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Physical Health Co-occurrences in Canadians with Attention-Deficit/Hyperactivity Disorder: A Cross-Sectional Study

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ABSTRACT

Increased rates of physical health conditions in individuals with attention deficit/hyperactivity disorder (ADHD) have been reported across multiple countries. In this study, we sought to identify whether Canadians with ADHD have greater rates of various physical health conditions than Canadians without ADHD. Data were extracted from the national 2022 Mental Health and Access to Care Survey, collected by Statistics Canada. Individuals who indicated a diagnosis of ADHD were matched with respondents without ADHD based on demographic characteristics, resulting in a final sample size of 930 participants. Chi-squared statistics and odds ratios were used to identify differences in rates of thirteen physical health conditions between Canadians with and without ADHD. Canadians with ADHD were more likely to have a co-occurring diagnosis of asthma, arthritis, back problems, fibromyalgia, migraines, chronic lung conditions, bowel diseases, chronic fatigue, chemical sensitivities, and prior diagnoses of high blood pressure. No differences were found in rates between Canadians with and without ADHD for diagnoses of current high blood pressure, diabetes, heart disease and cancer. Canadians with ADHD, like others across the globe with ADHD, are at an increased risk of multiple physical health conditions. To promote early identification and intervention of mental and physical health concerns, efforts should be made to integrate services and educate health care providers to investigate the presence of physical health conditions in those with ADHD, and vice versa.

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Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental disorder impacting approximately 7% of children and 2.5% of adults [1]. ADHD is characterized by patterns of developmentally-inappropriate impulsivity, hyperactivity, and inattention that

appear in childhood [1]. In adulthood, symptoms may impact daily functioning, such as difficulties remembering appointment, staying on-task at work, and building relationships [1].

Globally, those with ADHD are at risk for multiple co-occurring physical health conditions. While ADHD is likely not the cause of such physical health conditions [2], regardless of etiology, this population is at greater risk for adverse physical health concerns. It is known that those with ADHD experience higher rates of asthma, gastrointestinal disorders, epilepsy [3], migraine headaches [4-5], and sensory disorders [6]. Those with ADHD may also be more likely to be overweight [2] [7-8], although there is some evidence against this hypothesis [9]. Unfortunately, the physical health needs of those with ADHD may not receive adequate attention. A recent study found that Korean children and youth with ADHD were significantly less likely to receive treatment for their healthcare needs compared to their neurotypical counterparts [9]. Consequently, those with neurodevelopmental disorders, such as ADHD, may delay seeking or receiving services for other physical health ailments, potentially extending the time between noticing physical health symptoms and receiving a diagnosis and/or treatment. These findings highlight the importance of addressing mental and physical healthcare services concurrently to ensure neurodiverse individuals receive comprehensive care.

While evidence on a global scale highlights that individuals with ADHD face higher rates of various physical health concerns than those without ADHD, much less is known about the rates of co-occurring physical health concerns for those with ADHD across Canada. A recent longitudinal study completed in the province of Quebec, Canada, indicated that a diagnosis of ADHD predicted the occurrence of unintentional injuries, dental concerns, and being overweight in adolescence [8]. These findings suggest that Canadians with ADHD may experience a higher incidence of physical health concerns compared to those without ADHD, underscoring the need for further investigation at a national level. The present study aimed to address this gap by enhancing the understanding of physical health concerns among Canadians with ADHD compared to those without ADHD. As such, the following research question was posed: Is there a significant difference in the prevalence of various physical health conditions between Canadians with and without ADHD?

Method

Data extracted from the *2022 Mental Health and Access to Care Survey* (MHACS) were used [10]. The MHACS data was collected via telephone interviews from March to July 2022 [11]. Survey responses were coded by trained personnel as part of a computerized questionnaire. The survey aimed to understand the mental health landscape of Canadians, such as mental health status, access to mental health services, and the link between mental health and various characteristics and experiences [10]. The complete data set and further information are publicly available through the Statistics Canada webpage [10].

Sample

The MHACS survey included residents over the age of 15 years from ten Canadian provinces (the territories of Yukon, Northwest Territories, and Nunavut were not represented, although no rationale for the exclusion of these regions was provided) [11]. A list of potential participants was derived from those who had completed the long questionnaire of the 2021 Federal Census. Individuals were excluded from the survey if they were full-time members of the Canadian

armed forces, people living on reserves, people living in collective dwellings, were younger than 15 years old, or had moved outside of the ten provinces included in the sample since the 2021 Census [11]. The complete MHACS survey contained 9,861 respondents.

The present study examined rates of physical health concerns among Canadians with ADHD and explored how these rates may compare to a sample of Canadians without ADHD. To address this aim, all MHACS respondents who indicated a diagnosis of ADHD were included in the present study ($n = 477$). To allow for more accurate comparisons between Canadians with and without ADHD, participants with ADHD were matched with non-ADHD participants across reported sex, age group, visible minority status, and population centre size (living in a rural area, small/medium/large urban area). The provincial representation of MHACS respondents is not made publicly available by Statistics Canada, meaning this variable was not considered when matching participants. Twelve participants with ADHD could not be matched across these four variables; thus, these individuals were excluded from the final sample. Overall, the final sample utilized for data analysis consisted of 930 participants, with 465 participants in each group (ADHD and non-ADHD). Participant demographic information is presented in Table 1.

Table 1. Sample demographic information ($n = 930$).

Variable	%(n)	
	ADHD	No ADHD
Sex		
Female	43.0 (200)	43.0 (200)
Male	57.0 (265)	57.0 (265)
Age group (years)		
15-19	18.3 (85)	18.3 (85)
20-24	22.4 (104)	22.4 (104)
25-29	10.5 (49)	10.5 (49)
30-34	6.9 (32)	6.9 (32)
35-44	14.4 (67)	14.4 (67)
45-54	9.7 (45)	9.7 (45)
55-64	6.7 (31)	6.7 (31)
65+	11.2 (52)	11.2 (52)
Population centre size		
Rural (< 1,000)	16.3 (76)	16.3 (76)
Small (1,000-29,999)	10.1 (47)	10.1 (47)
Medium (30,000-99,999)	12.7 (59)	12.7 (59)
Large urban ($\geq 100,000$)	60.9 (283)	60.9 (283)
Visible minority status		
South Asian	3.9 (18)	3.9 (18)
Chinese	4.5 (21)	4.5 (21)
Black	5.2 (24)	5.2 (24)
Filipino	1.9 (9)	1.9 (9)
Arabic, Latin American, Southeast Asian, Korean, Japanese, and Visible Minority	5.2 (24)	5.2 (24)
Not a visible minority	75.7 (352)	75.7 (352)
Not stated	3.7 (17)	3.7 (17)

Measures

ADHD. As part of the questionnaire, respondents indicated whether a healthcare professional had diagnosed them with *attention deficit disorder*. For clarity, while the question asked about “attention deficit disorder (ADD)”, it should be noted that ADD has not been a diagnosable disorder since the late 1980s and was replaced with attention-deficit/hyperactivity disorder (ADHD) in 1987 [12]. To maintain consistency with current literature and conceptualization of

the disorder, the term ADHD is used in replace of ADD in the present report. Responses to the ADHD question were coded *Yes*, *No*, *Don't Know*, *Refusal*, or *Not Stated*.

Physical Health Diagnoses. Participants reported their experiences with 13 different chronic physical health conditions, including asthma, arthritis, back problems (excluding fibromyalgia and arthritis), fibromyalgia, high blood pressure, migraine headaches, chronic bronchitis/emphysema/chronic obstructive pulmonary disease (COPD), diabetes, heart disease, cancer, bowel disorder/Crohn's disease/ulcerative colitis, chronic fatigue syndrome, and multiple chemical sensitivities. Item prompts specified that the conditions were to be diagnosed by a healthcare professional and were to have lasted or were expected to last at least six months. All responses were coded as *Yes*, *No*, *Don't Know*, *Refusal*, or *Not Stated*. Two items (high blood pressure and cancer) asked respondents if they *ever had* the condition if they selected *no* to currently having the condition.

Analytical Approach

Statistical analyses were carried out using IBM SPSS Statistics (Version 29.0.1.1). The Pearson Chi-Square test was used to test for statistical significance of the prevalence of physical health conditions between ADHD and non-ADHD groups. *P*-values of $< .05$ were considered statistically significant. In the case of significant differences between groups, odds ratios (ORs) were calculated to determine the extent of increased risk those with ADHD are of select physical health conditions. ORs were calculated from cross-tabulations and selecting risk in SPSS. ORs were reported with 95% confidence intervals.

Results

Overall Sample

Of the full sample of 930 Canadians (including both individuals with and without ADHD), back problems, as diagnosed by a health care practitioner, were the highest reported physical health concern ($n = 194$, 20.9%) followed by migraines ($n = 141$, 15.2%), asthma ($n = 137$, 14.7%), and arthritis ($n = 117$, 12.6%). Frequencies of all reported physical health conditions are reported in Table 2.

Table 2. Frequencies of physical health conditions ($n = 930$).

Health condition	Yes %(n)	No %(n)	Don't know %(n)	Not stated/Question not asked %(n)
Asthma	14.7% (137)	84.5% (786)	0.8% (7)	0% (0)
Arthritis	12.6% (117)	87.1% (810)	0.2% (2)	0.1% (1)
Back problems	20.9% (194)	78.7% (732)	0.4% (4)	0% (0)
Fibromyalgia	2.5% (23)	96.5% (897)	1.1% (10)	0% (0)
High blood pressure	9.5% (88)	89.1% (829)	1.4% (13)	0% (0)
Ever diagnosed with high blood pressure ^a	2.9% (27)	87.3% (812)	0.3% (3)	9.5% (88)
Migraine headaches	15.2% (141)	84.4% (785)	0.4% (4)	0% (0)
Chronic bronchitis/emphysema/COPD ^b	2.4% (22)	39.5% (367)	0.1% (1)	58.1% (540)
Diabetes	4.5% (42)	94.9% (883)	0.4% (4)	0.1% (1)
Heart disease	4.1% (38)	95.7% (890)	0.2% (2)	0% (0)
Cancer	1.1% (10)	98.7% (918)	0.2% (2)	0% (0)
Ever had cancer	3.3% (31)	95.3% (886)	0.3% (3)	1.1%
Bowel disorder/Crohn's disease/ulcerative colitis	6.6% (61)	93.2% (867)	0.2% (2)	0% (0)
Chronic fatigue syndrome	3.7% (34)	95.2% (885)	1.2% (11)	0% (0)
Multiple chemical sensitivities	3.8% (35)	95.4% (887)	0.9% (8)	0% (0)

Note. ^a Participants who selected yes to currently having high blood pressure or cancer were not presented with the questions of ever having the respective condition. ^b Only participants aged 35 or older were asked about chronic bronchitis/emphysema/COPD.

ADHD vs. Non-ADHD Sample

Higher frequencies were present in the ADHD group for all conditions aside from diabetes and having received a prior diagnosis of cancer. However, not all differences were statistically significant. To identify whether ADHD status is significantly associated with differences in the prevalence of physical health conditions between Canadians with and without ADHD, Pearson Chi-square results and ORs are presented in Table 3.

Table 3. Chi-square and ORs of physical health conditions between Canadians with and without ADHD.

Health condition	Yes Response %(N) 95% CI		N ^a	p	OR ^d 95% CI	Significant ORs Reported in Relevant Literature
	ADHD	No ADHD				
Asthma	17.8% (83) [14.5% - 21.7%]	11.6% (54) [8.9% - 15.0%]	923	.007*	1.7 [1.2 - 2.4]	2.1 [3] - 2.4 [15]
Arthritis	15.9% (74) [12.8% - 19.6%]	9.3% (43) [6.8% - 12.3%]	928	.002*	1.9 [1.2 - 2.8]	1.8 [20]
Back problems	27.3% (127) [23.4% - 31.7%]	14.4% (67) [11.4% - 18.0%]	926	<.001*	2.2 [1.6 - 3.1]	2.4 [15]
Fibromyalgia	3.9% (18) [2.4% - 6.2%]	1.1% (5) [0.3% - 2.6%]	920	.005*	3.8 [1.4 - 10.2]	—
High blood pressure	10.3% (48) [7.8% - 1.4%]	8.6% (40) [6.3% - 11.6%]	917	.34	—	—
Ever diagnosed with high blood pressure ^b	4.1% (19) [2.5% - 6.4%]	1.7% (8) [0.8% - 3.5%]	839	.026*	2.5 [1.1 - 5.8]	—
Migraine headaches	20.9% (97) [17.3% - 24.9%]	9.5% (44) [7.0% - 12.6%]	926	<.001*	2.5 [1.7 - 3.7]	1.8 [3, 5] - 2.0 [15]
Chronic bronchitis/ emphysema/COPD ^c	3.4% (16) [2.0% - 5.6%]	1.3% (6) [0.5% - 2.9%]	389	.027*	2.8 [1.1 - 7.4]	2.2 [20] - 3.2 [15]
Diabetes	4.5% (21) [2.9% - 6.9%]	4.5% (21) [2.9% - 6.9%]	925	.99	—	1.5 [15] - 2.1 [20]
Heart disease	4.9% (23) [3.2% - 7.4%]	3.2 (15) [1.9% - 5.4%]	928	.18	—	1.8 [20]
Cancer	1.3% (6) [0.5% - 2.9%]	0.9% (4) [0.2% - 2.3%]	928	.52	—	—
Ever had cancer	3.0% (14) [1.7%-5.1%]	3.7% (17) [2.2% - 5.9%]	917	.61	—	—
Bowel disorder/ Crohn's disease/ ulcerative colitis	9.9% (46) [7.4% - 13.1%]	3.2% (15) [1.9% - 5.4%]	928	<.001*	3.3 [1.8 - 6.0]	—
Chronic fatigue syndrome	5.8% (27) [3.9% - 8.4%]	1.5% (7) [0.6% - 3.2%]	919	<.001*	4.1 [1.8 - 9.6]	—
Multiple chemical sensitivities	5.6% (26) [3.8% - 8.2%]	1.9% (9) [0.9% - 3.8%]	922	.003*	3.0 [1.4 - 6.6]	2.0 ^e [22]

Note. ^a Only participants who selected yes or no to the presence of a physical health condition were included in the analysis for that health condition, resulting in variations in sample size amongst conditions. ^b Participants who selected yes to currently having high blood pressure or cancer were not presented with the questions of ever having the respective condition. ^c Only participants aged 35 or older were asked about chronic bronchitis/emphysema/COPD. ^d Odds ratios (ORs) are reported to indicate the extent of increased likelihood those with ADHD are at for select physical health conditions. ORs were reported with 95% confidence intervals. ^e The odds ratio of those with ADHD to have chemical intolerance, a milder form of multiple chemical sensitivities.

Discussion

The present study examined rates of physical health conditions in Canadians with ADHD and found significantly increased rates of self-reported asthma, arthritis, back problems, fibromyalgia, migraines, chronic lung conditions, bowel diseases, chronic fatigue, chemical sensitivities, and prior diagnoses of high blood pressure as compared to Canadians without ADHD. Of these conditions, individuals with ADHD were at the highest risk of chronic fatigue

(4.1 times more likely), fibromyalgia (3.8 times more likely), and bowel disorders (3.3 times more likely).

Further, those with ADHD were 1.7 times more likely to have asthma, 1.9 times more likely to have arthritis, 2.2 times more likely to have back problems, 3.8 times more likely to have fibromyalgia, 2.5 times more likely to have migraine headaches, 2.5 times more likely to have had a past diagnosis of high blood pressure, 2.8 times more likely to have a chronic lung disease, and 3.0 times more likely to have multiple chemical sensitivities compared to those without ADHD. No differences were found in rates of current high blood pressure, diabetes, heart disease and cancer. These findings build on previous knowledge of ADHD and co-occurring physical conditions across the globe.

Across the literature, support was found for the findings relating to greater rates of asthma [3], back problems [13], fibromyalgia [14], migraine headaches [5], chronic lung conditions, bowel diseases [15], and chronic fatigue [16] in individuals with ADHD. Although most studies of this nature have been correlational, research on select conditions have identified possible causal links between these health concerns and ADHD.

A Norwegian-based population study linked maternal and paternal diagnoses of asthma with higher rates of offspring with ADHD, whereas only maternal diagnoses of various other autoimmune conditions (e.g., Crohn's disease, arthritis) accounted for offspring ADHD [17]. This finding suggests that asthma has a stronger genetic link with ADHD than other autoimmune disorders [17]. Regarding increased rates of lung conditions, recent evidence from a genome-wide study indicates that individuals with ADHD who smoked were more likely to have COPD compared to those with ADHD who had never smoked cigarettes [18]. Individuals with ADHD are more likely to start smoking cigarettes at a younger age and continue daily smoking habits into adulthood [19]. Thus, findings of increased rates of adverse lung conditions in those with ADHD may, in part, be a result of more common smoking habits in this population. Lastly, research on bowel diseases in those with ADHD identified maternal inflammatory bowel diseases to be a risk factor for ADHD in offspring [17]. This finding suggests a shared environmental or genetic link between bowel diseases and ADHD. No further specific evidence was found for causal links between ADHD and the other aforementioned physical health conditions, although correlational studies examining the connection between the two are continuing.

Mixed results have been reported regarding the current findings of increased rates of arthritis in those with ADHD. Specifically, the current study found 1.9 times greater risk of arthritis for those with ADHD. In support of these findings, a Japanese study linked ADHD with increased rates of arthritis compared to healthy controls [20]. In contrast, a Swedish population study noted individuals with ADHD were at no greater risk for arthritis compared to healthy controls [15]. Further research is needed to identify whether a shared pathway for these conditions exists or whether there are other factors (e.g., environmental risks) that may impact the development of arthritis in those with ADHD.

Additionally, the current study found Canadians with ADHD to be at a three times greater risk of multiple chemical sensitivities. While there has been limited research investigating ADHD and multiple chemical sensitivities, a recent Japanese study reported no significant association between ADHD and multiple chemical sensitivities [21]. In contrast, a study in the United States found that maternal chemical intolerance (CI), a milder form of multiple chemical

sensitivities, was associated with a greater likelihood of their child having ADHD compared to mothers without CI [22]. This study also found that children with ADHD whose mothers had CI were at a greater risk themselves of developing CI [22]. It remains unclear whether this association is a result of genes or shared environment. Inconsistent findings emphasize a need for further inquiry in this area.

Within the current sample, mixed findings regarding high blood pressure were found. Specifically, individuals with ADHD were at no greater risk for current high blood pressure than those without ADHD but were more likely to have had a diagnosis of high blood pressure in the past. One potential explanation for these findings is the use of stimulant medications, often used for treating ADHD symptoms. A meta-analysis of ADHD medication found small, but significant effects of amphetamine and atomoxetine treatments on increased systolic and diastolic blood pressure in children with ADHD [23]. Additionally, methylphenidate treatments, the most prescribed ADHD treatment in Canada, were found to increase systolic blood pressure [23-24]. A recent Canadian study found rates of stimulant medication use to be more common among those aged 25 and younger, with those above the age of 25 being the least likely group to use stimulant medications [24]. Most of the present sample was above the age of 25, indicating that these individuals may have used stimulant medication at a younger age and, consequently, they may have experienced high blood pressure at that time. If they ceased use of stimulant medication as they aged, there may be a parallel reduction of blood pressure. While information regarding medication usage was not collected in the present study, future research may wish to further investigate this link.

Contradictions emerged regarding differences in rates of diabetes among groups. The current sample found no significant differences in rates of diabetes between Canadians with and without ADHD. This finding has been partially supported in recent literature, with previous research finding no link between type 2 diabetes and ADHD [17], but a link between maternal type 1 diabetes and a higher risk of ADHD in their offspring in a Norwegian population study [17]. Type 2 diabetes is a metabolic disorder, whereas type 1 diabetes is an autoimmune disease [25]. Although no significant causal relationship has been found between ADHD and type 1 diabetes [26], growing research has begun to investigate the link between autoimmune diseases and the onset of neurodevelopmental disorders. Specifically, maternal histories of autoimmune diseases, including type 1 diabetes, has been associated with greater odds of ADHD [17]. Further research on the Canadian population is needed to parse apart the association between ADHD and type 1 and type 2 diabetes to better understand this relationship.

No differences in the current sample were found in rates of having a past or present diagnosis of cancer. These findings are supported by Alabaf and colleagues' [3] twin study, which indicated adolescents with ADHD were at no greater risk of cancer than the typical population. A genome wide study further provides support, establishing that individuals with ADHD who never smoked had no significant association with lung cancer [27]. However, a recent study done in Taiwan reported childhood cancer survivors to be at risk of ADHD [28]. Adverse childhood experiences, which may include childhood cancer, are associated with greater risk of ADHD [29], which may explain this discrepant finding. However, given that the current survey did not query types of cancer, further research is needed to better understand this potential connection.

Finally, current findings of heart disease rates were consistent with prior research in populations with and without ADHD. More specifically, no group differences were found in heart disease rates between those with and without ADHD [6].

Overall, the current findings add to the current literature and provide insight of ADHD and rates of co-occurring physical health conditions in a Canadian context. Results support the understanding that individuals with ADHD are at greater risk for various physical health conditions compared to neurotypical individuals.

Limitations

The current study has several limitations that should be considered when interpreting findings. All data, including the presence of an ADHD diagnoses and all physical health conditions, were self-reported by respondents. Although participants were prompted to only select yes if they had been diagnosed by a professional, respondents may have incorrectly self-reported their status of each condition. Evidence of diagnosis should be obtained in further research to ensure that participants meet the criteria and strengthen the validity of findings (e.g., using health record reviews). Additionally, the term ADD was used in the MHACS survey to refer to attention deficit disorder. As noted, ADD is no longer used in the diagnosis of attentional concerns and has since been replaced with ADHD. Participants with ADHD may have selected *no* to a diagnosis of ADD, simply because the survey utilized older or unfamiliar terminology for the disorder. Updated terminology should be utilized in future surveys to ensure alignment with current diagnostic practice.

Additionally, sampling bias may be present, as the current sample was limited to those who participated in the 2021 Canadian Federal Census. It may be that there was something unique about individuals who chose to participate in research as compared to those who did not participate. Additionally, select groups were excluded from the MHACS survey (e.g., those currently serving in the armed forces), as well as those living in the three Canadian territories, limiting the generalizability of the findings. Further, survey information did not include details on provincial representation, making it unclear whether respondents were evenly distributed across all provinces. These factors limit findings to the current sample and prevent results from being generalized to the entire Canadian population. These limitations should be addressed in future surveys to more accurately understand and interpret the physical health landscape of Canadians with ADHD.

Implications

The present findings pose several implications for health practices in Canada. It is evident that Canadians with ADHD are at increased risk for multiple physical health condition, making it important for medical professionals to be aware of such co-occurrences to provide comprehensive services to patients. For example, a physician who is identifying chronic fatigue syndrome in a patient may also consider querying for ADHD. Similarly, a general practitioner or psychiatrist who identifies ADHD in a patient should be mindful to look for signs for more commonly co-occurring physical health conditions, such as asthma or fibromyalgia. Raising awareness for possible co-occurring conditions may promote early identification of physical and mental health conditions, allowing for earlier intervention and more positive patient outcomes.

Further, these findings support the need for integrated health services to account for the co-occurring physical and mental health challenges that individuals may face. Although efforts have been made to support individuals with multiple chronic health conditions, further action may be warranted to encompass the complex health concerns faced by some individuals. Additionally, individuals with ADHD are more likely to access health care services, leading to higher medical expenditures than those without ADHD [30]. Integrating services may support the identification of multiple physical and mental health conditions in fewer visits, helping reduce the load and cost of medical service use.

Conclusion

Findings across the globe indicate that individuals with ADHD are at greater risk for multiple physical health conditions. The present study adds to this literature, indicating a similar landscape in Canada, with Canadians with ADHD reporting a greater likelihood of multiple physical health conditions compared to those without ADHD. Health care practitioners identifying ADHD in a patient should look for signs of various health conditions, and vice versa. By strengthening practitioners' knowledge of co-occurring conditions and integrating physical and mental health services, patients can receive more comprehensive, timely care.

Declarations

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