renting a home. Nearly half, 48.4% (90), of the respondents reported that they had not received a mental health diagnosis from a health professional following the flooding. The study also showed that 31.2% (58) of the respondents received a mental health diagnosis for depression, and 41.9% (78) of the participants received a diagnosis for anxiety. However, 1.1% (2) received a mental health diagnosis of bipolar disorder and personality disorder while a few, 9.1% (17), received other diagnoses from a health professional following the flooding.

The respondents reported that they received antidepressants, 31.7% (59); sleeping tablets, 11.3% (21); mood stabilizers, 6.5% (12); antipsychotics, 2.2% (4); benzodiazepines, 2.2% (4); and other medications, 1.6% (3), while 64.5% (120) were not on any medication due to mental health. Most of the respondents, 61.3% (114), did not receive mental health counseling in the past year, while 38.7% (72) received mental health counseling in the past year; 50.7% (98) reported that they would like to receive mental health counseling, while 47.3% (88) declined mental health counseling.

Seventy percent (123) reported that they were fearful of their life and family during the flooding, 29.3% (51) were not fearful; 66.7% (116) watched television images about the devastation caused by the flood on a daily basis; 21.3% (37) and 12.1% (21) did not watch daily and did not watch at all, respectively. Most of the respondents, 88.7% (156), did not suffer any loss of property during the flood, while 11.3% (21) reported that they suffered a property loss. Most, 85% (147), were living in the same household before the floods, 12.7% (22) were living in a different house even though their previous home wasn't destroyed, and 2.3% (4) reported that they live in a different house because their previous home was destroyed by the flood.

Forty-four percent (74) received absolute support from family and friends, 15.6% (26) had some support, and 10.2% (17) only had limited support from family and friends (absolute support from family and friends implies full support without any restriction or condition while limited support is referred to not receiving full support from their family and friends); 6.4% (11) of the respondents claimed that they received absolute support from the

Government of Alberta, 4.1% (7) had some support, 3.5% (6) got limited support, 7.0% (12) did not receive any support, and 78.9% (135) reported they were not impacted by the flood, hence there was no support from the Government of Alberta. The prevalence of mild to severe depression among the respondents was 53.7% (75).

Table 2 shows a summary of the results of univariate analysis of the association between respondents' demographic profile, flood-related variables, and moderate to severe depression.

The chi-square test showed a significant ($P \leq 0.05$) relationship between sociodemography, clinical variables, and moderate to severe depression. Nine variables were statistically significant, including (1) employment status, (2) received mental health diagnosis on depression from a health professional, (3) received mental health diagnosis on anxiety from a health professional, (4) received mental health diagnosis from a health professional, (5) would like to receive mental health counseling, (6) on antidepressant medication, (7) on benzodiazepine medication, (8) on sleeping tablet medication, and (9) on any mental health medication for health concerns.

Table 3 below shows the logistic regression model to determine the likelihood of moderate to severe depression among the study participants in Fort McMurray.

The multivariate binary logistics regression model was statistically significant; $\chi^2(df = 11; n = 162) = 59.90, P < 0.001$; this indicated that the multivariate binary logistic regression model could differentiate between the respondent who had a moderate to severe depression and respondents who had a mild depression.

The model accounted for 30.9% (Cox and Snell R^2) to 41.3% (Nagelkerke R^2) of the variance. According to the goodness-of-fit statistic using Hosmer-Lemeshow goodness-of-fit test, the model was adequately fit ($\chi^2 = 5.34; P = 0.72$) and correctly classified 75.9% of cases.

According to Table 3, only 3 variables—employment status, received a mental diagnosis of depression, and would like to receive mental health counseling—significantly predicted likely MDD. Study participants who reported that they are unemployed are 12 times more likely to present with MDD symptoms (OR = 12.16; 95% CI: 1.08–136.26).

Study participants who have received a mental health diagnosis of MDD are 5 times more likely to have moderate to severe depression (OR = 5.306; 95% CI: 1.84–15.27). Respondents who would like to receive mental health counseling are 6 times more likely to show MDD symptoms (OR = 6.12; 95% CI: 2.41–15.49).

Discussion

This study provides a strong indication of an association between flooding and probable MDD. Given projections that both the frequency and severity of flooding events will continue to increase in the future,^{21–23} populations living in flood-susceptible areas may be exposed to multiple flooding events, which may cause repeated mental health issues.

In this study, unemployment showed a relationship with likely MDD among the study participants. Climate change and economic downturns have become a global problem that has been influencing many of the key social determinants of health, especially through unemployment and changes to living conditions. A natural disaster such as flooding is characterized by a rise in unemployment, reductions in income, as well as a reduction in total well-being. Unemployment is associated with an increase in distress

Table 1. Demographic profile, clinical characteristics, and received support for the study population

Variables	Male n (%)	Female n (%)	Overall n (%)
Age categories			
< 25years	4 (14.8)	9 (5.7)	13 (7.0)
< 26-40years	5 (18.5)	70 (44.0)	75 (40.3)
> 40years	18 (66.7)	80 (50.3)	98 (52.7)
Employment status			
Employed	24 (88.9)	151 (95.0)	175 (94.1)
Unemployed	3 (11.1)	8 (5.0)	11 (5.9)
Marital status			
Married/partnered	17 (63.0)	115 (72.3)	132 (71.0)
Divorced/separated	1 (3.7)	17 (10.7)	18 (9.7)
Single	9 (33.3)	27 (17.0)	36 (19.4)
Did you reside at Fort McMurray during the 2020 flood?			
No	2 (7.4)	8 (5.0)	10 (5.4)
Yes	25 (92.6)	151 (95.0)	176 (94.6)
Housing status before 2020 flooding			
Own a home	17 (63.0)	124 (78.0)	144 (75.8)
Renting	10 (37.0)	35 (22.0)	45 (24.2)
Mental health diagnosis from a health professional			
Depression	6 (22.2)	52 (32.7)	58 (31.2)
Bipolar disorder	1 (3.7)	5 (3.1)	6 (3.2)
Anxiety	9 (33.3)	69 (43.4)	78 (41.9)
Schizophrenia	0 (0.0)	0 (0.0)	0 (0.0)
Personality disorder	0 (0.0)	2 (1.3)	2 (1.1)
Other diagnosis	5 (18.5)	12 (7.5)	17 (9.1)
No mental health diagnosis	15 (55.6)	75 (47.2)	90 (48.4)
Medications due to a mental health concern			
Antidepressants	7 (25.8)	52 (32.7)	59 (31.7)
Antipsychotics	3 (11.1)	1 (0.6)	4 (2.2)
Benzodiazepines	0 (0.0)	4 (2.5)	4 (2.2)
Mood stabilizers	3 (11.1)	9 (5.7)	12 (6.5)
Sleeping tablets	4 (14.8)	17 (10.7)	21 (11.3)
Other	1 (3.7)	2 (1.3)	3 (1.6)
Not on medication	18 (66.7)	102 (64.2)	120 (64.5)
Mental health counseling in the past year			
No	18 (66.7)	96 (60.4)	114 (61.3)
Yes	9 (33.3)	63 (39.6)	72 (38.7)
Would like to receive MH counseling			
No	18 (66.7)	70 (44.0)	88 (47.3)
Yes	9 (33.3)	89 (56.0)	98 (52.7)
Fearful for your life and family during the flooding			
No	19 (79.2)	104 (69.3)	123 (70.7)
Yes	5 (20.8)	46 (30.7)	51 (29.3)
How frequently did you watch the television images about the devastation caused by the flood?			
Daily	15 (62.5)	101 (67.3)	116(66.7)
Not daily	6 (25.0)	31 (20.7)	37 (21.3)
Did not watch TV images of the devastation	3 (12.5)	18 (12.0)	21 (12.1)
How frequently did you read newspaper and Internet articles related to devastation caused by flooding?			
Daily	15 (62.5)	117 (78.5)	132 (76.3)
Not daily	8 (33.3)	27 (18.1)	35 (20.2)
Did not watch TV images of the devastation	1 (4.2)	5 (3.4)	6 (3.5)
Did you lose property as a result of the floods in Fort McMurray?			
Home suffered substantial damage	1 (3.7)	8 (5.0)	9 (4.8)
Home suffered slight damage	1 (3.7)	4 (2.5)	5 (2.7)

(Continued)

Table 1. (Continued)

Variables	Male n (%)	Female n (%)	Overall n (%)
Car was completely destroyed by flood	1 (3.7)	3 (1.9)	4 (2.2)
Business was completely destroyed by flood	0 (0.0)	6 (3.8)	6 (3.2)
Did you suffer any loss of property in the flood?			
No	24 (88.9)	141 (88.7)	156 (88.7)
Yes	3 (11.1)	18 (11.3)	21 (11.3)
Did you live in the same household before the floods?			
Yes	18 (75.0)	129 (86.6)	147 (85.0)
No, I live in a different house even though my previous home was not destroyed by the flood	5 (20.8)	17 (11.4)	22 (12.7)
No, I live in a different house because my previous home was destroyed by the flood	1 (4.2)	147 (85.0)	4 (2.3)
Did you receive support from family and friends after the floods?			
Yes, absolute support	10 (43.5)	64 (44.4)	74 (44.3)
Yes, had some support	3 (13.0)	23 (16.0)	26 (15.6)
Yes, but only limited support	2 (8.7)	15 (10.4)	17 (10.2)
Did you receive support from Red Cross after the floods?			
Yes, absolute support	2 (8.3)	11 (7.5)	13 (7.6)
Yes, had some support	2 (8.3)	4 (2.7)	6 (3.5)
Yes, but only limited support	0 (0.0)	7 (4.8)	7 (4.1)
Not at all	2 (8.3)	8 (5.4)	10 (5.8)
I was not impacted by the flood	18 (75.0)	117 (79.6)	135 (78.9)
Did you receive support from the Government of Alberta during and after the floods?			
Yes, absolute support	2 (8.3)	9 (6.1)	11 (6.4)
Yes, had some support	2 (8.3)	7 (4.1)	7 (4.1)
Yes, but only limited support	0 (0.0)	6 (3.5)	6 (3.5)
Not at all	2 (8.3)	12 (7.0)	12 (7.0)
I was not impacted by the flood	18 (75.0)	135 (78.9)	135 (78.9)
Did you receive support from insurers during and after the floods?			
Yes, absolute support			
Yes, had some support	0 (0.0)	4 (2.7)	5 (2.9)
Yes, but only limited support	1 (4.2)	6 (4.1)	7 (4.1)
Not at all	1 (4.2)	10 (6.8)	11 (6.4)
I was not impacted by the flood	21 (87.5)	122 (83.0)	143 (83.6)

and psychosomatic symptoms, anxiety, depression, melancholy, feeling of dependency, inability to solve routine problems, self-dissatisfaction, and lower self-esteem.^{24,25} While this study has shown an association between unemployment and depression in this vulnerable population exposed to flooding, it has not ascertained causality.

In our study, the prevalence of mild to severe depression among the respondents was 53.7% (75); this is in line with a prevalence of 54% among adults in a study on depression following natural disaster.²⁶ Our study also showed that respondents who have received a mental health diagnosis for depression are more likely to have moderate to severe depression. Those who were already diagnosed with MDD seem to be having MDD symptoms, meaning that they were either not controlled on medications or therapies they received or the experienced trauma was out of control. In a community sample, Cao et al.²⁵ identified 4 response patterns in the outcome of a natural disaster: (1) minimal symptoms, (2) predominant depression, (3) predominant PTSD, and (4) comorbid PTSD and depression. Of note, persons with a predominately depressed presentation represented approximately one-fifth of the community sample (and 40% of those presenting with symptoms) and reported more somatic complaints and a high level of interpersonal problems compared to those considered to be PTSD symptoms.

Experiences during the natural disaster (eg, flooding) may be more indicative of PTSD following a natural disaster compared to depression. Meanwhile, a collection of studies shows that further processes, specifically disaster-related stressors and individual-level factors, may lead to post-disaster depression.^{27–29} Furthermore, past symptoms of depression may also serve as a strong indicator of post-disaster depression. Stander et al.²⁹ proposed a causal relation between PTSD and depression, in which pre-military trauma PTSD forecasted depressive symptoms succeeding exposure to war, signifying a strong relation between lifetime PTSD and post-disaster depression can have important implications in disaster-preparedness protocols within mental health services.³⁰

The study population has experienced multiple natural disasters in the past 5 years, and in view of climate change, this may become the norm in other places, making it an ideal population. However, because they have experienced other natural disasters may act as a confounding factor either by increasing resilience or increasing vulnerability to developing mental health problems like depression.

MDD has a substantive negative impact on quality of life. Several studies suggest that depression is underdiagnosed and undertreated amongst older people in Western nations.^{31–34}

Table 2. Chi-square test of association between demographic profile, clinical, flooding-related variables, and likely depression

Variables	Mild depression	Moderate to severe depression	Chi-square value	Effect size (Phi/Cramer V's)	P-value
Gender					
Male	14 (60.9)	9 (39.1)	0.367	0.47	0.654
Female	79 (54.1)	67 (45.9)			
Age categories					
<25years	4 (44.4)	5 (66.6)	1.014	0.77	0.596
<26-40years	36 (52.2)	33 (47.8)			
>40years	53 (58.2)	38 (41.8)			
Employment status					
Employed	92 (57.9)	67 (42.1)	8.709	0.227	0.040
Unemployed	1 (10.0)	9 (90.0)			
Marital status					
Married/partnered	70 (56.9)	53 (43.1)	0.646	0.062	0.737
Divorced/separated	8 (50.0)	8 (50.0)			
Single	15 (50.0)	15 (76)			
Received mental health diagnosis on depression from a health professional					
No	77 (67.0)	38 (33.0)	20.688	0.350	0.001
Yes	16 (29.9)	38 (70.4)			
Received mental health diagnosis on bipolar disorder from a health professional					
Yes	3 (50.0)	3 (50.0)	0.064	0.019	1.000
No	90 (55.2)	73 (44.8)			
Received mental health diagnosis on anxiety from a health professional					
No	66 (67.3)	32 (32.7)	14.301	0.291	0.001
Yes	27 (38.0)	44 (62.0)			
Received mental health diagnosis on alcohol abuse from a health professional					
Yes	2 (66.7)	1 (33.3)	0.167	0.031	1.000
No	91 (54.8)	75 (45.2)			
Received mental health diagnosis on drug abuse from a health professional					
Yes	1 (50.0)	1 (50.0)	0.021	0.011	1.000
No	92 (55.1)	75 (44.9)			
Received mental health diagnosis on personality disorder from a health professional					
Yes	1 (100.0)	0 (0.0)	0.822	0.070	1.000
No	92 (54.8)	76 (45.2)			
Other mental health diagnosis not listed by a health professional					
Yes	8 (50.0)	8 (50.0)	0.181	0.033	0.793
No	85 (55.6)	68 (44.4)			
Have you received any mental health diagnosis from a health professional?					
Yes	36 (41.4)	51 (58.6)	13.501	0.283	0.001
No	57 (69.5)	25 (30.5)			
Mental health counseling in the past year					
No	66 (62.9)	39 (37.1)	8.865	0.202	0.110
Yes	27 (42.2)	37 (57.8)			
Would like to receive mental health counseling					
No	60 (75.0)	20 (25.0)	24.481	0.381	0.001
Yes	33 (37.1)	56 (62.9)			
Are you on antidepressant medication?					
No	71 (61.7)	44 (38.3)	6.547	0.197	0.013
Yes	22 (40.7)	32 (59.3)			
Are you on antipsychotics medication?					
No	91 (55.2)	74 (44.8)	0.042	0.016	1.000
Yes	2 (50.0)	2 (50.0)			
Are you on benzodiazepines medication?					
No	93 (56.4)	72 (43.6)	5.013	0.172	0.039
Yes	72 (43.6)	4 (100.0)			

(Continued)

Table 2. (Continued)

Variables	Mild depression	Moderate to severe depression	Chi-square value	Effect size (Phi/Cramer V's)	P-value
Are you on mood stabilizers medication?					
No	88 (57.7)	70 (44.3)	0.436	0.051	0.545
Yes	5 (45.5)	6 (54.5)			
Are you on sleeping tablets medication?					
No	90 (60.0)	60 (40.0)	13.319	0.281	0.001
Yes	3 (15.8)	16 (84.2)			
Are you on other mental health medication not listed?					
No	90 (54.2)	76 (45.8)	2.496	0.122	0.253
Yes	3 (100.0)	0 (0.0)			
Are you on any mental health medication for health concerns?					
Yes, on mental health medication	25 (41.0)	36 (59.0)	7.610	0.212	0.007
No	68 (63.0)	40 (37.0)			
Fearful for your life and family during the flooding					
No	69 (57.5)	51 (42.5)	1.021	0.312	0.394
Yes	24 (49.0)	25 (51.0)			
How frequently did you watch the television images about the devastation caused by the flood?					
Daily	58 (51.8)	54 (48.2)	1.656	0.099	0.440
Not daily	23 (63.9)	13 (36.1)			
Did not watch TV images of the devastation	12 (57.1)	9 (42.9)			
How frequently did you read newspaper and Internet articles related to devastation caused by flooding?					
Daily	66 (51.6)	62 (48.4)	3.179	0.138	0.228
Not daily	21 (61.8)	13 (38.2)			
Did not watch TV images of the devastation	5 (83.3)	1 (16.7)			
Home suffered substantial damage					
No	91 (56.9)	69 (43.1)	4.135	0.156	0.080
Yes	2 (22.2)	7 (77.8)			
Did you suffer any loss of property in the flood?					
No	90 (54.5)	75 (45.5)	0.660	0.063	0.628
Yes	3 (75.0)	1 (25.0)			
Did you live in the same household before the floods?					
Yes	81 (57.0)	3 (75.0)	2.498	0.122	0.314
No, I live in a different house even though my previous home was not destroyed by the flood	10 (45.5)	76 (45.2)			
No, I live in a different house because my previous home was destroyed by the flood	1 (25.0)	76 (42.2)			
Did you receive support from family and friends after the floods?					
Yes, absolute support	47 (65.3)	25 (43.7)	7.209	0.211	0.65
Yes, had some support	11 (42.3)	15 (57.7)			
Yes, but only limited support	7 (41.2)	10 (58.8)			
Did you receive support from Red Cross after the floods?					
Yes, absolute support	8 (66.7)	4 (33.3)	4.283	0.161	0.381
Yes, had some support	1 (16.7)	5 (83.3)			
Yes, but only limited support	4 (57.1)	3 (42.9)			
Not at all	5 (50.0)	5 (50.0)			
I was not impacted by the flood	72 (55.0)	59 (45.0)			
Did you receive support from the Government of Alberta during and after the floods?					
Yes, absolute support	5 (50.0)	5 (50.0)	2.748	0.129	0.625
Yes, had some support	2 (28.6)	5 (71.4)			
Yes, but only limited support	3 (50.0)	3 (50.0)			
Not at all	8 (66.7)	4 (33.3)			
I was not impacted by the flood	72 (55.0)	59 (45.0)			

(Continued)

Table 2. (Continued)

Variables	Mild depression	Moderate to severe depression	Chi-square value	Effect size (Phi/Cramer V's)	P-value
Did you receive support from the Government of Alberta during and after the floods?					
Did you receive support from insurers during and after the floods?					
Yes, absolute support	3 (60.0)	2 (40.0)	0.500	0.055	0.992
Yes, had some support	3 (60.0)	2 (40.0)			
Yes, but only limited support	4 (57.1)	3 (42.9)			
Not at all	5 (45.5)	6 (54.5)			
I was not impacted by the flood	75 (54.3)	63 (45.7)			

Table 3. Logistic regression model for respondents' likelihood to present with likely MDD

Variables in the equation	Coefficient	Standard error	Wald	Degree of freedom	P-value	Odds ratio	95% CI for odds ratio	
							Lower	Upper
Are you currently employed? (No)	2.499	1.233	4.109	1	0.043	12.166	1.086	136.263
Have you received a mental health diagnosis for depression from a health professional?	1.669	0.539	9.574	1	0.002	5.306	1.844	15.270
Have you received a mental health diagnosis for anxiety from a health professional?	0.520	0.522	0.992	1	0.319	1.681	0.605	4.674
Received sleeping tablet medication for a mental health concern.	1.684	0.891	3.575	1	0.059	5.387	0.940	30.860
I am not on any medication for mental health concerns.	-0.831	0.600	1.916	1	0.166	0.436	0.134	1.413
Have you received mental health counseling in the past year? (Yes)	-0.843	0.517	2.657	1	0.103	0.431	0.156	1.186
Would you like to receive mental health counseling? (Yes)	1.812	0.474	14.627	1	<0.001	6.123	2.419	15.496
Did you lose property as a result of the floods in Fort McMurray? Please check all that apply. (Choice = Home suffered substantial damage.) (Yes)	1.314	0.935	1.976	1	0.160	3.723	0.595	23.276
Did you receive sufficient support from family and friends during and after the floods? (No)			2.223	3	0.527			
Did you receive sufficient support from family and friends during and after the floods? (Yes)	0.639	0.565	1.280	1	0.258	1.895	0.626	5.734
Did you receive sufficient support from family and friends during and after the floods? (Yes, has some support)	-0.189	0.686	0.076	1	0.783	0.828	0.216	3.177
Did you receive sufficient support from family and friends during and after the floods? (Yes, but limited support)	0.484	0.473	1.049	1	0.306	1.623	0.643	4.097
Constant	-1.822	0.379	23.059	1	<0.001	0.162		

*P < 0.05.

Respondents who would like to receive mental health counseling were more likely to express moderate to severe depression. Seeking counseling from a health care professional with a self-care focus contributes greatly to the treatment of any illness. Recent studies have shown that counseling encourages patients to actively contribute in treatment programs and promotes their positive outcomes.^{35,36} Counseling helps the patients control their feelings, adhere to the therapy, clearly understand the treatment rationale, improve quality of life, decrease stress, reduce anxiety, feel more secured, and increase life satisfaction.³⁶

One of the factors that influences people's perception of flood disaster preparedness is an early warning system. Early warning systems are an important part of community preparedness mechanism.³⁷ Shelter becomes a disaster preparedness factor that cannot be excluded in flood disaster management. People affected by floods or vulnerable to disasters are usually advised to evacuate. The existence of shelter is also one of the factors influencing community preparedness.

Studies on disaster victims found that changes in substance abuse vary from mild to moderate increases among diverse populations.³⁸⁻⁴⁰ For example, a study following Hurricane Andrew of August 1992 found only 2% of area residents reporting alcohol dependence.³⁸

Study Limitations

Ethnicity and income may be potential confounders given that some studies have found correlations between these variables and mental health.^{41,42} Unfortunately, this study did not collect data on these. As part of an online survey limitation, the population to which gave responses cannot be described, and respondents with biases may select themselves into the sample.

Additionally, there may be a strong indication that the results of this study would have been different if the study were conducted prior to the flooding. Also, flooding at Fort McMurray occurred during the COVID-19 pandemic, so considering that some people

may have been exposed to COVID-19 during that time, it is our assumption that this may have affected our results. We mainly focused on flooding variables and their correlation with Major Depression Disorder, through a cross-sectional study design that captured the data at the time.

Conclusions

This study makes a good contribution to the growing literature on the mental health effects of flooding, and its large scale and natural disaster also represent a unique opportunity to increase the understanding of the impacts of flooding on population health and well-being. It is important that the impact of flooding on people's health and well-being is carefully understood. This will help inform public health actions to mitigate adverse health consequences of future flooding events.

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