Volume 1, Number 2 | October 2022

Journal of Undergraduate Health Research

UNIVERSITY OF WATERLOO

Investigating the Effects of Venlafaxine on Oxidative Stress
Ladees Al Hafi, Nicole L. Gauvreau & Paul M. Craig

Comparing the Efficacy of Pharmacological vs Non-pharmacological Methods of Treatment
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Dear Reader…

We are pleased to bring you the second issue of the University of Waterloo (UW) Journal of Undergraduate Health Research (JUHR)!

In this past term, we were fortunate enough to introduce some normalcy into our lives again since the beginning of the COVID-19 pandemic. Many students returned to in-person learning and workplaces began bringing employees back into the office. While we are all grateful to have returned in-person, there has been no shortage of challenges accompanying these transitions. We hope that you all continue to be resilient through these ever-changing times and look to your communities to offer you support.

Community and the potential it has to bring people together is one of the most overlooked qualities of health research. Within the JUHR team, we are grateful to have a community of hardworking students committed to fostering opportunities for growth and development in student-led health research. This issue would not have been possible without the team supporting JUHR. The Editorial Team, led by Senior Editors Megan Dol and Takuya Shibayama, were diligent in their review of each piece that has been chosen for this issue's publication. Thanks to the leadership of the Creative Director, Kimberly D'Mello, the issue reflects the artistic and innovative visions of our talented Creative Team.

In this issue, we explore a wide range of relevant topics at the biomedical, clinical, and social intersections of health. From a biomedical perspective, Ladees Al Hafi walks us through the relationship between neurodegenerative disease and factors affecting oxidative stress in zebrafish, while Sarah Ismail compares different treatment options for anxiety in patients with Parkinson's disease. In two publications, Simrit Dhillon advocates for the need for improved nutritional education among individuals living with Down syndrome and raises awareness surrounding mental health assessment avoidance in South Asian communities.

Lastly, Jalisa Lynn Karim discusses the stigma surrounding infertility and calls for changed attitudes toward people without children, while Fatima Abbas explores the issues surrounding food insecurities in Canada and calls for action to solve these disparities.

Upon reading this issue, you will discover that advocacy is a key theme explored by the featured authors. We hope that as you continue your studies in health research, you will consider ways in which you can advocate for improved health outcomes within the community.

Thank you to the amazing UW Open Journal Systems team led by Jordan Hale and our faculty of Health Senior Advisors, Drs. Diane Williams, Ellen MacEachen, and Craig Janes, for their endless support.

Happy reading!

Tara Behroozian and Shayanne Thomas

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ORIGINAL RESEARCH

ISSN 2816-2420

INVESTIGATING THE EFFECTS OF VENLAFAXINE ON OXIDATIVE STRESS AND EXPLORING ITS RELATIONSHIP TO NEURODEGENERATIVE DISEASE

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ABSTRACT

The rise in presence of pharmaceuticals in wastewater effluent has had behavioural effects on fish, which this study aimed to investigate.[4] The pharmaceutical studied was venlafaxine (VEN), a commonly prescribed antidepressant.[4] Previous studies have shown that venlafaxine contributes to oxidative stress.[3] Notably, oxidative stress has been linked to neurodegeneration and plays a role in the pathogenesis of neurodegenerative diseases, such as Alzheimer's, and Parkinson's in humans.[1]

This study applied a novel approach through in vitro methods to directly expose zebrafish brains to varying VEN concentrations (0.01, 0.1, and 1 µg/L) and quantify oxidative stress. Zebrafish brains were used due to their neuroanatomical similarity to humans.[14] Results demonstrated decreases in cell viability, and increases in antioxidant enzyme activity (catalase and superoxide dismutase) with rising concentrations of VEN.

These findings demonstrate increases in oxidative stress, which was indirectly measured by antioxidant enzyme activity, as well as the effects of VEN on cell viability and protein amounts in the brain cells. These results indicate a possible link between venlafaxine exposure and increased risk of neurodegeneration in humans. Further investigation should be done to examine the association between venlafaxine concentrations in water and increased incidence of neurodegenerative disease in mammalian brains.

INTRODUCTION

The recent increase in Canadian drug consumption due to the COVID-19 pandemic has caused a rise in the presence of pharmaceuticals in aquatic systems via the effluent discharged from wastewater treatment plants. The presence of pharmaceuticals in freshwater results in increased uptake by aquatic species, increasing the risk of chronic effects to aquatic organisms and, subsequently, to humans.[6] Humans are impacted by drinking water, and/or ingestion of pharmaceutical residues in plants, fish, dairy, and meat.[6] Many pharmaceuticals are neuroactive and exert their effects through an alteration of the nervous system functions.[7] Neuroactive pharmaceuticals include antidepressants such as venlafaxine (VEN) which will be investigated in this study.[8] VEN is a selective serotonin reuptake inhibitor (SSRI) which operates by increasing serotonin levels among other neurotransmitters in the brain by blocking transport protein and stopping their reuptake.[9] VEN is a commonly prescribed anti-depressant used to treat illnesses such as depression and general

anxiety disorder and statistics have shown that 22,186 kg of VEN were dispensed in Canada in 2007 which is an ever growing number.[10]

Studies have shown that SSRIs such as VEN can cause oxidative stress, particularly in brain tissues, leaving impacts on fish behaviour.[11] Some of the changes in fish behaviours observed include increased vulnerability to predators, reduced aggression, and negative impacts on reproduction.[4] As well, Neuroactive pharmaceuticals also impose significant risks to human health such as the onset of different neurological impairments, ranging from attention deficit hyperactivity disorder (ADHD) to Alzheimer's and Parkinson's.[1]

This study will explore the developmental neurotoxicity of VEN exposure in Danio rerio (zebrafish). Zebrafish are used as the model organism as they show fast neurodevelopment and a significant resemblance to the human system.[2] As such, Zebrafish are useful models for understanding the health effects of environmental exposures on humans.[12] Specifically, zebrafish in vitro studies can be used to address potential hazards to human health that result from pharmaceuticals in the water by exposing cells directly to VEN, manipulating environmental conditions and assessing cell responses.[12]

This project aimed to take advantage of in vitro studies by utilizing a primary cell culture of brain cells and directly exposing them to VEN. The brain was used as the organ of study because of its susceptibility to the adverse effects of reactive oxygen species (ROS) since it's a major metabolizer of 20% of the body's oxygen consumption.[13] The brain also contains a large amount of polyunsaturated peroxidizable fatty acids which act as prooxidants that induce oxidative stress because of their cellular membranes' vulnerability to damage from ROS.[13] Monitoring these changes can be done through enzyme assays. Enzymes play an important role in lowering ROS levels and protecting against oxidative stress so their activity can be indicative of antioxidant stress responses.[13] Thus, enzyme assays provide researchers with a better understanding of the effects of pharmaceutical exposure on cells.

Effects of pharmaceuticals are important to study because they can trigger ROS.[11] ROS are toxic oxygen molecules that can cause functional and structural damage to cell components which may lead to cell death and oxidative damage to lipids, proteins, and DNA.[14] ROS can be used to explain some of the underlying physiological changes that are impacting the behavior of fish in pharmaceutical contaminated water.[13] Cells, thus, contain defense mechanisms to detoxify the adverse effects caused by an accumulation of ROS.[13] These include the increased expression of numerous enzymes and small molecules such as superoxide dismutases (SOD), catalase (CAT), and glutathione among others that function to reduce ROS produced molecules into water and oxygen, decreasing potential oxidative damage.[13]

Previous studies have been conducted to show effects of VEN in other species such as the brains of fathead minnows.[3] Results showed that following exposure to VEN, genes related to neural development were upregulated in the brains of fathead minnows.[7,15] There has been research regarding brains of zebrafish and effects of VEN on them; however, it has only been done on zebrafish embryos.[16] In zebrafish embryos, studies have shown that early life exposure to venlafaxine disturbs brain development, which is possibly due to reduced serotonin levels and further causes altered larval behaviour.[17] Our study is unique from others because it examines neurotoxicity on in vitro primary cell cultures of adult zebrafish. The purpose for the in vitro approach is its ability to mimic in vivo responses with reduced animal usage, and controlled exposure environments.

The main objectives of this study were to investigate the neurotoxicity of environmentally relevant concentrations, as measured in the Grand River in 2020 and 2021, of VEN on adult zebrafish brains.[18] The study consisted of producing a primary cell culture of zebrafish brains, measuring cell viability, and antioxidant enzyme activity. It was hypothesized that there would be decreased cell viability and increased antioxidant activity in brain cells due to VEN elicited increased ROS production.

MATERIALS & METHODS

2.1 Fish Husbandry

The adult zebrafish were purchased from Big Al`s Aquarium, ON, Canada and kept in the University of Waterloo WATER Aquatic Facility in a continuous water circulation system. The water circulation system was

maintained at a 12-hour light/dark cycle, and at an average temperature of 27.0°C. They were fed the Gemma 300 pellets diet once per day. Animal collections were approved by the Animal Care Committee at the University of Waterloo and followed the guidelines set out by the Canadian Council of Animal Care.

2.2 Cell Cultures

The adult zebrafish brains were cultivated through an adapted version of an original the protocol conducted by Sounders II et al. (2021). In brief, the adult zebrafish were euthanized in 3-aminobenzoic acid ethylester (MS222) (180 mg/L) and their spinal cords were severed using spring scissors. The whole brains were then dissected and placed into a 2.0 mL tube and rinsed twice with 1 mL of Hanks Balanced Salt Solution (HBSS; 400 mg KCl, 600 mg KH2PO4, 350 mg NaHCO2, 8 g NaCl, 48 mg Na2HPO4, and 1 g D-Glucose in 1 L ddH2O) with Antibiotic-Antimycotic solution (Gibco) and then minced into small explants. Following this, the tissues were dissociated with trypsin (0.25%; Gibco) for 30 minutes and then transferred into a 50 mL Falcon tube with 10.0 mL of Leibovitz's L-15 medium (Gibco) with 15% Fetal Bovine Serum (FBS; Gibco) and Antibiotic-Antimycotic. Afterwards, 0.4 mL of the cell suspension was plated into a 48-well cell culture specific plate (Thermo-fisher).

2.3 Experimental Design

2.3.1 Venlafaxine Exposure

The cell cultures were incubated in the 48-well plates at 37.0°C for 24 hours to proliferate. Following the 24-hour incubation period, the media was removed from each well into 2.0 mL tubes. Each tube was then centrifuged to minimize loss of cells upon removal of media. After centrifugation, the media was removed, and the pellet was covered with 0.4 mL of varying concentrations of venlafaxine. The three concentrations of venlafaxine used were 0.01, 0.1, and 1 µg/L with a control sample of 0 ug/L. These tubes were incubated for another 24 hours with the corresponding venlafaxine concentrations. After incubation, the media from the control wells as well as the venlafaxine from the remaining wells was removed after centrifugation. The supernatants were discarded, and pellets were homogenized using a mini pestle homogenizer in 50 µL of cold 20 mM HEPES buffer, containing 1 mM EGTA, 210 mM mannitol, and 70 mM sucrose, pH 7.2. Homogenates were then placed in -80°C freezer for enzyme analysis.

2.3.2 Cell Viability

To assess viability of the cells before and after exposure to venlafaxine concentrations, cell counts were conducted. Trypan Blue (0.2% w/v) exclusion assay was used to count the number of brain cells in the suspension upon dissection and before initial incubation. Counts were also taken following incubation with the varying venlafaxine concentrations. The viability was tracked over multiple samples and trials for an understanding of the effects of venlafaxine on cell proliferation and death. The basic protocol of Trypan Blue counting followed the one discussed in "Trypan Blue Exclusion Test of Cell Viability" (Strober, 1997). The samples were obtained through three trials with 6-7 samples each for controls and experimental concentrations.

2.3.3 Bradford Protein Assay

Protein concentrations of the samples were determined using a Bicinchoninic Acid (BCA) protein assay (Sigma-Aldrich) where bovine serum albumin (BSA) was used as a standard. The protocol followed instructions provided by the Sigma-Aldrich BCA protein assay kit. Samples were plated in singles on a 96-well plate due to limited sample quantity. Plate was then read at 562 nm using the Molecular Devices Spectramax 190 spectrophotometer with SoftMax Pro 6.4 software. The protein concentrations were then calculated by extrapolating concentrations using the standard curve (mg/mL) and then divided by the dilution factor of the buffer. The samples were obtained through three trials with 6 samples each for controls and experimental concentrations.

2.3.4 Catalase Assay

Homogenates were then assayed for catalase activity following the protocol of Craig et al. (2007). The reactions were initiated using 10 µL of 800 mM stock H2O2 with a final concentration of 40 mM. The samples were then run in duplicates on 96-well UV spec plates and read at 240 nm for 5 minutes using the Molecular Devices

Spectramax 190 spectrophotometer with SoftMax Pro 6.4 software. The CAT activity (µmol/min/mL) calculations

were using the extinction coefficient of 43.6 and pathlength of the wells observed on the spectrophotometer. The CAT activity was then divided by the total protein (mg) amount determined through the protein assay done earlier. This number was further multiplied by the buffer dilution (mL) resulting in final units of µmol/min/mg protein. The samples were obtained through three trials with 6 samples each for controls and experimental concentrations.

2.3.5 Superoxide Dismutase (SOD) Assay

SOD enzyme activity was measured following the Superoxide Dismutase Assay Kit (Cayman chemicals, MI, USA) instructions. The samples were run in duplicates on 96-wellmicroplates and read using the Molecular Devices Spectramax 190 spectrophotometer linked to SoftMax Pro 6.4 software. The SOD activity calculations in (units/mL) were done according to the kit instructions with an additional step of division by the total protein (mg), then multiplied by buffer dilution (mL) resulting in units of units/mg/mL. The samples were obtained through three trials with 6 samples each for controls and experimental concentrations.

2.4 Statistical Analysis

The data collected from the enzyme assays was analyzed using GraphPad Prism Version 9.1.2. One-way ANOVAs and Tukey's post-hoc were used to determine any significance between groups. Normality of data was assessed using a Shapiro-Wilk's normality test and the homogeneity of variance was assessed using F-test for homogeneity of variance. However, RBD were analyzed via Kruskal-Wallis non-parametric test due to inability to achieve equal variances and normality. All p-values were compared to alpha (α) value of 0.05 and considered significant if less than α. Figures present data as means +/- standard error of the mean (SEM).

RESULTS

3.1 Cell Viability

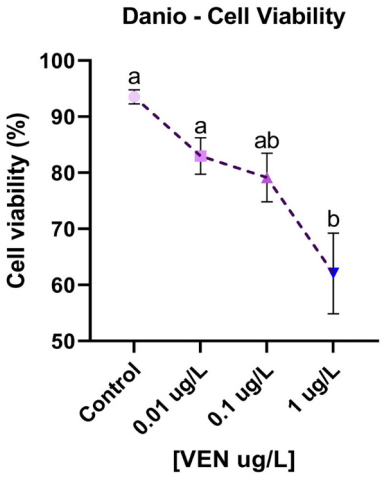

Figure 2. Cell Viability

Cell viability (%) of the zebrafish (Danio rerio) brain cells following 24-hour exposure to 0, 0.01, 0.1 and 1 µg/L of VEN. Data is presented as means +/- SEM, compared using One-Way ANOVA. Different letters 'a' and 'b' represent significant differences displayed by Tukey test ($n = 6\text{-}7$), ($F(3,23) = 8.25$, $p < 0.001$).

In this study, it was seen that with increased concentrations of VEN, the cell viability significantly decreased. In Figure 2, there are evident statistical differences between the cell viability at control and 1 µg/L concentrations of VEN. The overall decrease in cell counts demonstrates increased cell death caused by oxidative stress from VEN exposure. There is a significant difference between the control and the 1 µg/L ($p < 0.001$), and between 0.01 µg/L and 1 µg/L ($p = 0.0228$).

3.2 Bradford Protein Assay Results

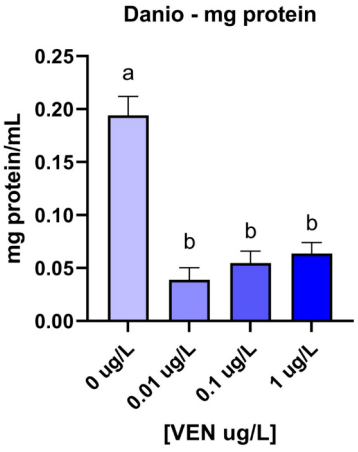

Figure 3. Bradford Protein Assay

Protein amounts (mg protein/mL) in the zebrafish (Danio rerio) brain cells following 24-hour exposure to 0, 0.01, 0.1 and 1 µg/L of VEN. Data is presented as means +/- SEM, compared using One-Way ANOVA. Different letters 'a' and 'b' represent significant differences displayed by Tukey test (n = 6-7), and F(3,20) = 29.95, p < 0.0001. The results indicated a decrease in protein concentrations with increased VEN exposure concentrations as can be seen in Figure 3. There are significant differences between the control (0 µg/L) and the 0.01 (p <0.0001), 0 µg/L and 0.1 (p <0.0001), and 0 µg/L and 1 µg/L (p <0.0001). The protein content decreased significantly between the control and the exposed samples indicating presence of oxidative damage and possible protein degradation. However, further studies are needed.

3.3 Superoxide Dismutase (SOD) Activity

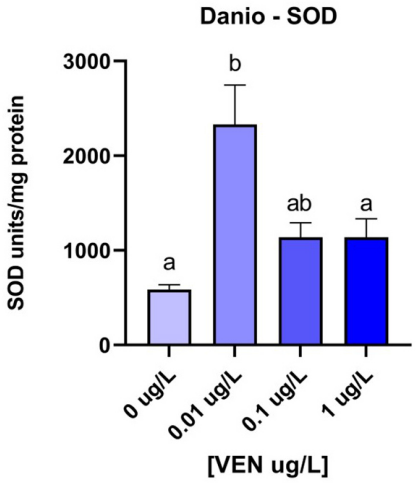

Figure 4. Superoxide Dismutase SOD Assay

SOD enzyme activity of the zebrafish (Danio rerio) brain cells following 24-hour exposure to 0, 0.01, 0.1 and 1 µg/L of VEN. Data is presented as means +/- SEM, compared using One-Way ANOVA. Different letters 'a' and 'b' represent significant differences displayed by Tukey test (n = 6-7), (F(3,20) = 9.173, p = 0.0005).

The results seen in Figure 4 indicated significant increases in SOD enzyme activity following initial venlafaxine exposure. There are significant differences between 0.01 µg/L and 1 µg/L (p = 0.0418), and 0 µg/L and 0.01 µg/L (p <0.001).

3.4 Catalase Activity

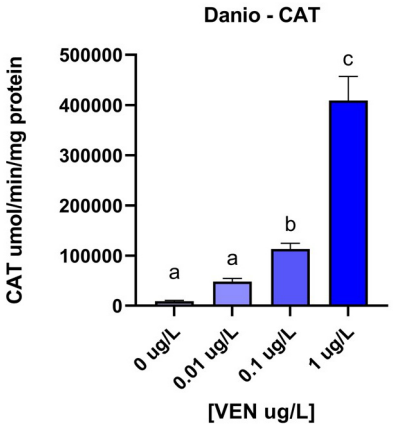

Figure 5. Catalase Assay

Catalase enzyme activity of the zebrafish (Danio rerio) brain cells following 24-hour exposure to 0, 0.01, 0.1 and 1 µg/L of VEN. Data is presented as means +/- SEM, compared using One-Way ANOVA. Different letters 'a' and 'b' represent significant differences displayed by Tukey test (n = 6-7), (F(3,20) = 53.15, p < 0.0001).

Following exposures to VEN, zebrafish catalase activity had an overall increasing trend. The catalase activity increases significantly between the control samples and 0.1 µg/L concentration of VEN seen in Figure 5. there is then a much larger rise in activity of catalase at 1 µg/L concentration. There are significant differences between 0 µg/L and 0.1 µg/L (adjusted p = 0.0354), 0 µg/L and 1 µg/L (p <0.0001), 0.01 µg/L and 1 µg/L (p <0.0001), and 0.1 µg/L and 1 µg/L (p <0.0001). Thus, there is an overall increase in activity of catalase post VEN exposure starting at 0.1 µg/L.

DISCUSSION

Venlafaxine's Effects on Oxidative Stress

This study has shown that there is an increase in oxidative stress in the brain cells of Danio rerio (zebrafish). This was displayed indirectly through the rise in antioxidant enzyme activity as well as decreased cell viability and protein amount with increased exposures to venlafaxine (VEN). Firstly, superoxide dismutase (SOD) and catalase

which are first line of defence antioxidant enzymes showed increased activity after exposure to VEN which indicates a presence of reactive oxygen species.13 SOD and catalase enzymes work to repair and prevent further damage to the cell from oxidative stress.[13] Secondly, cell death has previously been associated with neurodegeneration from oxidative stress in the brain.[1] The results also showed decreases in cell viability upon exposures. Lastly, the presence of oxidative stress was seen through the loss of protein concentrations with exposure. This is because the presence of ROS can have significant negative impacts on proteins in the cell by damaging them and disrupting lipid membranes.[14] These results align with the initial hypotheses by indicating toxicity and oxidative stress caused to the brain cells following exposure to VEN.

These results are significant because they allude to a possible cause for the changes in behaviour observed in fish nearby wastewater effluent discharge that is polluted with similar VEN concentrations.[4] This is especially important because there has been an increase in the use of anti-depressants over the past years which have increased their presence in wastewater effluents.[3] Unfortunately, the effects of venlafaxine are not often studied and thus this study aimed to quantify its effects on zebrafish.[3] Previous studies have investigated the effects of VEN on zebrafish brains however it was conducted in vivo.[3] One study examined the effects of VEN on hybrid striped bass brains and determined that there were significant decreases in brain serotonin concentrations.[3] Other studies have shown that VEN induces oxidative stress in the hepatocytes of rats and causes cell damage.[19]

The underlying causes for venlafaxine mediated oxidative stress are still unknown however previous studies have hypothesized that it may due to its effects on reducing the ability of antioxidants to eliminate reactive oxygen species.[19] Through the results of this study, it was evident that increased antioxidant enzyme activity occurred for SOD and catalase to repair and prevent further damage caused by VEN. Furthermore, oxidative stress has the ability to damage cells by causing lipid peroxidation and damaging cell membranes and lipoproteins.[1] This correlates with the decrease in cell viability. As well, protein degradation may have occurred as seen by the decrease in protein amounts.

Neurodegeneration & Oxidative Stress

Previous studies have shown a link between oxidative stress and the rise of multiple pathologies such as neurodegenerative diseases.[1] Neurodegenerative diseases that are potentially induced by oxidative stress are Alzheimer's, Parkinson's, and attention deficit hyperactivity disorder (ADHD).1 The results of this study may suggest a link between excess use of selective serotonin reuptake inhibitor (SSRI) anti-depressants and neurodegeneration.1 Since, zebrafish have very similar neuropathways to the human system, results of venlafaxine mediated oxidative stress may be applicable to the human system as well.[1]

Alzheimer's and Parkinson's diseases are both the results of protein-misfolding and are characterised by the presence of protein deposits in the brain.[1] The human brain is especially vulnerable to the effects of reactive oxygen species and oxidative stress due to it consuming around 20% of the body's oxygen.[1] This puts it at an increased risk of having excessive ROS.[1] Moreover, the lipid bilayer in the brain is suspectable to peroxidative by ROS because of its polyunsaturated fatty acid nature.[1] This further leads to neurodegeneration and the rise of pathologies.[1] With Alzheimer's, mitochondria damage is prevalent and since the mitochondria is the source of reactive oxygen species, its damage may cause rising levels of ROS.[1] This increase in ROS due to mitochondrion damage further contributes to Aβ overproduction and deposition which then causes neurodegeneration.[1] Thus, increased intake of VEN and similar antidepressants would induce further damage to the cells and cause higher risk of neurodegeneration.[1]

LIMITATIONS & FUTURE DIRECTIONS

Overall, these results are significant since they investigate the pharmaceutical effects of the commonly prescribed antidepressant on zebrafish, which can be further applied to the context of human health. Some limitations of this study are that in vitro studies were not conducted at temperature appropriate conditions that the zebrafish are normally found in. Additionally, more research is required to investigate the reasons behind the cell and protein loss such as using apoptosis assays. Further steps that can be taken are to reproduce the cell cultures investigating

specific response targets, investigate exposures with confounding effects such as higher temperatures due to climate change, and to repeat culturing protocols at appropriate temperatures for each species.

CONCLUSION

This study concluded that there is a significant increase in antioxidant enzyme activity, decrease cell viability and protein concentrations when zebrafish brain cells are exposed to environmentally relevant concentrations of venlafaxine. These results indicate the presence of oxidative stress in the brain cells which may be linked to neurodegeneration in humans.[1]

Although, this in vitro approach has indicated a rise in oxidative stress by the commonly prescribed antidepressant, venlafaxine, further studies should be done in vivo as well to compare results when there are other physiological effects involved. As well, more research is required to create an indicative link between neurodegenerative disease and oxidative stress.

Acknowledgements: I (Ladees Al Hafi) would like to express my sincere gratitude to my supervisor Dr. Paul Craig for providing me with the opportunity to participate in research, his continuous support, enthusiasm, and guidance. I would also like to thank Nicole Gauvreau for her continuous assistance with experimental procedures, support, and advice on troubleshooting. Lastly, I am thankful for everyone in the Craig Lab for their continuous support, advice, and counselling throughout the project. Special thanks to Heather Ikert and Ivan Cadonic for showing me around the lab, helping me understand many of the experimental techniques, and assisting me with laboratory equipment.

***Keywords*: Oxidative Stress, Neurodegeneration, Wastewater Effluent, Zebrafish, reactive oxygen species**

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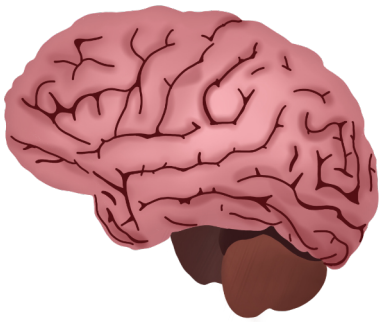
Received 03-07-2022
Accepted 05-20-2022
DOI:10.15353/juhr.v1i2.5159

ISSN 2816-2420



COMPARING THE EFFICACY OF PHARMACOLOGICAL VS NONPHARMACOLOGICAL METHODS OF TREATMENT FOR ANXIETY IN PARKINSON'S DISEASE: A NARRATIVE REVIEW

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ABSTRACT

Anxiety disorders comprise the most prevalent mental health disorders in the general population and remain a serious concern for patients with Parkinson's disease (PD). Current literature posits a myriad of methods, pharmacological and nonpharmacological, that may be utilized in the clinical management of this condition. However, recent systematic reviews and meta-analyses have not reached a definitive conclusion as to which method of treatment is most effective. This review aims to address this gap in the field by critically examining the efficacy of several notable treatment options. Specifically, this review highlights the need to discontinue the use of benzodiazepines in this PD-specific population and confirms findings from previous literature that tricyclic antidepressants (TCAs) are the most effective first-line defense for this condition. It additionally highlights the need for subsequent placebo-controlled randomized controlled trials (RCTs) to be conducted to further investigate the efficacy of numerous nonpharmacological treatment options.

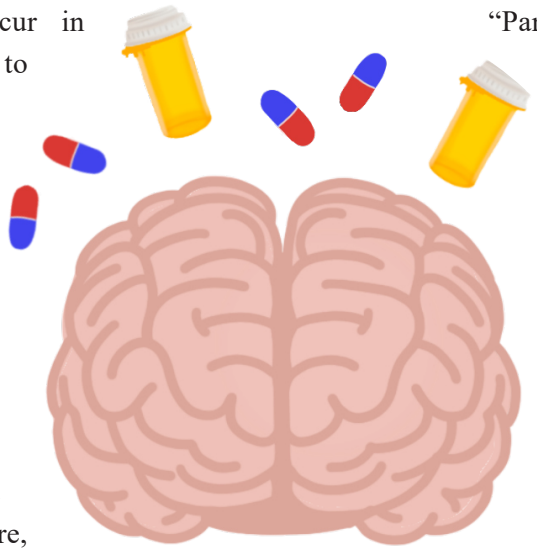
INTRODUCTION

Anxiety disturbances are recognized as some of the most distressing symptoms of Parkinson's disease (PD) and contribute to significant impairments in areas such as cognition, motor performance, social functioning, and overall quality of life.[1-3] Increasing evidence has shown that various non-motor symptoms of PD, including anxiety, have a more profound impact on reducing quality of life when compared to the characteristic motor symptoms.[1] Recent literature suggests a myriad of methods, pharmacological and nonpharmacological, that may be effective at relieving symptoms of anxiety in PD patients. However, the need in this field of research to critically examine many of these proposed methods remains. This narrative review aims to examine the impact of benzodiazepines, selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants (TCAs), dopamine agonists, cognitive behavioural therapy (CBT), and resistance training (RT) on the management of anxiety symptoms in individuals with PD.

Parkinson's disease is a progressive neurodegenerative disorder involving a loss of dopaminergic neurons in the substantia nigra region and affecting nearly 1 million people in North America alone.[2-4] This disorder is characterized by motor symptoms, such as tremors, rigidity, bradykinesia, and freezing of gait,[1,3,5] and non-motor symptoms, such as anxiety, depression, cognitive disturbances, and REM sleep disorder.[1,2,5,6]

Little is known about the underlying mechanisms contributing to this phenomenon. One theory posits that anxiety in PD is caused by the degeneration of ascending

dopamine, norepinephrine, and serotonin pathways within the basal ganglia,[2] while another attributes it to neurodegeneration within the locus coeruleus and amygdala.[7] Anxiety disorders comprise the most prevalent mental health disorders in the general population and remain a serious concern for patients with PD. Clinically significant anxiety symptoms occur in 20-50% of PD patients[1,2,5] with up to 40% having a diagnosed anxiety disorder under DSM-IV criteria,[8] This is of particular importance to these patients as comorbid anxiety and PD often lead to several adverse effects, including the worsening of motor symptoms, mental and somatic discomfort, and higher levels of medical care utilization and caregiver burden.[2] Furthermore, current literature suggests that anxiety and other mood disorders may be prodromal indicators of PD, given that symptoms of these disorders may precede the onset of motor parkinsonian symptoms by up to 10 years.[3,7]



Broadly, benzodiazepines are a class of drugs that work to depress the action of the central nervous system to induce feelings of calmness.[9] These drugs enhance the effects of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) in the amygdala of the brain, thus leading to an alleviation of the fear response.[9] In contrast, SSRIs are a class of drugs that increase the levels of serotonin, another neurotransmitter, throughout the brain, which is thought to have stabilizing effects on one's mood.[10] TCAs limit levels of two notable neurotransmitters used in the brain, serotonin and norepinephrine, by preventing their reabsorption.[11] The reduction in these neurotransmitter levels is thought to reduce anxiety symptoms.[11] Lastly, dopamine agonists are a class of drugs that mimic the action of the dopamine neurotransmitter, which regulates motor function and body movement and plays an important role in the experience of anxiety.[12]

METHODS

A comprehensive literature search was performed to identify pre-existing evidence of both pharmacological and nonpharmacological interventions for anxiety in individuals diagnosed with idiopathic PD. The following combinations of search terms were used to conduct an in-depth search of the literature using PubMed and Google Scholar: "Parkinson's disease and anxiety and pharmacological treatments and meta-analysis", "Parkinson's disease and anxiety and nonpharmacological treatments and meta-analysis", and "Parkinson's disease and anxiety treatment and randomized controlled trial". Only experimental studies were included in this review. Studies investigating anxiety as a primary or secondary outcome were included. Exclusion criteria consisted of case control studies and publication dates prior to 2005.

CBT and RT are both nonpharmacological methods of treatment used in the clinical management of various mood disorders. CBT is a form of psychological treatment that relies on changing patterns of thinking in order to form healthier patterns of behaviour.[1] Conversely, RT, or strength training, is a form of physical activity focused on improving muscular strength by exercising either an individual muscle or a muscle group against external resistance.[5]

RESULTS

Pharmacologic Treatments

Benzodiazepines

Despite overwhelming evidence that anxiety in PD is of growing concern, there have been no RCTs to date that have directly investigated the effects of pharmacologic treatments with anxiety as a primary outcome. Based on the lack of critical evidence, the current clinical recommendation for treating this condition is to follow the standard of care for treatment in the general population, consisting of the simultaneous use of antidepressants and benzodiazepines.[13] Despite this, there has been only 1 RCT2 conducted to evaluate the usage of benzodiazepines in this population. Bromazepam was reported to improve both emotional and somatic

symptoms of anxiety in this 1975 study. However, an inability to access this article originally published in an Italian medical journal, coupled with its date of publication led to its exclusion from the remaining review.[2]

Benzodiazepines have been examined as a method of treatment in other formats, including a 2021 cohort study in which patients with a diagnosis of idiopathic PD taking one or two benzodiazepines, including alprazolam, clonazepam, lorazepam, diazepam, and temazepam (n=36), were compared to a control group of PD patients not taking this class of medication (n=48).[14] In this study, a statistically significant difference in self-reported anxiety scores on the Beck Anxiety Inventory (BAI) was noted between the benzodiazepine users and non-benzodiazepine users, such that those using these medications reported significantly worse symptoms of both anxiety and depression.[14] This finding is limited by the study's small sample size (n=84), lack of randomization, and determination of effects on anxiety as a secondary outcome, all of which impede the interpretation of results. Furthermore, the usage of benzodiazepines in the PD population is complicated by a myriad of potential side effects, including unfavourable effects on cognition, alertness, and an increased risk of falls.[1,7,15] As such, benzodiazepines have not proven to be an effective method of treatment for anxiety in PD patients and should no longer remain the standard of care for this population.

SSRIs, SNRIs, TCAs

Other commonly administered pharmacologic treatments for anxiety in PD include SSRIs, selective norepinephrine reuptake inhibitors (SNRIs) and TCAs. To date, there have been 3 RCTs conducted to examine the efficacy of these drug classes in PD populations, however, anxiety was a secondary outcome to depression for each.16-18 In the first of these RCTs, Devos et al[16] compared the effects of desipramine (TCA) (n=17), citalopram (SSRI) (n=15), and placebo (n=16) on the symptoms of anxiety as reported by clinicians on the Hamilton Anxiety Rating Scale (HARS). At the end of the 4-week intervention, a statistically significant reduction of 12 points in overall HARS score was reported from baseline for both desipramine and citalopram.[16] Additionally, Menza et al[17] conducted an RCT comparing the efficacy of nortriptyline (TCA) (n=17), paroxetine CR (SSRI) (n=18), and placebo (n=17) on symptoms of anxiety for PD patients. The usage of nortriptyline during the 8-week intervention period resulted in large and statistically significant reductions (-10 points) in anxiety symptoms on the HARS scale, whereas paroxetine CR showed a trend advantage over placebo, but was not significantly better at improving anxiety symptoms.[17] Similarly, Weintraub and colleagues[19] reported a trend for greater reduction in anxiety symptoms with the usage of atomoxetine (SNRI) (n=28) when compared to placebo (n=27), however this trend was not statistically significant. Based on results from these RCTs, TCAs have been deemed likely efficacious (Table 1) at treating anxiety in PD, whereas there is insufficient evidence to make a conclusion about the efficacy of various SSRIs. While some of these results show promising outcomes for treatment, their interpretations are restricted by limitations in study design, including an inability to determine long-term efficacy, small sample sizes, and anxiety as a secondary outcome to depression.[16-18]

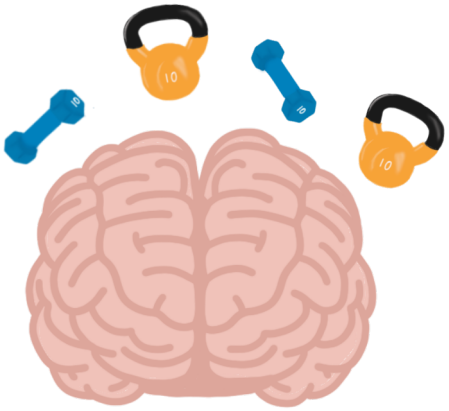
Table 1: Conclusions on Pharmacological Drugs for Treating Anxiety in PD

Reference	Evaluation	Duration of Study	Group	Overall Effect Size	Statistical Sig.	Efficacy
Devos et al. (2008)	Hamilton Anxiety Rating Scale (HARS)	4 weeks	Placebo (n=16)	-8pts	-	-
			Desipramine (TCA) (n=17)	-12pts	Significantly different ($p < 0.05$)	*Likely efficacious*
			Citalopram (SSRI) (n=15)	-12pts	Significantly different ($p < 0.05$)	*Insufficient evidence*
Menza et al. (2009)	Hamilton Anxiety Rating Scale (HARS)	8 weeks	Placebo (n=17)	-4pts	-	-
			Nortriptyline CR (TCA) (n=17)	-10pts	Significantly different ($p < 0.0001$)	*Likely efficacious*
			Paroxetine (SSRI) (n=18)	-6pts	Not significantly different	*Insufficient evidence*
Weintraub et al. (2010)	State Anxiety Inventory (STAI)	8 weeks	Atomoxetine (SNRI) (n=28)	-8.08pts	Trend for greater reduction in anxiety symptoms, but was not statistically significant	*Insufficient evidence*
			Placebo (n=27)	-3.39pts	-	-
Rascol et al. (2012)	Hospital Anxiety Depression Scale (HADS)	12 weeks	Pardoprunox (Dopamine agonist) (n=140)	-1.0pts	Not significantly different	*Not efficacious*
			Placebo (n=133)	-1.3pts	-	-

Dopamine Agonists

Another drug class that has been preliminarily studied as a pharmacologic treatment method for anxiety in PD includes dopamine agonists, though these are not as commonly administered. To date, there has been 1 RCT that has investigated the effects of Pardoprunox (n=140) on symptoms of anxiety in comparison to placebo (n=133).[20] After the 12-week intervention, Rascol and colleagues[20] reported a non-significant difference in anxiety symptoms on the Hospital Anxiety and Depression Scale (HADS) between the intervention and

control groups, making pardoprunox a seemingly ineffective method of treatment for this condition. However, inclusion criteria for this study did not require diagnosis of either an anxiety or major depressive disorder under DSM-IV or other criteria, affecting the interpretation of results.[20] The results of this study are further limited by the lack of consistency between sample sizes of the experimental and control groups. The results of all aforementioned studies investigating the effects of various methods of pharmacologic treatment have been summarized in Table 1.



Nonpharmacologic Treatments

CBT

Due to the risk of side effects as well as limited research investigating the effects of pharmacologic treatments, recent literature has proposed several nonpharmacologic methods as potentially safer, more viable alternatives. To date, there have been 4 RCTs conducted to evaluate the efficacy of CBT21-24 and 2 RCTs to evaluate RT [5,6] as potential treatment options for anxiety in PD. In the first of these, Dobkin and colleagues[21] investigated the effects of a 14-week CBT and clinical monitoring intervention on improving symptoms of anxiety on the HARS scale. From baseline to week 14, the intervention group (n=41) showed a statistically and clinically significant reduction in anxiety scores of 3.96 points (from 19.32 to 15.36).[21] This is significant as it reduced the severity level of anxiety symptoms on the HARS scale from mild-moderate to mild severity, which will considerably improve quality of life.[21] This study also displayed a significant improvement in motor Parkinson's symptoms ratings from baseline for both the CBT and clinical monitoring group, as measured on the Unified Parkinson's Disease Rating Scale (UPDRS). This improvement shows promise for CBT as a potential treatment to target both motor and non-motor symptoms of PD.[21]

Additionally, Troeung and colleagues[22] and Moonen and colleagues[23] both reported large, statistically significant improvements in symptoms of anxiety after introducing an 8-week (n=18) and 10-week (n=48) CBT program, respectively. Reductions in anxiety scores on the Depression, Anxiety, Stress Scale-21 (DASS-21)22, HARS23, and Parkinson Anxiety Scale (PAS)23 improved by 3.64 points, 6.7 points, and 9.9 points, respectively. Despite most of the literature regarding CBT treatment for anxiety showing promising results, one study did find a non-significant improvement in self-reported anxiety scores after a 10-week CBT intervention.[24] However, this study was limited in sample size (n=11).[24]

RT

An additional nonpharmacologic approach that has garnered interest as a potential treatment for anxiety in PD in recent literature is resistance training. Previous literature has shown RT to have positive effects on various physical aspects of PD patients, including balance, spatial features of gait, and functional capacity, thus prompting investigation into its potential effects on anxiety.[5] An RCT by Ferreira and colleagues[5] (n=35) reported a significant decrease in anxiety symptoms from baseline after a 24-week RT intervention program, with an improvement of 5.8 points on the BAI. However, another RCT[6] comparing

Table 2: RCTs of Nonnpharmacological Methods of Treatment for Anxiety in PD

Reference	Evaluation	Duration of Study	Group	Overall Effect Size	Statistical Sig.	Efficacy
Dobkin et al. (2011)	Hamilton Anxiety Rating Scale (HAM-A)	14 weeks	CBT + Clinical Monitoring (n=41)	-3.96pts	Statistically significant (p < 0.01)	*Efficacious*
			Clinical Monitoring only (n=39)	-0.19pts	-	-
Wuthrich et al. (2019)	Geriatric Anxiety Inventory	10 weeks	CBT (n=6)	-2pts	Non-significant (p > .05)	*Efficacious*
			Control Group (n=5)	+1.8pts	-	-
Ferreira et al. (2018)	Beck Anxiety Inventory (BAI)	24 weeks	Resistance Training (n=18)	-5.8pts	Statistically significant (p = 0.001)	*Insufficient evidence*
			Control Group (n=17)	-1.4pts	-	-
Moonen et al. (2021)	Hamilton Anxiety Rating Scale (HARS) & Parkinson Anxiety Scale (PAS)	10 weeks	CBT + Clinical Monitoring (n=24)	-6.7pts (HARS) '-9.9pts (PAS)	Statistically significant (PAS) (p = 0.012)	*Efficacious*
			Clinical Monitoring only (n=24)	-3.9pts (HARS) '-5.2pts (PAS)	-	-
Troeung et al. (2014)	Depression, Anxiety, Stress Scale-21 (DASS-21)	8 weeks	CBT (n=11)	-3.64pts	Statistically significant (p = .009)	*Efficacious*
			Clinical Monitoring (n=7)	-0.43pts	-	-
Kwok et al. (2019)	Hospital Anxiety and Depression Scale (HADS)	8 weeks	Mindfulness Yoga (n=71)	-3.28 pts	Statistically significant (p = .001)	-
			Stretching and Resistance Training (n=67)	-0.71 pts	Not statistically signficant	*Insufficient evidence*

the efficacy of mindfulness yoga (n=71) to stretching and resistance training (n=67) on anxiety in PD patients found no statistically significant improvement in anxiety scores on the HADS for the RT group. The results of both studies are limited by short duration times and the fact that participants maintained pharmacologic treatment throughout the program.[5,6] The results of these studies have been summarized in Table 2. As these are the only RCTs conducted to-date investigating the effects of RT on this condition, a need for additional studies is required to reach a conclusion about efficacy.

DISCUSSION

In a 2013 meta-analysis of RCTs for anxiety and depression in PD, Troeung and colleagues[25] concluded that there was insufficient evidence upon which to base a treatment plan for anxiety specifically in this population. While progress has been made in the years since this analysis was published, there remains a clear lack of randomised, placebo-controlled trials investigating the effects of pharmacologic treatments on anxiety as a primary outcome. Thus, despite the high prevalence of anxiety in PD, researchers and clinicians alike must look to other, nonpharmacologic options as potentially more promising methods of treatment.

The findings of this report are consistent with prior research, which regards TCAs as the most effective first-line defense for this condition.[25] While there is insufficient evidence to make a conclusion regarding the overall efficacy of SSRIs/SNRIs and RT, both TCAs and CBT have proven to be likely efficacious for this condition. However, many of these studies included several limitations, including small sample sizes, the continuation of pharmacologic treatment, and short duration times, contributing to an inability to investigate long-term effects of treatment.[6,16,20,21,23,24,25] These limitations showcase the need for future studies to be conducted to determine the long-term effects of TCAs, CBT, and RT on anxiety symptoms and prove them to be truly efficacious.

CONCLUSION

With the increasing prevalence of anxiety disturbances among PD patients, there is an urgent need to conduct research trials to determine the efficacy of TCAs and other potential pharmacologic treatments, specifically with anxiety in PD as a primary outcome. Furthermore, additional studies investigating the long-term effects of CBT on this condition are warranted, as current literature has shown it to be a very promising method of treatment with the potential to become superior to TCAs. Finally, future research should also look to determine if anxiety is indeed a prodromal indicator of PD. Although this review provides direction for future studies in anxiety in PD, several limitations arose throughout the inclusion process. Firstly, various methods of assessing and subsequently diagnosing anxiety were utilized in each of the studies included. This includes the HARS,16,17,21,23 State Anxiety Inventory,19 HADS,6,20 Geriatric Anxiety Inventory,24 BAI,5 PAS,23 and the DASS-21.22 As such, diagnostic criteria for the clinical diagnosis of an anxiety disorder varied for each study included, leading to varying results. Additionally, due to the lack of literature investigating anxiety as a primary outcome in PD patients, this review included many studies in which anxiety and/or anxiety symptoms were measured as a secondary outcome. In terms of this narrative review paper itself, limitations arose due to a lack of access to certain studies, namely the 1975 bromazepam study mentioned previously.[2]

Acknowledgements: Thank you to Dr. Kaylena Ehgoetz Martens (University of Waterloo) for your continued guidance and mentorship throughout the research and writing process.

***Keywords*: Parkinson's disease (PD), anxiety disturbances, SSRIs, cognitive behavioural therapy, TCAs, resistance training**

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Received 03-01-2022
Accepted 05-20-2022
DOI: 10.15353/juhr.v1i2.5160

Mental Health Assessment Avoidance Amongst South Asians

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Mental health is a taboo topic amongst the South Asian community. Although at an increased risk of developing mental health disorders, the belief that discussing mental health is shameful leads to the community's underutilization of psychological resources. Essentially, it seems that attempts to evade shame increase assessment avoidance.[1]

Gossip, Fear & Stigma

Family honour and the respect of the family unit is extremely important amongst South Asians, with a specific term being coined for the sense of familial duty, known as "izzat."[2]
Many South Asians express fear that medical professionals may pass along health information to community members at large. The perceived threat this poses to family honour limits the utilization of mental health care amongst South Asians.[2]

Community Perspective

Toronto's South Asian community members and health sector workers identified mental health as the community's most undiscussed and stigmatized issue.[3]

Negative Perceptions

Some research has found higher levels of mental health stigma in South Asian college students than Caucasian college students. Moreover, South Asian college students hold more negative perceptions and attitudes toward mental health service use than their Caucasian counterparts.[4]

Why Does This Matter?

The underutilization of resources amongst a community that is at a higher risk for mental health disorders may lead to mental health conditions that develop being left undiagnosed and untreated. Moreover, the root cause of this avoidance seems to stem from stigma and shame, both of which need to be addressed to remove this barrier and lack of help occuring.

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Received 03-01-2022

Accepted 05-20-2022

DOI: 10.15353/juhr.v1i2.5161

OPINION PIECE

ISSN 2816-2420

MORE THAN A PHYSICAL CONDITION:
THE STIGMATIZED EXPERIENCE OF INFERTILITY

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ABSTRACT

Despite its high prevalence, infertility is a very stigmatized experience. This paper explores how infertility can be seen not only in physical health terms, but also as a distressing event with significant mental health implications that result from living in a pronatalist society. Women are especially impacted by the consequences of infertility due to gendered expectations of parenthood and the medicalization of infertility. Moving forward, to destigmatize infertility and reduce adverse mental health effects, society as a whole must start normalizing childfree people and valuing women for more than their reproductive capabilities.

INTRODUCTION

Couples of reproductive age are frequently questioned about why they do not have children yet and when they plan to start. Although these questions are often well-intended, they illustrate the strong expectation for parenthood in Western societies and overlook the negative effects they can have on the people being asked. The Canadian infertility rate has doubled since the 1980s, with about one in six couples experiencing infertility.[1] The rise in infertility, however, has not been accompanied by a large shift in social attitudes.[2,3] Therefore, increasing numbers of people are finding out they are infertile and having to deal with the stigmatizing consequences of such a label in a society that expects all couples to have children.

This paper argues that infertility is a burdening life experience that disproportionately affects women both psychologically and physically because of its intrinsic connections to normative conceptions of motherhood. Firstly, Western societies have prevalent pronatalist ideals that expect all couples to have children, resulting in the stigmatization of childfree couples.[4] Secondly, gender roles contribute to much higher expectations of parenthood for women than for men.[5] These expectations cause the stigma of infertility and the associated psychological consequences to disproportionately impact women.[6] Finally, the female-focused medicalization of infertility leads to women facing most of the physical challenges of infertility as well as the many psychological difficulties resulting from medical interventions.[7,8] Although diverse couples want children, this paper focuses primarily on cisgender, heterosexual relationships because of the particularly strong expectation for them to follow the normative script that dictates marriage and starting a (biological) family.[2]

DEFINITION

Significantly, being medically diagnosed as infertile does not necessitate self-defining as infertile. The medical

definition of infertility is the failure to conceive after twelve months of unprotected intercourse.[9] However, despite the medical definition, infertility cannot be completely understood in medical terms. According to Greil et al., infertility is a "socially constructed process whereby individuals come to regard their inability to have children as a problem, to define the nature of that problem, and to construct an appropriate course of action."[10] In other words, infertility becomes an obstacle when people who are unable to have biological children decide they need to fix this problem. Not all people who are medically infertile personally identify as infertile. For example, those who have known for a long time that they never wish to have children may not be distressed by or even aware of their medical infertility. In a study of women who had accessed assisted reproduction services, most of them found out about their fertility issues only after trying to become pregnant.[11] Therefore, it is not solely the medical diagnosis of infertility that results in self-identification as infertile. Rather, the infertile identity is established when people are at the intersection of wanting a biological child and not being able to have one. The discussion of infertility in this paper will focus on those who wish to conceive but are unable to and are thus both medically defined and self-defined as infertile.

PRONATALISM & STIGMATIZATION OF INFERTILITY

Although some couples choose to not have children, they are still a minority in a pronatalist society that dictates childbearing as a natural life stage. Pronatalism is "a social bias that favors childbearing"[4] and is a prominent ideology across North America, as married couples are expected to have children and are socially rewarded for doing so.[8] The special attention awarded to emerging parents can be observed in media propagations of pregnancy photos and gender reveal parties.[4] Couples are often questioned about their plans for conception as soon as they get married, before they have even left for their honeymoon. Simultaneously, most heterosexual couples assume they will have children once they get married.[3] These pronatalist expectations are ingrained into children from a young age; kids often play "house," which socializes them to believe all normal families have children.[5] Cumulatively, the aforementioned examples illustrate how pronatalist ideals are manifested in Western societies. The attention given to new parents, and the importance placed on starting a family, perpetuates the procreative norm that all married couples should reproduce.[8] In essence, "having children is synonymous with adulthood,"[3] and it is an expectation instead of a conscious choice. People who find out that they are infertile not only let down their own expectations, but society's expectations as well.

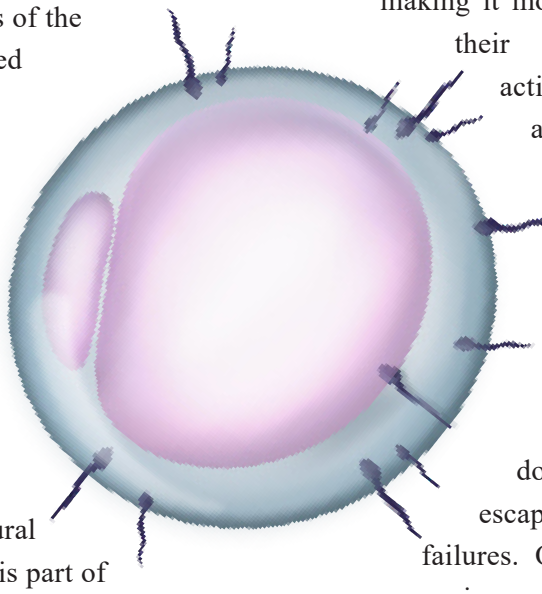
In a pronatalist society, failure to fulfill the cultural expectation of parenthood results in stigma surrounding childfree couples that often leads to mental health ramifications. Couples without children are othered for failing to fit the mould of what society deems to be the correct and socially acceptable life path.[2] Many studies have found that infertility is not only stigmatizing but is also "one of the most distressing life crises for most people who experience it."[11] The stigma surrounding infertility results in adverse outcomes, including high levels of stress and low levels of self-esteem. People who are unable to become biological parents might feel that they have failed to live up to both personal and societal expectations. An unanticipated life crisis may then result, which could be acute or chronic, sometimes with no medical explanation.[8] Women speak of infertility as an experience of "stigmatization, isolation, and alienation" and feel a wide range of negative emotions from anger, to humiliation, to jealousy.[8] Additionally, infertility generates feelings of powerlessness and depression, as well as marital tension.[3] Compared with fertile women, there is a higher rate of psychiatric disorders among infertile women.[6] Based on these research findings, adverse mental health effects could arise due to infertile individuals being perceived as failures in society for their inability to have their own children.

Without the current pronatalist norms and expectations about having children, the negative mental health outcomes associated with infertility might not exist. Canadian feminist philosopher Christine Overall distinguishes between infertility as an impairment and infertility as a handicap.[12] On the one hand, infertility is an impairment that entails "loss of […] procreative capacities."[12] Causes of this impairment include exposure to environmental pollutants, sexually transmitted

infections, smoking or other drugs, high stress levels, and age.[3] On the other hand, infertility is also a handicap, which is a "socially constructed entity" that involves judgement being applied to people who cannot fulfill conventional social norms.[12] Overall's argument is consistent with the social model of disability, which posits that disability is a product of social structures and barriers precluding people from being wholly integrated into the broader community.[13] In short, alienation does not result from the biological inability to conceive, but rather from the social scripts dictating that an infertile person is defective or "less than."

GENDER DIFFERENCES WITH INFERTILITY

The aforementioned social scripts for having children are not applied evenly to men and women; rather, gender roles contribute to uneven expectations where women are judged more harshly for failing to bear children. Although both men and women in infertile couples are stigmatized for failing to achieve parenthood, this stigma is stronger for women because there are much higher expectations for women in the realm of family life and parenting.[11] Traditionally seen as the breadwinners of the family, men have not historically played as large a role as women in nurturing their children.The role of the parent was construed primarily as the mother's, and this sentiment prevails today despite the increasing equality in gender representation in the workforce. For instance, girls are socialized from a young age to believe that they should and will become mothers one day.[5] Cultural expectations dictate that childbearing is part of a woman's role in society.[6] In a pronatalist society, women are often defined by the presence or absence of children of their own.[4] Thus, women without children are considered incomplete,[5] even if they are highly successful in their careers. In an interview by Whiteford and Gonzalez, one woman who was infertile due to polycystic ovary disease explained that she "did not see meaning in [her] life if [she] could not become a mother,"[8] illustrating the salience of the motherhood identity that many women have internalized. The lower expectations of parenthood for men mitigate the negative mental health outcomes that accompany infertility. Notably, men do have higher levels of depression when their inability to conceive is due to their low sperm count instead of their partner's infertility.[6] However, the same literature review of experiences with infertility found that females generally had more negative experiences with infertility than men, including higher levels of depression, stress, and shame.[6] These gendered outcomes are likely connected to the fact that motherhood is often the central identity for mothers, while fatherhood is simply one aspect of a father's identity.[14] In particular, studies have found that male infertility is more strongly connected to men's feelings of masculinity than to their self-identity as a whole.[6,14] While a woman's perceived femininity and role fulfillment largely rest on her bearing a child, a man's masculinity can be channelled through other activities.[6] These other activities, including sports and their occupations or careers, provide an escape for men from the adverse mental health effects resulting from the stigma of infertility. In contrast, women without children are seen as failing to fulfill their primary role regardless of any other activities they participate in, making it more difficult to find reprieve from their stigmatization through these activities. Also, while a woman's absence of pregnancy can usually be inferred by looking at her physical appearance (i.e., lack of a baby bump), a man's infertility can stay hidden. A man may conceal his infertility in cases where a couple uses artificial insemination or a sperm donor, which thus provides another escape for men from being perceived as failures. Overall, among infertile couples, women experience a greater loss of identity, a greater loss of self-esteem, and a greater stigma compared with their male partners. The noticeable physical changes accompanying pregnancy, together with pronatalist ideals rewarding childbearing, produce further negative psychological effects for women who cannot carry a child. Biological motherhood is the single most valued life course for women.[5] Pregnant women are often congratulated, asked about their due date, told they are



"glowing," and thrown special parties to celebrate their pregnancy. Many girls grow up imagining themselves in that position one day, and it can be devastating to discover they may never have that experience. Giving birth becomes a major chapter of a woman's personal history that shapes her self-identity, and infertility is a massive, sometimes undefeatable, obstacle separating dream from reality.[12] Consequently, infertility results in a spoiled identity for women and can leave them feeling incomplete.[8] In some ways, women are doubly stigmatized for failing to portray the images of both pregnancy and motherhood.

The centrality of motherhood to women's identities ultimately makes infertile women feel that they have failed to fulfill their dictated gender roles. A study in Hungary found that femininity is a positive predictor of infertility-related stress.[6] One infertile woman spoke of feeling like she "had lost all [her] womanness."[12] Gender roles and stereotypes merge together motherhood and womanhood,[3] so women often feel that their womanhood has been shattered once they find out they cannot have children. Even if the male partner, and not the female partner, is infertile, it is the woman who feels as though her femininity is impaired.[6] In a gender-binarized society where individuals are often defined by how well they fit their prescribed gender roles, these feelings of lost femininity can have immense implications for self-identity and self-esteem.

THE FEMALE-FOCUSED MEDICALIZATION OF INFERTILITY

In addition to gender roles, the medicalization of infertility also results in greater challenges for infertile women than for infertile men. Infertility has become medicalized through a focus on assisted reproductive technologies. Medicalization means infertility is treated as a medical problem instead of a problem to do with social norms and expectations. Numerous treatments exist for infertility, including lifestyle changes, hormone shots, clomiphene, Pergonal, Danazol, in vitro fertilization, and intrauterine insemination.[7,8] Almost all of the treatments available, however, are interventions on the female body, and not the male body.[7] This medical focus on women's bodies seems to result in infertility being more of a "women's issue," and consequently, women may bear the brunt of the stigmatization. Even if the male partner has infertility problems, it is the female partner whose body is put through invasive testing and treatments.[8] In this medical model, the female infertile body is seen as defective or diseased.[8] Labelling theory posits that when people have labels placed on them, they may come to identify with the label and act in accordance with it.[15] Through the lens of labelling theory, women may internalize the label of their body being defective, or of them being "damaged goods." Believing that oneself is defective, damaged, and inadequate can clearly have devastating effects on one's self-esteem and overall mental health.

While the prospect of more infertile couples being able to conceive through new technologies seems desirable, additional challenges should be considered. Medical advances present a narrative of choice for infertile couples, but this creates a façade of hope where the ideal outcome is conception and pregnancy. With the proliferation of medical interventions, infertile couples see themselves as "not yet pregnant," sometimes creating unrealistic expectations that they may be able to have biological children one day.[8] Some women engage in several infertility treatments in attempts to conceive a child and release themselves from the stigma they often experience with infertility.[8] Assisted reproductive technologies are construed as their final chance for social acceptance into the pronatalist society in which they live.[3] Every time a woman gets a new treatment, the couple experiences a surge and fall in the hopes of becoming pregnant.[16] This constant focus on the possibility of becoming pregnant increases the couple's belief in the importance of parenthood and results in even more distress after each failure to become pregnant.[16] Consequently, the woman's identity and mental health rest upon the outcome of each treatment. During each attempt at conception, she is in a state of limbo, not knowing if she will become pregnant or will remain childless. Repeated attempts at conceiving through assisted reproductive technologies may prolong stress about infertility and prevent couples from either moving on to other solutions, such as adoption, or coming to terms with the fact that they may never have children. Moreover, focusing on other life plans is difficult because

they do not know if she will become pregnant in the near future.[8] Altogether, the unrealistic expectations and stress that accompany the use of assisted reproductive technologies expose the consequences of combining a medical model of infertility with a pronatalist ideology.

On top of the existing expectations of natural parenthood, the medicalization of infertility has created further expectations for those who cannot conceive without medical assistance. While assisted reproductive technologies offer more avenues to conception, they also reinforce the social pressure to reproduce.[3] Christine Overall refers to the concept of infertility as prescriptive because it implies that once diagnosed as infertile, there are specific actions one must take.[12] The abundance of treatments and new inventions communicates to infertile women that they should put themselves through invasive treatments.[8] The prevailing narrative says: "If you really want a child, you will do whatever it takes to have one." Women are thus compelled to continue seeking treatments until they successfully conceive or until they have exhausted every medical intervention available.[8] If couples choose to forego the treatments, they may be further stigmatized for not trying hard enough to become parents. Unfortunately, for women, receiving infertility treatments means enduring side effects from the drugs, including weight changes, depression, and mood swings, as well as giving up much of their time and energy.[3] Some women even come to see the intrusive tests and treatments as punishment for being defective.[8] Once again, societal expectations of parenthood have produced more challenges for infertile women than for infertile men, and in both a physical and psychological manner.

CONCLUSIONS & FUTURE DIRECTIONS

In summary, infertility is a highly stigmatized experience that disproportionately affects women due to the combination of pronatalism, gender roles, and the medicalization of infertility. Strong pronatalist ideals in Western societies result in the stigmatization of infertile couples for failing to fulfill the cultural expectation of parenthood. Due to this stigma, many people experience adverse physical and mental health effects. The medicalization of infertility further perpetuates these effects by making people feel defective. Finally, gender roles attributing parenthood more strongly to women and the female-focused model of infertility both enhance the negative effects of infertility for women.

The stigmatization of infertility lacks a clear-cut solution. Some people suggest increasing accessibility of fertility testing so individuals can have a greater awareness of their fertility levels before attempting to conceive. However, increasing testing accessibility does not address the source of negative experiences among infertile individuals: pronatalist ideology. Instead, prioritizing testing may only further heighten expectations for parenthood and increase the already high importance that society places on childbearing. Rather than focusing on fertility levels, a start to decreasing the stigma surrounding infertility would be to begin changing the narrative that all couples should have children. As Shanley and Asch note, if society starts to give more recognition and higher respect to adults who play significant roles in the lives of other people's children, infertile couples may feel less stigmatized and have more fulfilling lives.[17] Valuing non-parental figures in children's lives still does not consider how to address those who do not help other children, but it can be a start towards destigmatizing childfree couples. Additionally, in alignment with many feminist arguments, there must be a

shift away from seeing women as vessels of reproduction. Women should be valued for more than their childbearing capacity because there are so many other ways women contribute to this world. Infertility is a stigmatized experience affecting millions of people around the world, and traditional concepts of adulthood need to change to make planning for the future a more positive experience for all those affected.

Acknowledgements: This paper was originally written for the course SMF 205, taught by Joseph Pazzano, whom I would like to thank for his feedback on the first draft.

***Keywords*: Infertility, Pronatalism, Gender roles, Assisted reproductive technologies, Mental health, Stigma**

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Received 03-01-2022

Accepted 05-20-2022

DOI: 10.15353/juhr.v1i2.5162

OPINION PIECE

ISSN 2816-2420

FOOD INSECURITY AND FINDING A WAY FORWARD: THE RIGHT TO FOOD

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ABSTRACT

The right to food protects the right of all human beings to live free from hunger and food insecurity, with dignity. Despite Canada's developed image on the world stage, there are Canadians that still lack the ability to consume adequate quantities and qualities of food. The causal link between food insecurity and poverty has been well-established, but much focus still lies on downstream approaches aimed at addressing the hunger instead of the root problem. This entry provides a historical background for the current state of food security in Canada, highlights the steps currently being taken to control the issue, and presents issues of equity to showcase the disproportionate impact of food insecurity in this country. The right to food as a framework to improving both availability of and access to food is proposed as a guiding principle to tackling food insecurity in Canada, in addition to suggestions that allow accountability and equitable and just systems to flourish.

INTRODUCTION

Humankind is a beautifully diverse species across many domains, but some of our most striking similarities can be seen in the context of food. Food is much more than a substance consumed for the maintenance of life – it contributes to our health while connecting us to our cultures and each other. It is deeply entrenched in our ability to lead holistically healthy lives; as Virginia Woolf once said, "one cannot think well, love well, sleep well, if one has not dined well").[1] Without this fundamental human need, survival is called into question and thriving it is out of reach. The economic, health, social, and ethical costs of ignoring = or inadequately addressing food insecurity are much too high for Canada's current courses of action to remain unchanged. Whether driven by motivations that are economical, ethical, religious, or any combination thereof, eradicating food insecurity will produce immeasurable benefits to public collectives.

Food insecurity is the inability or uncertain ability to consume adequate quantities and/or qualities of food.[2] This state arises when food quantity and/or quality is compromised because of physical or economic constraints to access.[2] Canada is not often one of the first countries thought of when people consider inadequate access to food and states with hunger-related issues. On the world stage, Canada's image is a developed, socially progressive force that prioritizes the safety and well-being of its citizenry, yet so many of those who call the country home continue to suffer through food insecurity and its related issues. The Canadian Community Health Survey (CCHS) of 2017 and 2018 found that 12.7% of households (approximately 4.4 million people) experience some level of food insecurity.[2] Food insecurity can lead to a multitude of undesirable health outcomes; examples include mental

health issues, obesity, hypertension, and diabetes.[3] It is a systemic issue which is perpetuated by profoundly engrained societal conditions.[4] Various systematic failures interact to foster an environment that allows food insecurity to flourish – enough food is produced to feed our population, but strong social, cultural, economic, environmental, and political influences permit the continued undernourishment of millions.[4] Hunger is often seen as an issue of supply and demand, but in actuality, it is a manifestation of insufficient supports and safety nets. Similarly to other indicators of social disadvantage, a morally frustrating aspect of food insecurity is its propensity to disproportionately affect the most vulnerable members of communities.[3] For example, the condition is associated with low socioeconomic status, being a racial/ethnic minority, renting a home, living with a disability, and/or being a student, immigrant, or member of the LGBTQ+ community.[3] Adding to this frustration is the fact that many vulnerable individuals fall through data collection gaps; for example, levels of food insecurity are evidently difficult to accurately measure among homeless populations. Inadequate data allows inappropriate overarching statements to be made and can further be used as an excuse for remaining passive – to be allowed to do nothing, those in power must be able to claim ignorance.[5] Incomplete data impedes health promotion efforts; without a complete understanding of the issue at hand, addressing it becomes difficult because we cannot provide adequate supports if we are unaware of who needs to be served. Being food insecure introduces a state of scarcity that strips individuals of the vital values of autonomy and freedom by impinging on the mind and forcing one to behave differently.[6] It demands a narrowing of one's focus to their immediate lack and creates circumstances where other aspects of life may need to take a back seat in the name of addressing the most pressing problem. This can lead to an unfortunate cycle whereby scarcity of adequate food, in quality or quantity, forces attention to be redirected from one's other needs and desires. There are already so many issues facing vulnerable populations; being in such a state can do nothing but hinder the ability of individuals to uplift themselves.

If Canada's public collective hopes to decrease levels of food insecurity and ensure conditions for equitable health, we must no longer view the issue narrowly. The main underlying cause of food insecurity can be attributed to financial constraints; approximately two-thirds of food insecure households are among the "working poor".[7] Figure 1 depicts the negative correlation in the relationship between food insecurity and income – food insecurity decreases where income increases. This suggests that targeting the financial issues that underscore food insecurity is appropriate and necessary, but policies of this nature take time to design and implement. Telling an individual who is food insecure right now to wait for higher level change is both unjust and unreasonable. To meaningfully affect change, the issue must be combatted with upstream approaches in conjunction with downstream ones to ensure gaps are filled. As a country, measured decreases in household food insecurity rates have been seen where comprehensive poverty reduction measures were taken, as seen in Newfoundland.[7] Newfoundland is indicative of the impact that can be made through systemic policy activities, as seen in Figure [2]. Sadly, Newfoundland is also an example of what can happen with unreliable data collection and a lack of long-term strategy. The province stopped tracking food insecurity and effectively "turned the lights off" on studies of prevalence until tracking was made mandatory in 2016, and when those lights turned back on, higher rates of food insecurity were revealed.[8] The province went from having the country's lowest rate of food insecurity (10.6%), to the highest (15.9%).[8] Newfoundland serves as a dual example first by showcasing the benefits of comprehensive strategies, and second by highlighting the detrimental effects of inadequate data collection methods and a lack of long-term planning. Solving food insecurity is not something that can happen overnight; it requires long-term change.

We must be more critical of the systems that are currently in place to help the most vulnerable among us. When vulnerable populations do not have a place at the table where decisions are made, how can we ensure that we are addressing their needs? Which players should be accountable to addressing the issue? Significant changes are not being seen as a result of current interventions, so what aspects of our approach need to be altered? As a country, do our actions or lack thereof, perpetuate food insecurity? These are tough questions, but they are necessary to allow growth. Food insecurity can take on

different forms and affect people in multiple ways, making it difficult to understand. To aid in comprehension, food insecurity can be classified into three categories: (1) Marginal, (2) Moderate, and (3) Severe. The principle of the Five A's – (1) Availability, (2) Accessibility, (3) Adequacy, (4) Acceptability, and (5) Agency – provides a framework for determining food security status (mild versus moderate versus severe), but they can be extended to understand what needs to be done to ensure the internationally recognized, fundamental human right to food is protected. The answers to these important questions and remaining anchored to the principle of the Five A's will allow us to build a foundation of understanding from which we can affect sustainable, long-term change. Solutions to the problem must reflect its complexity through holistic measures. Grounding policy work in multidisciplined, multifaceted approaches is the only viable course of action. Short of this, the problem will continue to fester and deliver detrimental implications for the well-being of all Canadians. I begin by analyzing the current climate around food insecurity to understand how bad the issue is, how we got to where we are, and what we are doing about it.

CURRENT CLIMATE

In high-income countries like Canada, food insecurity is a vital measure of population well-being.[8] Since financial constraints are the main underlying cause of food insecurity, it serves to capture levels of financial vulnerabilities. Canada's main tool for monitoring household food insecurity is its CCHS, by including a section called the Household Food Security Survey Module (HFSSM).[8]

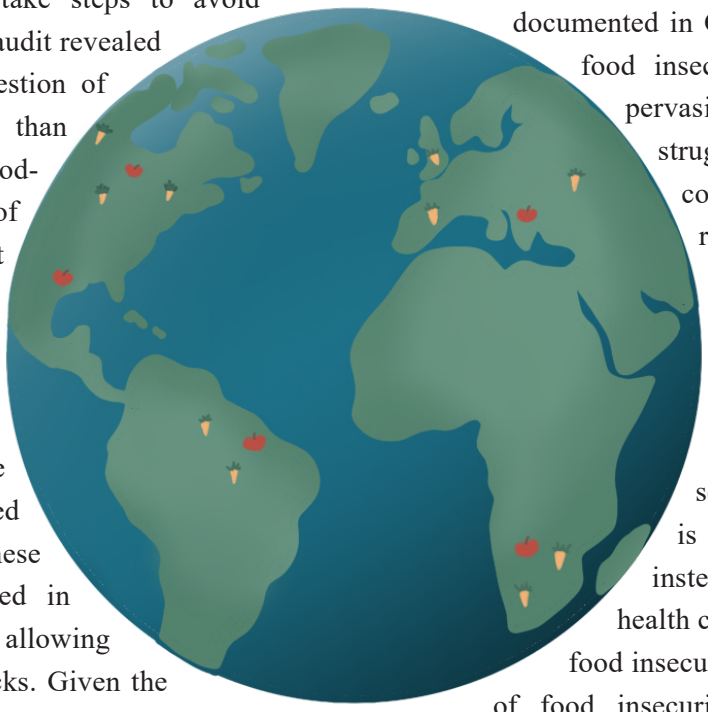
The systemic nature of food insecurity in this country can be attributed to the issue's strong link to poverty. Consider the following examples of communities most severely affected: Indigenous populations in Canada have faced, and continue to face, significant challenges since the arrival of European settlers, and these obstacles have only served to perpetuate the issue; homeless communities face stigma and other barriers to accessing services that may help them.[9] Additionally, the influence of private players (i.e. corporations) on the current climate is undeniable.

Current activities employed by Canada to combat food insecurity are highly focused on downstream approaches. They follow the trend of temporarily treating the issue without addressing its root causes. The data we do have indicates this course of action is unsatisfactory, as significant, beneficial changes have not been seen. Evidence shows that in recent years, total household food insecurity in Canada has increased, and this supports the notion that current paths to combatting the issue are insufficient.[10] This has been acknowledged, and a growth in thinking can be seen in a recent attempt to coordinate efforts.

2.1 How Bad is the Problem?

In the early 1980s, food insecurity became a recognized issue in Canada when community members took matters into their own hands and created charitable food assistance programs after noticing hunger among them.[11] Since then, the prevalence of food insecurity has only grown.[11] 8.8% (~1.2 million) of households in Canada experience food insecurity.[2] This could be a gross underestimation; as a result of both indirect and direct negligence, vulnerable populations are routinely omitted from data collection, making it difficult to ascertain the depth of the issue among them. Despite Canada's efforts to capture a complete image of the situation through its CCHS, we are still woefully lacking in understanding. As the most utilized measurement tool, the HFSSM module raises issues of inclusivity, as it includes 18 items strictly inquiring about household food-related experiences. Data collection in Canada also routinely excludes marginalized populations like those living on First Nation Reserves or Crown Lands, incarcerated individuals, and the growing homeless population.[12] In a study of country's largest portion of homeless people (single men), the HFSSM was deemed insufficient.[12] The questions asked in the survey are adequate only if we decide not to cater to our most vulnerable populations, but otherwise, they display a lack of understanding with respect to the diverse food-related experiences of various populations. Additionally, ensuring the dignity of those who access food supports can have impacts on quality data collection. In response to stigma's ability to stop people from accessing resources, some services forego collecting personal information (e.g. UWaterloo's Food bank), raising the risk of critical data not being collected. Recent studies in Northern Aboriginal communities have documented a

massive prevalence of food insecurity, with rates in excess of 60%.[11] The role played by the transportation of food in affecting access must be considered; in geographic size, Canada is the world's second largest country, meaning food sometimes has to travel long distances. Not only does this affect access, but it has potential ramifications on the quality of food. Incarcerated individuals are often overlooked, as they are guaranteed meals by Corrections Canada. Recalling the definition of food security, quality and safety of food are vital components – Canada's prison food system has been criticized for providing subpar meal portions, failing to meet Canada's Food Guide nutrition guidelines, and failing to take steps to avoid contamination.[13] An internal audit revealed these issues, raising the question of bias – are things worse than currently indicated? The food-related experiences of homeless individuals are not viewed as "socially acceptable" and are highly stigmatized, exacerbating the inability of measuring food insecurity within the scope of Canada's accepted definition. Furthermore, these experiences are not reflected in data collection methods, allowing them to fall through the cracks. Given the extreme vulnerability of these populations and the gaps in understanding how food insecurity presents itself among them, any estimates made must be regarded as understatements.[11] The neglect vulnerable communities have faced underscores both the importance of improving and the incompleteness of current knowledge.



Food-related health promotion activities in Canada advocate for healthful dietary choices, but again, the activities fail to consider vulnerable populations as the choices encouraged represent increased food costs.[14] In this context, income is again highlighted as a major barrier to food security. The nutritional implications of food insecurity in Canada are poorly understood due to a lack of data on the relationship between food security and dietary intake. Dietary assessments are limited to small samples, unrepresentative of the population at large. Those that are available highlight a high prevalence of nutrient deficiencies: more than ½ of 231 homeless respondents consumed insufficient amounts of vital nutrients15; low-income, female, lone-parent households consistently indicate that women compromise their own nutritional needs in favour of their children's. The absence of population data renders knowing the extent of compromised dietary intake impossible, but it is clear from smaller studies that vulnerable populations are again, the hardest hit.

The significant relationship between food insecurity and the likelihood of reporting poor health has been heavily documented in Canada.[16] It would seem that food insecurity is a dimension of a pervasive vulnerability among those struggling with financial constraints to experience a range of mental, physical, and social health problems.[17] The causal relationship between health and food insecurity is clear; it would be difficult, for example, to design a scenario where nutrient intake is a cause of food insecurity, instead of the inverse.[18] Mental health can be negatively impacted by food insecurity by recalling that the state of food insecurity impinges on the mind through scarcity. Stress (another significant determinant of health) can occur because of this state of scarcity. The adverse outcomes on physical health are centered around insufficient intake in both quantity and quality. Not having enough good food fosters an environment in the body for poor health, creating or exacerbating the conditions for various conditions. Social health is impacted when we recall that food is more than just sustenance – for ages, humans have connected over food, and a growing body of research indicates the need to connect socially is as basic as our need for food itself.[19] To be food insecure is to lack in social connectedness; without this critical contributor to health, the well-being of nearly every bodily system is undermined.[19]

The sheer number of people affected by food insecurity and its overall impacts on human health highlights the

severity of the issue in Canada.

2.2 How Did We Get Here?

We must investigate how the issue has gotten to where it is in order to learn from our mistakes and decide next steps. Put briefly, the history of food insecurity highlights an increase in poverty that has deepened over the years. Food insecurity can be seen as a child of the 1980s, but Canada experienced food problems long before this. Malnutrition prior to World War I, the Great Depression, and a famine among the Inuit are prominent examples.[20] When the public collective took action into their own hands and created charitable food assistance programs, the concept of food insecurity emerged.[19] Following this, the 90s were marked by a period of restructuring of and cutbacks on social programming, in both activity and spending.[20] Funds directed to employment insurance and welfare services, and taxes imposed on corporations were reduced, all of which contributed to the expansion of poverty within the country. Without funds to run programs, the impact of social services was severely restricted. Canada's activities in the 90s set the stage for the country's global growth, but despite the optimistic hope of a positive impact on Canada, the income gap between the wealthy and the poor advanced and increasing food insecurity levels appeared as a manifestation of the growing inequities.[20] The issue of inequality in the context of food insecurity is further highlighted when we consider that vulnerable populations already face immense systemic barriers.

In its efforts to grow on a global scale, Canada created the perfect conditions for greed to supersede humanity. Corporate tax breaks were created with the intent to incentivize private players to make meaningful contributions to communities while alleviating economic pressures, and while there have been positives on a downstream scale, corporations have twisted the situation to create a cycle where they receive more money and perpetuate systems that keep people in distress. Most abhorrent is how some corporations who have acquired influential roles within food systems have effectively been able to mislead Canadian citizens and distract us from their contributions to the problem. Consider Walmart; the company has been hailed as an "anti-hunger champion" because of its financial contributions to food banks, but employees of the company are denied a living wage, often leaving them food insecure.[21] For the corporation, it is more politically and economically beneficial for them to promote and fund downstream approaches instead of doing their part to better the lives of their workers. Corporate social responsibility (CSR) has become a widespread concept, but do companies engage in philanthropic activities to look good, or to do good?[22] These players have political capital to influence meaningful change, but they remain passive, choosing to instead play within the bounds of maintaining considerable profit. One need not look further than the composition of food bank board members for another example of this; many employees of Fortune 1000 companies become members of these boards, where conflicts of interest arise – are decisions made to protect the company they work for, or the clientele they serve? Many food banks have policies in place to attempt to curb any chance of bias, but the reality is that these policies cannot stop the cycle perpetuated by corporations; businesses such as Walmart directly benefit from poverty-creating employment practices and from donating surplus foods to food banks via tax incentives.[23] Furthermore, these boards lack diversity and display a striking discrepancy between them and clients. Oftentimes they are composed of white middle-aged men who have no first-hand experiences related to food insecurity.[21] Food bank runners have identified the lack of understanding and support of board members as a key barrier to engaging in progressive policy advocacy.[21]

The combination of the social history of food insecurity, conditions for greed, and unsatisfactory data collection has had a synergistic effect on Canada's current state of food insecurity. Understanding this is essential to combatting the issue moving forward.

2.3 What is Being Done?

Canada's current courses of action rely heavily on downstream approaches; much of the focus has been directed toward addressing the immediate lack of food that food insecurity poses, rather than its root causes. Despite research indicating that food insecurity is first and foremost a financial issue, the country's responses center on food provision.[24] Charitable food assistance programs in the form of food banks are widespread in Canada, but

there is a significant disconnect between the number of people who are food-insecure and those accessing these banks).[25] For example, in 2010, five times more people were food insecure than those who accessed food banks.[25] In general, low rates of utilization cannot be explained by problems of geographic proximity, and by framing food as charity, the Canadian government implicitly ignores the human right to food, meaning factors that act as barriers to access are not addressed on a policy level.[26] A variety of community level initiatives also exist, including community kitchens and gardens, farmers' markets, food buying clubs, and food boxes.[27] The limited existing research on these programs depict very low participation rates, suggest little impact on food insecurity.[27] It has become clear that this trajectory is insufficient, because while providing temporary relief, there is no evidence pointing to these activities as the solution. In what has been deemed an absurdly tardy – albeit positive – step, the government recently announced Canada's first ever Food Policy.[28] It is an ambitious initiative attempting to take a systems approach in the context of food policy by instituting a Food Policy Advisory Council to bring diverse voices together.[28] High amounts of funding ($134 million) have been directed towards this initiative and it will be a vital support to community-led food programs, as $50 million has been designated to a Local Food Infrastructure Fund.[29] The Food Policy in general is set to invest in four short-term action areas: (1) helping communities access healthy food, (2) making Canadian food the top choice, (3) supporting food security in Indigenous and Northern communities, and (4) reducing food waste.[29] While a critical analysis of the policy indicates the country is moving in the right direction, its most pressing gap becomes clear in the context of income insecurity. The policy acknowledges links between desired food system outcomes and income support programs while highlighting its intended alignment with the Poverty Reduction Strategy, and there are references to food security within it, but it fails to mention food security as a primary outcome.[28] It also fails to prioritize addressing income security in efforts to address food insecurity. Additionally, the policy fails to mandate the monitoring of food insecurity rates. The Food Policy has the potential to address the "quality" dimension of food insecurity, but it is lacking in infrastructure to address the remaining elements. Canada has often been criticized for not having a comprehensive food policy, and the statement remains true. "Comprehensive" suggests a need for transdisciplinary and intersectoral thinking;[30] our country's initiatives continue to operate in silos.[22] These downstream approaches are great short-term solutions, but if we wish to affect meaningful change, the systems that perpetuate food insecurity must be addressed.

The fact of the matter is current actions are not enough to effectively address the problem of food insecurity – as the issue increases in magnitude, it is clear that simply investing in downstream solutions is insufficient. The following section harnesses the lessons learned from Canada's food security climate to investigate how best to protect the right to food.

PROTECTING THE RIGHT TO FOOD

Clearly, current approaches are not working. In the face of such a daunting task as eradicating food insecurity, it can be tempting to see the right to quantitively and qualitatively adequate food as a desirable long-term objective that is currently beyond reach.[31] With this lens, the relatively passive nature of Canada's current approaches is understandable, but this betrays a crucial misunderstanding about what the right to food truly is. The right to food is not just a goal; it, in conjunction with our understandings of food insecurity, creates the path towards fulfilling it. It is not the right to be fed, but rather the right to be able to feed oneself with dignity. Anchoring initiatives in this pillar (i.e. the right to food) will aid in creating and cultivating conditions for sustainable, long-term change.

3.1 Safeguarding Vulnerable Populations

Investigations on the impact of food insecurity highlight the detrimental effects experienced by those who are most vulnerable; the negative outcomes of being in a food insecure state disproportionately affect these communities. Operating with the right to food as a pillar to addressing the issue requires taking the struggles of these populations as our starting point.[31] To do this, the issue of insufficient data collection methods must be tackled, because reliable data is integral to understanding the severity of the issue. Canada cannot continue excluding marginalized communities and methods of

collecting data that can reach these populations need to be created. The case of Indigenous communities being excluded from HCSS data collection displays a blatant neglect for people that this country has historically mistreated.[32] Furthermore, the food-related experiences of homeless and incarcerated populations are not accurately captured by current methods. Incomplete data can be used as an excuse for remaining inactive in the face of food insecurity, but we cannot continue to be willfully ignorant – the power to garner a more in-depth understanding is in our hands. For these reasons, this paper proposes a complete evaluation of current data collection methods. Evaluation should center the needs of vulnerable populations to ensure data collection methods are both wide reaching and effective – current trends indicate that gaps exist.

The time has come to listen to and learn from the people we want to help uplift. Only by identifying what they need, can we hope to design policies that will remove barriers to the right to food. Space must be made at tables where decision-making occurs because we cannot hope to affect change without representation. The emphasis placed on downstream approaches should encourage us to incorporate the views of those whom we are serving. For example, food bank boards cannot continue to be comprised the way they are, as these boards are directly responsible for how food banks are run; they must be restructured to include individuals with first-hand knowledge of food insecurity. We need to learn to favour collective learning and acknowledge the value of tackling food insecurity in a multifaceted manner. We acknowledge the complex nature of food insecurity without translating this complexity in our approaches combatting it. As the saying goes, it takes a village.

More visible vulnerable populations than the ones highlighted above merit attention as well. Recall how food insecurity is associated with single parenthood, renting a home, living with a disability, and/or being a student or immigrant.[4] Oftentimes, being a member of these communities' means being of lower socioeconomic status.4 Again, effects of economic constraints on food insecurity are highlighted, underscoring the importance of upstream policy activities. It is clear that the playing field needs to be leveled through an income-oriented response that considers the unique needs of marginalized groups. Put simply, to protect vulnerable populations, Canada must return to the so-called "drawing board" and ensure a complete understanding is determined.

3.2 Political Economy of Food

In both a historical and present context, corporations exert powerful influence and control over food programs.[33] They contribute to the institutionalization of food charity by having employees who participate as board members and by providing significant resources to food banks. These corporations benefit from their charity in many ways; they avoid landfill fees by donating food34 and they see benefits with respect to public perceptions of their brands.[25] The promotion of these activities perpetuates the idea that food charity is an appropriate response to food insecurity (i.e. institutionalization), which further impedes the advancement of upstream policy activities.[30] "As long as the illusion that immediate food assistance is available for people unable to feed themselves persists, there is little impetus for governments to review the adequacy of their welfare programs, or for the public to pressure them to do so".[8] Food charity programs should be viewed as a tool, rather than an absolute answer. Additionally, the deep pockets of these corporations give them political capital to influence various policy activities. Though their current actions can bolster the state of food insecurity, corporate activity can be harnessed in an interdisciplinary manner to better the situation. Protecting the right to food extends beyond ensuring access – governments must implement laws, regulations, and policies that control the conduct of private actors and their contributions to the problem. Corruption and greed can be controlled to a certain extent if a government takes it upon itself to hold corporations accountable for actions that perpetuate food insecurity (e.g. Walmart refusing to pay employees a living wage). The beneficial impact of the role played by companies in downstream approaches addressing immediate lack and gaps cannot be ignored, but it also cannot continue to be viewed as the "be all and end all" of solving food insecurity. Canada's new Food Policy presents a unique opportunity for policy makers to investigate how corporations can further agendas rather than impede them. We must consider how downstream approaches can go hand-in-hand with upstream ones. In short, protecting the right to food entails government actions that mitigate/

control for the features of systems that perpetuate food insecurity.

3.3 So, What Works?

Obviously, telling food insecure individuals to wait for higher level change is unrealistic, but so is exclusively utilizing downstream approaches. So, what can be done? What will work? An interdisciplinary, multifaceted, income-related method rooted in the right to food that stays true to the principles of the five A's while incorporating both down and upstream approaches may be the answer we are looking for. Advocacy and policy changes that prioritize investigations into a guaranteed annual income (GAI) must be supported.[35] Each element of the principles of the five A's would be supported with a GAI. Economic accessibility (Accessibility) and barriers to accessing nutritious food, which is more expensive(Adequacy), would be addressed, and people would be able to obtain food without compromising their dignity (Acceptability).[36] Canada has enough food to feed its populations, and a policy such as this would enable the achievement of food security (Agency).[36] A GAI would be highly upstream and it would take a long time to implement, but downstream initiatives like food charity and assistance programs can fill the gaps until they are no longer needed. Policy recommendations need to help address the root cause of food insecurity – poverty – while providing supports that ensure no one is left behind.[35] Combining upstream and downstream approaches will be most helpful in enabling a rights-based approach to food insecurity.

STEPS FORWARD – A RIGHTS BASED APPROACH

With an understanding of the depth of food insecurity and a general understanding of plausible solutions, we must consider Canada's obligations to its people and reflect on what this means for improving food security.

Canada has a responsibility to meet its human rights obligation of ensuring the realization of the right to adequate food for all its citizenry.[37] The main recommendation made to Canada by the former UN Special Rapporteur on the Right to Food was to adopt a food strategy that would assist Canada in meeting its obligation.[37] Additionally, the UN Committee on Economic, Social and Cultural Rights urged Canada to implement a human rights-based approach, developed in tandem with provinces, vulnerable peoples, and civil society organisations.[38] Despite this, the newly introduced Food Policy is still not human rights-based.[25] The right to food encompasses Canada's definition of food security by emphasizing the creation of an enabling environment where people can access their potential and procure adequate food for themselves. The right places three obligations on countries: two of them seek to ensure conditions are made that allow people to meet their own needs, while one serves as a fulfillment factor.[39] First, the obligation to respect requires that states do not take measures that may challenge adequate access.[39] This may mean that legislations and government programs avoid interfering with access or availability of food. The second obligation, protect, calls upon states to ensure private players cannot deprive populations of access.[39] We are reminded of the imperative nature of regulating industries. Finally, the obligation to fulfill can be thought of in two components: (1) governments should take steps to provide access directly and (2) states must engage in activities and initiatives that strengthen access and the ability to utilize resources.[39] This obligation calls for measures aimed at reducing/eliminating reliance on downstream approaches (e.g. food banks). In addition to the obligations put forth by a rights-based approach, the right to food places procedural requirements on governments with respect to policymaking. Namely, accountability, participation, transparency, non-discrimination, human dignity, the rule of law, and empowerment should all be ensured.[40] These requirements underscore the importance of an interdisciplinary approach to tackling food insecurity.

Canada has made multiple commitments to ensuring the realization of the right to food. It is therefore concerning that the country has not adhered to fulfilling these commitments in the form of a food policy rooted in the right to adequate food. Human rights laws indicate the governments need to do their part to ensure this vital right.[40] Food policies that take a rights-based approach have many characteristics. To name a few, they recognize that individuals are not beneficiaries of

policies, but rather rights holders; they recognize that realizing the right to food is an obligation of the state, and they avoid actions that may exacerbate food insecurity.[41] To fulfil its commitments, Canada must adapt and alter its current Food Policy. First, the policy must unequivocally state that all those living in Canada deserve to enjoy the right to food. It must then incorporate robust avenues for participation of communities affected in all aspects of the policy and any activities that stem from it. Specific targets and benchmarks must be outlined while highlighting who is to be held accountable for achieving what. Subsequently, the policy must also include comprehensive monitoring and accountability measurement tools. Ensuring the right to food will finally put Canada on a path that moves us away from relying heavily on charitable assistance programs that do little more than addresses gaps, and towards collaboration and innovation.

CONCLUSION

Through an extensive literature review and analysis, this paper has investigated the state of food insecurity in Canada today. There are many important takeaways, but perhaps paramount among them is the need for a new approach. Current activities to promote food security are inadequate as significant, measurable decreases in food insecurity have yet to be seen. This alone should be sufficient motivation to revisit our understanding of the issue and what can be done to combat it. Undeniably, Canada has the ability to drastically reduce food insecurity among its citizens. The stagnant nature of the issue is a manifestation of passive action that leads to insufficient supports for the people who need it most.

To improve the state of food security, this paper highlights the following suggestions:

1. Center all policy activity in a rights-based approach to effectively address the root causes of food insecurity

2. Evaluate existing methods of data collection to promote inclusion of vulnerable populations

3. Moderate and control the activities of influential private players within the food sector, specifically in the application of downstream approaches

4. Adopt an interdisciplinary approach to learning by including the voices of those being served, decision-makers, advocates, and private players

5. Move away from relying on charitable food assistance programs and other downstream approaches as main solutions to using them as gap fillers while systemic change is implemented

We know that food insecurity is an extremely complex issue, but when considering its root causes, the solution becomes clearer. There is a substantial body of work indicating that food insecurity is an issue of inadequate supports. Therefore, if we wish to empower people to eat and eat well, we must create conditions in which this can occur. The practical implications of remaining on our current trajectory are obvious: food insecurity has detrimental impacts on every single dimension of health. We must reframe our thinking because the right to food is more than just charity – it is justice, and the demands of justice are enforceable, while those of charity are not.[42] If we do this, we allow accountability to flourish and we create systems that are both equitable and just.

The foremost job of any government is to protect and cater to the needs of its people. If we accept food insecurity as indication of failure in that role, Canada cannot continue to claim its title as a socially progressive country, especially when we consider that its most vulnerable people are most affected by the issue. Hubert Humphrey, the 38th Vice President of the United States, once said that the "moral test of government is how that government treats the children, those in the shadows of life, the sick, and the needy".[43] Armed with the information we have now, we can conclude that while Canada is doing work, it is not enough to do well on that moral test. To pass that test, the question is now: what will change?

***Keywords*: Food security, poverty, human rights, data collection, income**

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Received 03-01-2022

Accepted 05-20-2022

DOI: 10.15353/juhr.v1i2.5163

Nutrition & Nutritional Education Amongst Individuals with Down Syndrome

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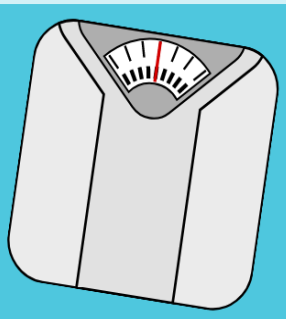
Children with Down syndrome display increased tendencies of overeating, and are at an increased risk of obesity[1]



Food is used as a reinforcer for desired behaviors, making its purpose confusing to those with disabilities[1]

School-based interventions often do not consider those with disabilities[1]

Awareness of Healthy Eating Practices

- This study examined 38 adolescents with Down syndrome through a semi-structured interview to measure knowledge of hygiene, substance use, exercise, and healthy eating[2]
- An alarming deficit in awareness of healthy foods and nutritional knowledge was found amongst individuals with Down syndrome: only 44% of those interviewed were able to provide an example of a healthy food[2]
- This article illustrates the lack of consideration of students outside of the general stream and may help explain the detrimental consequences this neglect can have

Exercise & Health Education Programming

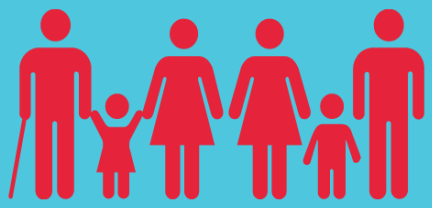
- This primary research study examines attitudinal and psychosocial outcomes from a joint health education and exercise program aimed at adults with Down syndrome[3]
- It was discovered that the training group (12-week exercise and health education program, 3 days per week) had significant attitudinal shifts for exercise (e.g., improved exercise self-efficacy, more life satisfaction, and slightly decreased depression)[3]
- Thus, this highlights that a combination of education and exercise can improve the well-being of those with Down syndrome, so the provision of such opportunities is vital

Health Inequality is Present

Education is Vital

Nutrition is Important

Accommodations (e.g., resources with appropriate reading levels) and nutritional knowledge should be considered for school-based interventions[1]



Youth with disabilities are more likely to experience poverty, which decreases accessibility[1]

Many work environments for school-age individuals with Down syndrome revolve around unhealthy foods[1]

Potential of Simulation Video Games

- Adolescents with Down syndrome take in fewer calories, vitamins, and trace elements than they should, based on their Recommended Daily Intake[4]
- The author of the journal article created a simulation video game to help those with Down syndrome develop more balanced nutrition through behaviour change[4]
- The game provides rewards for healthy food and beverage choices[4]
- This is a clear potential solution to the gap in knowledge that is currently present, especially in regards to those individuals who have aged out of the education system, as it is educational, interactive, and engaging[4]

Conclusion

To conclude, it is evident that there is a gap between the level of nutritional knowledge that those in general education streams and those without disabilities have in comparison to individuals with Down syndrome. There are many negative outcomes of this, whether that be obesity, abnormal associations with food, or another unfavourable consequence, which is why it is so important to address this instance of inequality.

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Received 03-09-2022

Accepted 05-20-2022

DOI: 10.15353/juhr.v1i2.5164

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The University of Waterloo (UW) Journal of Undergraduate Health Research was founded in 2021 by Tara Behroozian and Shayanne Thomas, both undergraduate students in Hon. Health Studies. The UW Journal of Undergraduate Health Research hopes to bring together undergraduate students'. Research works related to health from all faculties at the University of Waterloo. This will act as a platform to bring current undergraduate research work to light while allowing students to make contributions to the field of health research.

Publishing research work during undergraduate studies can be a difficult task to achieve, so the opportunity to publish one's research through a peer-reviewed process can be extremely important for students looking to pursue further professional or graduate studies.

Through the peer-review process, our team ensures that accepted works are well-written, accurate, and address relevant topics in the field of health research. All editors have successfully completed mandatory Elsevier peer-review training.

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The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg and Haudenosaunee peoples.

Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. Our active work toward reconciliation takes place across our campuses through research, learning, teaching, and community building, and is centralized within our Indigenous Initiatives Office.

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Cover Illustrator

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Volume 1, Number 2 | October 2022


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ISSN 2816-2420