

## Brief Communication

# Epidemiology of Parkinson's Disease Among Chinese Canadians in the Greater Toronto Area: A 15-Year Retrospective Study

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**ABSTRACT:** We present a 15-year retrospective study comparing the epidemiology of Parkinson's disease (PD) between Chinese and non-Chinese populations in the Greater Toronto Area. A cohort of 88 patients with PD revealed that Chinese patients ( $N = 36$ ) had a significantly lower mean age at diagnosis ( $67.3 \pm 12.6$  years) compared to non-Chinese patients ( $72.1 \pm 9.2$  years) ( $p = 0.039$ ). Higher obesity rates were found in non-Chinese patients ( $p = 0.0004$ ). Chinese patients experienced more motor fluctuations ( $p = 0.028$ ) and amantadine use ( $p = 0.041$ ). These findings underscore the importance of future research on ethnic variations in PD.

**Résumé :** Résultats d'une étude rétrospective, d'une durée de 15 ans, sur l'épidémiologie de la maladie de Parkinson au sein de la population chinoise au Canada, dans la région du Grand Toronto. On présente les résultats d'une étude rétrospective, d'une durée de 15 ans, qui visait à comparer l'épidémiologie de la maladie de Parkinson (MP) entre la population chinoise et la population non chinoise dans la région du Grand Toronto. L'âge moyen des sujets au moment de la pose du diagnostic, dans la cohorte de 88 patients atteints de la MP, était significativement plus bas chez les Chinois ( $n = 36$ ) ( $67,3 \pm 12,6$  ans) que chez les non-Chinois ( $72,1 \pm 9,2$  ans) ( $p = 0,039$ ). Par contre, le taux d'obésité était plus élevé chez les sujets non chinois que chez les sujets chinois ( $p = 0,0004$ ). Enfin, une fréquence accrue des fluctuations de la motricité ( $p = 0,028$ ) et un usage étendu de l'amantadine ( $p = 0,041$ ) ont été observés chez les patients chinois comparativement aux patients non chinois. Ces résultats soulignent l'importance de poursuivre la recherche sur les variations ethniques observées dans l'épidémiologie de la MP.

**Keywords:** Chinese Canadians; epidemiology; Greater Toronto Area; retrospective study; Parkinson's disease

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Parkinson's disease (PD) is a progressive neurodegenerative condition characterized primarily by motor symptoms such as resting tremor, bradykinesia, rigidity and postural instability. The disease is associated with the loss of dopaminergic neurons in the substantia nigra, affecting neurotransmission within the nigrostriatal pathways. Increased age and the male sex are known risk factors of PD, while modifiable factors such as obesity, while known to worsen progression, are still debated in terms of their role as a direct risk factor.<sup>1</sup> In recent decades, PD has seen the fastest growth in prevalence among all neurological disorders.<sup>2</sup> Among all nations, Canada has one of the highest rates of growth in age-standardized PD prevalence, spanning from 1990 to 2019.<sup>3</sup>

Despite significant increases in the prevalence of PD, there is still a substantial gap in the knowledge regarding its epidemiology across different ethnic populations, particularly within the Chinese population in Canada. Although recent research has provided insight into ethnic variations in PD, most studies focus primarily on Caucasian populations from Western countries. A review article on ethnic variations in PD suggests, among several

recommendations, that to ameliorate ethnic inequalities in PD research, cohort studies with ethnically diverse samples of PD cases should be conducted.<sup>4</sup>

To this extent, the present study aims to address this gap by conducting a 15-year retrospective chart review to compare the epidemiology, treatment and outcomes of PD between Chinese and non-Chinese populations in the Greater Toronto Area.

Our study cohort included patients diagnosed with PD between January 1, 2009, and December 31, 2023, whom Dr Joseph Y. Chu had consulted in his neurology clinic in Etobicoke. Patient data were collected from charts stored in Dr Chu's OSCAR EMR system. Among those included in the study, patients were identified as either Chinese or non-Chinese through a last name algorithm by Shah et al.<sup>5</sup> Patients of Chinese descent include individuals with Han ethnic origins from Taiwan, Hong Kong, Macau and mainland China. The Veritas IRB Research Ethics Board has approved this study, and informed consent was acquired verbally by telephone or in person for each participant. Basic demographic information, disease-related information, presence of symptoms at the time of diagnosis, comorbidities, disease

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**Table 1.** Univariate analysis. *P*-values were obtained from a *t*-test for continuous variables and a Fisher's exact test for categorical variables. \* = *p* < 0.05, \*\* = *p* < 0.001. Continuous variables include age, duration of symptoms prior to diagnosis and duration of follow-up post-diagnosis. Categorical variables include everything else. Symptoms at diagnosis, comorbidities, disease complications, psychological disorders, disease interventions, diagnostics and death were recorded as binary measures (yes or no). For example, for motor fluctuations, any single instance of a motor fluctuation symptom noted and observed by the physician resulted in the patient being classified as having the disorder. Similarly, any use of a disease intervention or drug, regardless of dosage, at least once, as noted by the physician, is counted as the patient having undergone that intervention. Motor fluctuations include on-off states and freezing of gait. Psychiatric dysfunction includes visual or auditory hallucinations, depression, anxiety and mood disorders. Cognitive dysfunction includes memory disturbance, difficulty concentrating and dementia. Obesity was defined as having a BMI  $\geq 30$

Characteristics	Chinese (N = 36)	Non-Chinese (N = 52)	P-value
<b>Demographic information</b>			
Mean age at diagnosis (years)	67.25 $\pm$ 12.6 (32–90)	72.1 $\pm$ 9.2 (44–87)	*0.0394
Sex			
Male	24 (66.7%)	38 (73.1%)	0.6355
Female	12 (33.3%)	14 (26.9%)	
Living situation			
% Home	35 (97.2%)	48 (92.3%)	0.7868
% Home for aged	0 (0%)	2 (3.8%)	
% Long-term care	1 (2.8%)	2 (3.8%)	
<b>Disease-related information</b>			
Mean duration of symptoms prior to diagnosis (years)	1.6 $\pm$ 1.1 (0.15–5.1)	1.2 $\pm$ 1.0 (0.03–4.5)	0.137
Mean duration of follow-up post-diagnosis (years)	5.9 $\pm$ 3.6 (1.3–14.2)	4.4 $\pm$ 2.7 (0.3–13.1)	*0.0311
Hoehn and Yahr stage at time of diagnosis			
Hoehn and Yahr stage 1	32 (88.9%)	46 (88.5%)	1
Hoehn and Yahr stage 2	4 (11.1%)	5 (9.6%)	
Hoehn and Yahr stage 3	0 (0%)	1 (1.9%)	
Hoehn and Yahr stage 4	0 (0%)	0 (0%)	
Hoehn and Yahr stage 5	0 (0%)	0 (0%)	
Family history of Parkinson's disease	2 (5.6%)	5 (9.6%)	0.6955
<b>Symptoms at time of diagnosis</b>			
Resting tremor	22 (61.1%)	38 (73.1%)	0.254
Bradykinesia	31 (86.1%)	42 (80.8%)	0.576
Rigidity	30 (83.3%)	42 (80.8%)	1
Postural instability	11 (30.6%)	19 (36.5%)	0.65
<b>Comorbidities</b>			
Hypertension	18 (50%)	35 (67.3%)	0.124
Hyperlipidemia	16 (44.4%)	32 (61.5%)	0.132
Diabetes	9 (25%)	16 (30.8%)	0.635
Myocardial infarction	1 (2.8%)	3 (5.8%)	0.642
Congestive heart failure	0 (0%)	3 (5.8%)	0.267
Cerebrovascular disease	6 (16.7%)	7 (13.5%)	0.764
Obesity	1 (2.8%)	18 (34.6%)	**0.000370
Alzheimer's	1 (2.8%)	5 (9.6%)	0.394
Multi-infarct dementia	0 (0%)	1 (1.9%)	1
Mixed dementia	0 (0%)	0 (0%)	N/A
<b>Disease complications</b>			
Motor fluctuation	14 (38.9%)	9 (17.3%)	*0.0286
Psychiatric dysfunction	11 (30.6%)	19 (36.5%)	0.65
Cognitive dysfunction	1 (2.8%)	8 (15.4%)	0.0762
Falls	12 (33.3%)	8 (15.4%)	0.0697
Autonomic dysfunction	11 (30.6%)	11 (21.2%)	0.33

(Continued)

**Table 1.** Univariate analysis. *P*-values were obtained from a *t*-test for continuous variables and a Fisher's exact test for categorical variables. \* =  $p < 0.05$ , \*\* =  $p < 0.001$ . Continuous variables include age, duration of symptoms prior to diagnosis and duration of follow-up post-diagnosis. Categorical variables include everything else. Symptoms at diagnosis, comorbidities, disease complications, psychological disorders, disease interventions, diagnostics and death were recorded as binary measures (yes or no). For example, for motor fluctuations, any single instance of a motor fluctuation symptom noted and observed by the physician resulted in the patient being classified as having the disorder. Similarly, any use of a disease intervention or drug, regardless of dosage, at least once, as noted by the physician, is counted as the patient having undergone that intervention. Motor fluctuations include on-off states and freezing of gait. Psychiatric dysfunction includes visual or auditory hallucinations, depression, anxiety and mood disorders. Cognitive dysfunction includes memory disturbance, difficulty concentrating and dementia. Obesity was defined as having a BMI  $\geq 30$  (Continued)

Characteristics	Chinese (N = 36)	Non-Chinese (N = 52)	P-value
Camptocormia	5 (13.9%)	3 (5.8%)	0.264
Dystonia	2 (5.6%)	3 (5.8%)	1
Dyskinesia	5 (13.9%)	5 (9.6%)	0.734
Torticollis	0 (0%)	0 (0%)	N/A
Compression fractures	4 (11.1%)	1 (1.9%)	0.154
Postural hypotension	2 (5.6%)	2 (3.8%)	1
<b>Psychological disorders</b>			
Smoking	4 (11.1%)	4 (7.7%)	0.711
Depression	5 (13.9%)	8 (15.4%)	1
Bipolar	0 (0%)	2 (3.8%)	0.511
Anxiety	1 (2.8%)	5 (9.6%)	0.394
Alcoholism	0 (0%)	0 (0%)	N/A
<b>Disease interventions</b>			
L-DOPA use	35 (97.2%)	49 (94.2%)	0.642
Dopamine agonist use	25 (69.4%)	32 (61.5%)	0.501
Neupro use	17 (47.2%)	17 (32.7%)	0.188
MAO inhibitors use	6 (16.7%)	5 (9.6%)	0.346
Anticholinergics use	3 (8.3%)	3 (5.8%)	0.685
Amantadine use	10 (27.8%)	5 (9.6%)	<b>*0.0419</b>
Autonomic regulator use	2 (5.6%)	3 (5.8%)	1
Antipsychotic use	1 (2.8%)	4 (7.7%)	0.645
Deep brain stimulation	1 (2.8%)	1 (1.9%)	1
Thalamotomy	0 (0%)	0 (0%)	N/A
<b>Diagnostics</b>			
MRI	32 (88.9%)	46 (88.5%)	1
CT	12 (33.3%)	17 (32.7%)	1
Bloodwork	31 (86.1%)	39 (75.0%)	0.284
Death	1 (2.8%)	1 (1.9%)	1

complications, psychological disorders, treatments, diagnostic tests and death were identified for each patient. For information about specific parameters collected, refer to Table 1. To maintain personal confidentiality, all personal identifiers were replaced with cohort numbers, and only clinical parameters were analyzed. Extracted data were compiled into Microsoft Excel. All statistical analyses were conducted in R, and statistical significance was set at  $p < 0.05$ . Categorical data were reported as counts and frequencies, while continuous data were reported as means  $\pm$  standard deviations and ranges. Each patient characteristic was compared between the Chinese and non-Chinese groups; a Fisher's exact test was performed for univariate analysis of categorical variables, while an independent samples *t*-test was performed for continuous variables. A multivariable analysis of key binary variables from the

univariate analysis was conducted using binary logistic regression to account for confounding variables such as age and sex.

This study identified 88 patients with PD, of which 36 were Chinese and 52 as non-Chinese. Most non-Chinese patients were identified as Caucasian. For details on differences between each parameter in the univariate analysis, see Table 1. Of note, the mean age at diagnosis was significantly lower in the Chinese group ( $67.3 \pm 12.6$  years) compared to the non-Chinese group ( $72.1 \pm 9.2$  years) ( $p = 0.039$ ). Additionally, the duration of follow-up after diagnosis was significantly longer for Chinese patients compared to non-Chinese patients ( $5.9 \pm 3.6$  years vs  $4.4 \pm 2.7$  years,  $p = 0.031$ ). Analysis of comorbidities revealed that non-Chinese patients were significantly more obese (34.6%) compared to Chinese patients (2.8%) ( $p < 0.001$ ). Regarding disease complications,

**Table 2.** Multivariable analysis. Odds ratios, 95% CI and *P*-values were obtained from a logistic regression. The reference group for odds ratios is the Chinese group for ethnicity and the female group for sex. \* = *p* < 0.05. 95% CI = 95% confidence interval

Regression model for amantadine use	Odds ratio	95% CI	<i>P</i> -value
Ethnicity	0.254236	0.0690081–0.8326155	*0.0284
Age	1.023371	0.9716473–1.0840790	0.4022
Sex	0.423556	0.1278687–1.4150675	0.1554
Regression model for motor fluctuation	Odds ratio	95% CI	<i>P</i> -value
Ethnicity	0.379657	0.1343115–1.0387030	0.0611
Age	0.968056	0.9231014–1.0124390	0.1623
Sex	1.01773	0.3513390–3.1604260	0.9747

Chinese patients had a significantly higher prevalence of motor fluctuations than non-Chinese patients (38.9% vs. 17.3%, *p* = 0.029). Analysis of treatment regimens showed that the use of amantadine was more frequent among Chinese patients (27.8%) compared to non-Chinese patients (9.6%) (*p* = 0.042).

Upon further analysis, a logistic regression controlling for age and sex found that only amantadine use, but not frequency of motor fluctuations, was significantly different across the two groups (adjusted *p* = 0.028). See Table 2.

Our study reveals several significant differences between Chinese and non-Chinese groups. In summary, we found that Chinese patients were diagnosed at a younger age, experienced more motor fluctuations and had higher amantadine use, while non-Chinese patients had higher obesity rates.

The interesting finding of younger age of PD diagnosis for Chinese patients aligns with previous research that indicates Asian patients are significantly younger at diagnosis than Caucasian patients.<sup>6</sup> This may be a result of a complex interplay between multiple factors, including differences in socioeconomic status (SES), knowledge of PD and genetics.

Individuals with higher SES tend to have better access to healthcare services, potentially enabling earlier diagnosis of PD. This notion aligns with research indicating that higher income is associated with younger age among PD patients.<sup>7</sup> While Canadian census data suggest Chinese women, but not men, earn significantly more than their Caucasian counterparts,<sup>8</sup> since our analysis did not collect income data, it is unclear whether SES played a role in our study. Varying levels of health literacy and awareness of PD may also contribute to the observed differences. In a US study, Chinese Americans were more likely to perceive PD as part of the aging process compared to White Americans.<sup>9</sup> Although this contradicts our findings, it may reflect the unique characteristics of our cohort. Regarding genetic impact, one meta-analysis found that the LRRK2 R1628P variant, an allele frequently seen in Chinese populations with PD, is associated with an increased risk of early-onset PD,<sup>10</sup> which may potentially factor into our results.

Another notable difference was the greater prevalence of obesity among the non-Chinese population compared to the Chinese. This observation is consistent with broader data suggesting lower obesity rates among Asians compared to Caucasians in the USA.<sup>11</sup> Regarding the effects of obesity on PD manifestation, obesity is associated with an increased risk of functional dependency and rapid motor progression.<sup>12</sup> However, since these factors were not measured in our study, it remains unclear whether obesity played a significant role in our cohort.

The most notable differences between Chinese and non-Chinese populations were observed in disease complications. Primarily, these differences revolved around an increased prevalence of motor fluctuations in Chinese patients, which include on-off states and freezing of gait, although this was not significant in the multivariable analysis. The literature discussing this association with other Chinese populations is mixed. Regarding freezing of gait, one study found the complication to be more prevalent among a Chinese-speaking population from Taiwan and Hong Kong compared to an English-speaking Western one.<sup>13</sup> Regarding on-off states, one study from mainland China found that the prevalence of “wearing off” in Chinese patients was in line with other non-Chinese populations.<sup>14</sup> Pathologically, differences in motor fluctuations can potentially be explained by variations in dopamine metabolism across ethnicity; this may particularly apply to on-off state complications as decreased dopamine levels, accelerated by increased metabolism of levodopa, are known to be associated with off states.<sup>15</sup> Another possible explanation is that since Chinese patients in our cohort were diagnosed at a younger age and have had the disease for longer, they are more likely to experience motor fluctuations; this is due to the progressive nature of PD, the increased time spent on levodopa therapy and continued degradation of physiological pathways.<sup>15</sup>

Additionally, motor fluctuation increases coincided with significantly greater use of amantadine among Chinese patients in univariate and multivariable analyses. Amantadine is used for the treatment of extrapyramidal symptoms in PD, though it can also be used in cases where first-line levodopa and pramipexole effectiveness have waned or when side effects of these medications have become too overbearing. As such, higher amantadine use may indicate a greater prevalence of dyskinesia among Chinese patients. In our cohort, Chinese patients showed a greater prevalence of dyskinesia, although not to a statistically significant degree. In the literature, the increased frequency of dyskinesia among Chinese is supported by some research<sup>13</sup> but contradicted by others.<sup>14</sup> The greater prevalence of amantadine use among Chinese patients may also be a response to the higher prevalence of motor fluctuations in our cohort since clinicians may opt to supplement first-line therapies when they are not achieving the desired outcomes.

This study has several limitations, the most significant being our small sample size of 88 patients. This presents constraints on the robustness of our findings and the study’s statistical power, reducing our ability to detect significant differences between the groups. Additionally, the generalizability of our findings is

constrained by the fact that the data were collected from a single center, which may not accurately represent the broader population of PD patients. Furthermore, our method of identifying Chinese patients by last name may lead to misclassification due to surname overlaps (e.g., Lee) and the misidentification of individuals with mixed ethnicities or different adopted names. In terms of statistical methodology, another potential concern is the lack of control for disease duration in the multivariate analysis, primarily due to missing data for some patients, as it may confound outcomes.

These limitations highlight the need for larger, multicenter studies to provide more definitive insights. Future research should aim to include a broader range of ethnicities and consider additional factors such as SES, lifestyle and genetic predispositions to better understand ethnic variation in PD. Our results, particularly the differences in motor fluctuations and age of diagnosis, suggest areas where further research is needed.

**Author contributions.** Dr Joseph Y. Chu is the Chair of Research at the CCHABA.

**Concept of the project**

Dr Joseph Y. Chu

**Design and implementation**

Alfred W. Kwan and Dr Joseph Y. Chu

**Collection of data and statistical analysis**

Alfred W. Kwan and Dr Joseph Y. Chu

**Writing of manuscript**

Alfred W. Kwan

**Critical review of manuscript**

Dr Joseph Y. Chu

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**Competing interests.** None for this manuscript.

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