Feature Analysis and Hierarchical Classification of Anxiety Severity during early COVID-19

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Problem Statement

- Mental health is among the greatest cross-national inequalities with 80% of those affected living in low- and middle- income countries [1]
- Mental health can be affected by internal factors such as a person's physical health and genetic predisposition as well as external factors such as financial insecurity, food insecurity, and lifestyle changes [2], [3]
- Statistics Canada created the Canadian Perspectives Survey Series (CPSS) to understand social issues and effects of COVID-19 on the Canadian labour force (LF)

Objectives

- The motivation for this work is to identify characteristics from the CPSS [5] data that are indicative of anxiety for the Canadian LF population
- We hypothesize that successful identification of survey data characteristics will allow for indirect assessment of anxiety
- We propose to use the more quantified General Anxiety Disorder-7 labels to look at anxiety among the public during the pandemic

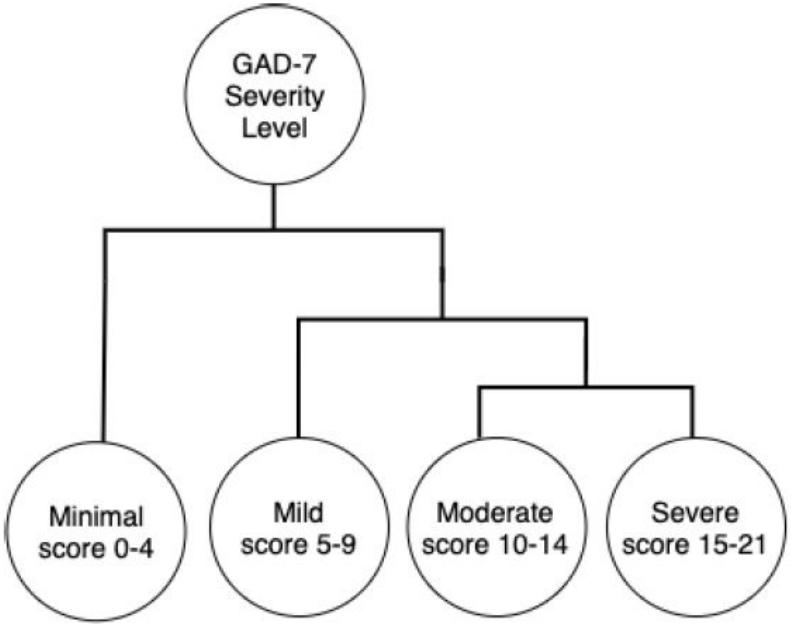
Related works

- A few studies have been conducted on CPSS using perceived mental health categories [4], [6]
  - Perceived mental health labels: Excellent, Very Good, Good, Fair, and Poor.
- Polsky and Gilmour compared food insecurity among Canadians during the COVID-19 pandemic [3]

Dataset

- CPSS2 [5]
  - Collected May 4 - May 10, 2020
  - The target population are Canadians aged 15 and older in the LF with the exception of full-time members of the Canadian Armed Forces
  - CPSS2 has 4600 sample points and 62 variables
  - Variables are categorized into
    - Behaviours and Health impacts (BH)
    - Demographics (DEM)
    - Derived Variables (DV)
    - Food security (FSC)
    - Labour market impacts (LM)
    - Mental health impacts (MH)
    - Survey related variables (SRV)

GAD-7


GAD-7
Severity
Level
Minimal
score 0-4
Mild
score 5-9
Moderate
score 10-14
Severe
score 15-21

Pre-processing

- Removal of data related to GAD-7
- Removal of Incomplete data

2	MH_15A	Feeling nervous, anxious or on edge - Freq last 2 weeks	discrete	numeric-1.0	4579	21	Over the last 2 weeks, how often have you been bothered by the following problems? - Feeling nervous, anxious or on edge
3	MH_15B	Not being able to stop or control worrying - Freq last 2 weeks	discrete	numeric-1.0	4563	37	Over the last 2 weeks, how often have you been bothered by the following problems? - Not being able to stop or control worrying
4	MH_15C	Worrying too much about different things - Freq last 2 weeks	discrete	numeric-1.0	4561	39	Over the last 2 weeks, how often have you been bothered by the following problems? - Worrying too much about different things
5	MH_15D	Trouble relaxing - Freq last 2 weeks	discrete	numeric-1.0	4566	34	Over the last 2 weeks, how often have you been bothered by the following problems? - Trouble relaxing
6	MH_15E	Being so restless that it is hard to sit still - Freq last 2 weeks	discrete	numeric-1.0	4558	42	Over the last 2 weeks, how often have you been bothered by the following problems? - Being so restless that it is hard to sit still
7	MH_15F	Becoming easily annoyed or irritable - Freq last 2 weeks	discrete	numeric-1.0	4568	32	Over the last 2 weeks, how often have you been bothered by the following problems? - Becoming easily annoyed or irritable
8	MH_15G	Feeling afraid as if something awful might happen - Freq last 2 weeks	discrete	numeric-1.0	4570	30	Over the last 2 weeks, how often have you been bothered by the following problems? - Feeling afraid as if something awful might happen
3	ANXDVGAC	Generalized Anxiety Disorder Cut-point	discrete	numeric-1.0	4512	88	-
1	ANXDVGAD	Generalized Anxiety Severity Score	continuous	numeric-2.0	4512	88	-

Feature ranking

- Minimum redundancy maximum relevance (mRMR) was selected

$$\max \Phi(D, R), \Phi = D - R$$

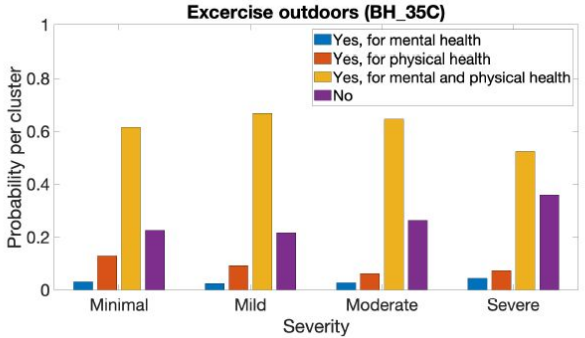
$$\max D(S, c), D = \frac{1}{|S|} \sum_{x_i \in S} I(x_i; c))$$

$$\min R(S), R = \frac{1}{|s|^2} \sum_{x_i, x_j \in S} I(x_i; x_j)$$

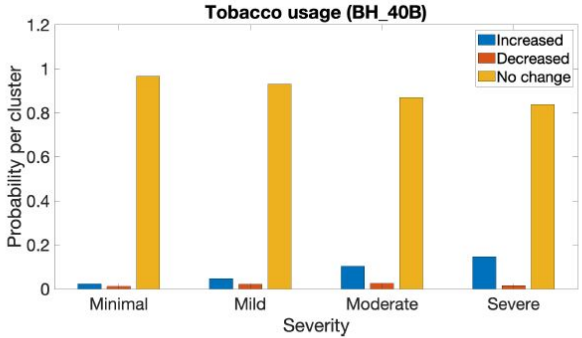
Results

- After pre-processing, 4512 samples remained
- mRMR reduced the feature set to 20

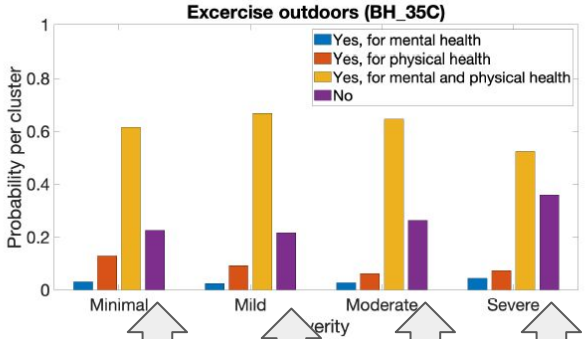
Feature	Description	Feature	Description
MH_05	Perceived mental health	LM_40	COVID impact ability meet financial obligations
BH_40D	Eating junk food or sweets	BH_20C	Made plan caring household member are ill
PFSCDV	Household food insecurity	BH_40F	Spending time on the internet
AGEGRP	Age group	SEX	Sex
MHDVMHI	Perceived mental health derived variable	BH_20M	Other precautions taken to reduce risk
BH_20A	Stocked up on essentials	BH_35C	Exercise outdoors
LM35BCDE	EI benefits (sickness/ caregiver/ worksharing/ other)	BH_40A	Consuming alcohol
RURURB	Rural or urban indicator	BH_110	Number of people in close contact
BH_40E	Watching TV	BH_20D	Made a plan for non-household member
BH_35E	Changing food choices	BH_40B	Using tobacco products



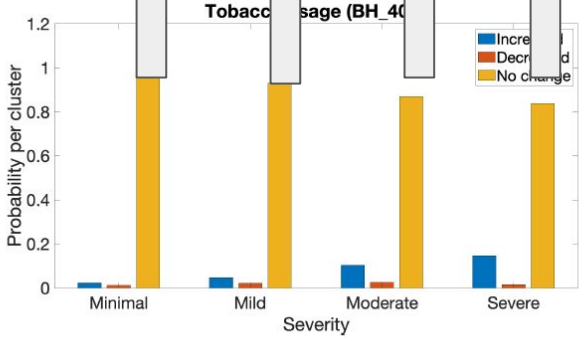
(a) Exercise outdoors



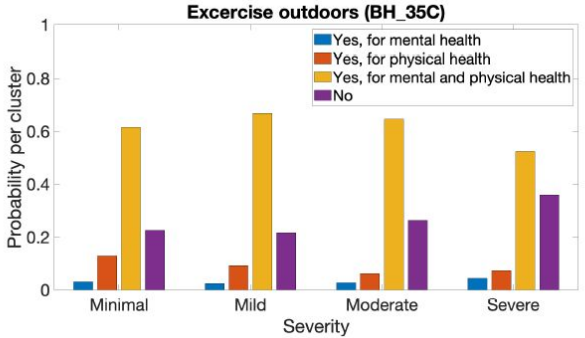
(b) Tobacco Usage



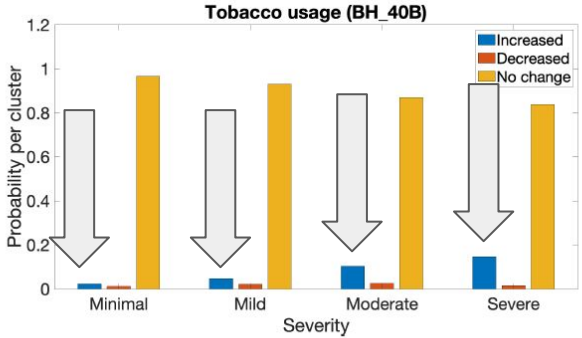
(a) Exer e outdoors



(b) Tobacco Usage



(a) Exercise outdoors

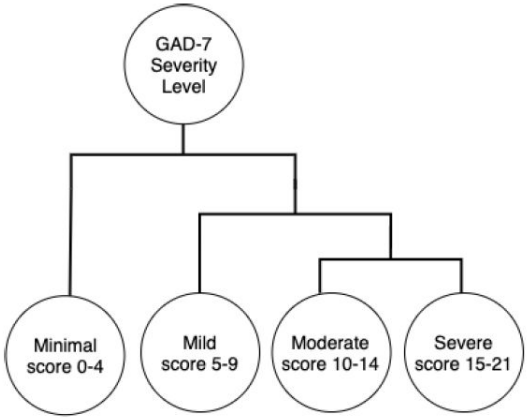


(b) Tobacco Usage

Results continue

- Minimal vs Severe GAD Severities
  - Decision tree: 92.03±0.30%
  - Support vector machine: 94.77±0.05%
    - Recall: 98.62±0.09%,
    - Precision: 95.72±0.05%
    - F1: 97.15±0.05%
- Hierarchical Classification

Hierarchical Classification



Classes	SVM(%)	DT(%)
Minimal vs Mild, Moderate, and Severe	76.99	68.79
Mild vs Moderate and Severe	71.05	62.64
Moderate vs Severe	63.94	57.52

Discussion and Conclusion

- The purpose of this work is to analyze the anxiety of the LF during the preliminary stages of COVID-19 using the CPSS2 dataset
- The application used the reduced 20 feature subset and 10-fold SVM to achieve an overall accuracy of 94.77±0.05% when comparing the classes Minimal and Severe
- Many of these features can be augmented as Pseudo Passive (PP) data. PP data is qualitative data that can be collected as passive data
  - RURURB (Rural or urban indicator) can use a GPS to determine a participant's location
  - BH 35C (Exercise outdoors) can use an accelerometer for activity recognition
  - BH 40E (Watching TV) can determine the audio environment to determine if the participant is watching TV
- Reduction of 62 survey questions to 20
  - Reduces survey fatigue, patients becoming apathetic or bored
- The study of continuous long-term data collection can further explore and understand how people cope during the COVID-19 pandemic [8,9]

References

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