HHS Public Access

Author manuscript

Parkinsonism Relat Disord. Author manuscript; available in PMC 2016 June 07.

Published in final edited form as:

Parkinsonism Relat Disord. 2013 August ; 19(8): 746–750. doi:10.1016/j.parkreldis.2013.02.019.

Co-occurring chronic conditions and healthcare expenditures associated with Parkinson's disease: A propensity score matched analysis

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Abstract

Background—The objective of this study was to ascertain co-occurring chronic conditions and expenditures associated with Parkinson's disease among elderly individuals (age ≥ 65 years).

Methods—A retrospective, cross-sectional matched case–control design with data from Medical Expenditure Panel Survey (MEPS), a nationally representative survey of households in the United States was used. Elderly with Parkinson's disease (N = 350) were compared to a matched control group (N = 1050) based on propensity scores. Ordinary Least Squares regressions on logged dollars were performed to understand the association between Parkinson's disease and expenditures. All analyses accounted for the complex survey design of the MEPS and were conducted in SAS 9.3.

Results—Among elderly, the average total expenditures were $15,404 for those with Parkinson's disease and $13,333 for those without Parkinson's disease. Results from regressions revealed that elderly with Parkinson's disease had 109% greater total expenditure compared to those without Parkinson's disease, when only demographic and socioeconomic variables were entered in the model. When co-occurring chronic conditions were additionally included in the model, those with Parkinson's disease had 84% greater expenditures compared to those without Parkinson's disease.

Conclusions—Excess expenditures associated with Parkinson's disease are partially driven by co-occurring conditions among individuals with Parkinson's disease.

Keywords

Parkinson's disease; Co-occurring conditions; Expenditure; Propensity score

1. Introduction

The prevalence of Parkinson's disease (PD) has been found to be highly variable with worldwide standardized prevalence (across all ages) of 57–230 per 100,000 [1]. In the United States, an estimated 2% of elderly individuals over the age of 65 years have PD [2].

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Existing literature suggests that compared to matched controls, individuals with PD experience higher comorbidity burden [3,4]. Using data from one county in Minnesota, it has been found that compared to gender and age matched controls without PD, individuals with PD had higher scores on Charlson Comorbidity Index (CCI) [3]. Using the same data, another study comparing the prevalence of mental health conditions found that the odds of anxiety and depression were approximately twice as high as among individuals with PD compared to their matched controls [4]. However, in a study of Medicare beneficiaries it was found that cardiovascular, renal, metabolic, and gastrointestinal conditions were not significantly different between beneficiaries with and without PD [5], suggesting that prevalence rates of some chronic conditions are comparable between the two groups.

Co-occurring conditions in individuals with PD can severely compromise their Health-Related Quality of Life (HRQoL) and can also lead to increased healthcare utilization and expenditures [6,7]. Although several studies have been conducted in European settings [8–10], only a handful of studies in the US have examined direct healthcare expenditures associated with PD [5,11–13]. Using commercial insurance claims, it has been estimated that average annual direct medical per-capita expenditures (in 2002 dollars) with PD ($23,101) was more than double compared to the individuals without PD ($11,247), with a projected annual direct healthcare expenditures of $23 billion for individuals with PD in the U.S. [11]. Among Medicare long-term care users, Medicare beneficiaries with PD had higher comorbidity cost ratios (ratio of average per person per year charges for PD alone vs. with comorbid conditions) compared to individuals without PD (adjusted to 2000 US dollars) [12]. Among nationally representative elderly Medicare beneficiaries, those with PD had approximately twice the total expenditures (expressed in 2002 dollars) compared to beneficiaries without PD [5].

Studies that examined the relationship between PD and direct healthcare expenditures have highlighted excess expenditures associated with PD. However, these studies have not examined the extent to which co-occurring conditions contribute to these excess expenditures. Therefore, the primary objective of this study is to examine incremental expenditures associated with PD and the role of co-occurring conditions in contributing to these excess expenditures. In addition, the present study builds on and improves existing research by including a nationally representative sample, recent data, use of a matched case–control design derived through rigorous statistical matching technique (i.e. propensity score matching).

2. Methods

2.1. Study design

A retrospective, cross-sectional matched case–control design was adopted for this study, matching individuals with PD to those without PD using a propensity score approach. A matched case–control design was adopted because individuals with PD may differ from individuals without PD in demographic characteristics, as well as physical and mental health status. To control for these systematic differences, we selected individuals with and without PD who were comparable on their demographic characteristics and health status.

Propensity score matching was performed using gender (male, female), race (white and other), perceived physical and mental health status (excellent/very good, good, fair/poor) and body mass index (BMI) [under weight or normal (BMI < 25 kg/m^2) and overweight or obese (BMI ≥ 25 kg/m^2)]. In addition, as our study pooled data from 10 years, two successive years were used to match, for e.g. 2000 and 2001, 2002 and 2003, 2004 and 2005, 2006 and 2007, 2008 and 2009 in order to avoid the matching of individuals with and without PD from distant years. Since the number of PD cases was low, for each individual with PD, 3 individuals without PD were selected in order to improve the power of the analysis [14].

2.2. Data source

We used data from annual releases of the Medical Expenditure Panel Survey (MEPS), a nationally representative survey of households and families. A wide array of information in terms of physical and mental health conditions, treatment, healthcare utilization and expenditures of non-institutionalized civilians in the United States are available in the MEPS. The household files from the MEPS provide information on the demographics, socio-economic status, employment, access to care, health status, and healthcare utilization and expenditures. Telephone interviews enquiring about the diagnosis (primary and other diagnoses) are conducted among a sample of physician offices and hospitals which rendered care to the MEPS sample population constituting the Medical Provider Component, which is often used to add and/or substitute the data on expenditures reported in the household component [15]. Medical conditions recorded in MEPS are self-reported. Studies conducted to demonstrate the accuracy of survey participants reported conditions have shown that household reports were consistent with provider reports for most of the salient conditions such as diabetes, mental health, and hypertension along with other conditions with a median sensitivity of approximately 70% [16].

2.3. Analytic sample

Our analytic sample consisted of elderly individuals aged 65 years or older and alive during the calendar years. We identified elderly individuals with PD using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes of 332.xx. In addition, we required that those without PD to have positive direct healthcare expenditures as all individuals with PD had positive direct healthcare expenditures. Matched controls were selected using the GREEDY 8 to 1 matching technique of propensity score [17].

The distribution of gender, race, health status, mental health status, and BMI categories, the matching variables, before and after propensity score matching are summarized in Table 1. Chi-square tests were used to determine the statistically significant differences between PD and no PD groups before and after propensity score matching. Before matching, all the characteristics except race were statistically significantly different between the two groups. Before matching, individuals with PD had a higher proportion of men (54.5%), whereas, the individuals without PD had higher proportion of women (57.8%). Overall, both the groups with and without PD comprised mostly whites (86.0% and 81.5% respectively). There were also statistically significant differences in physical health status between the two groups. A higher proportion of individuals with PD reported fair/poor health (53.9%) as compared to

those without PD (23.7%). In terms of mental health status, 33% of the individuals with PD reported fair/poor mental health, while only 11.1% individuals without PD reported fair/poor mental health. With respect to BMI, a lower proportion of individuals with PD (54.5%) were in overweight/obese group compared to 62.7% of individuals without PD. From Table 1, it can be observed that, after propensity score matching, none of the characteristics were statistically significant, and the distributions of individuals with and without PD were balanced.

2.4. Measures

2.4.1. Dependent variables—Dependent variables for this study consisted of total, inpatient, outpatient, emergency room, prescription drugs, home health agency and other expenditures (which included dental care vision care and other expenditures). Direct expenditures are defined as payments for different types of services (example: inpatient, outpatient) and from different sources (out-of-pocket or direct payments from the individuals, payments from private insurance, Medicaid, Medicare, Workers' Compensation, and others) [18]. As our data spanned across 10 years, we also expressed expenditures in real dollars. Medical care services part of the annual consumer price index (CPI) was utilized to transform/convert all expenditures to 2009 constant dollars. The CPI was obtained from the Bureau of Labor Statistics [19]. In addition, expenditure data were skewed to the right; logarithmic transformations of the expenditure data were conducted in order to fit a linear model.

2.5. Co-occurring conditions

Co-occurring conditions were identified using ICD-9-CM codes and Clinical Classification codes. We included the following co-occurring physical conditions: arthritis, asthma, cancer, diabetes, eye, gastro esophageal reflux disorder (GERD), heart disease, hypertension, osteoporosis, stroke, and thyroid disorders and mental health conditions: anxiety and depression. We also used total number of chronic physical conditions as an independent variable in multivariable models.

2.6. Other independent variables

Other independent variables consisted of marital status (married and other), area of residence (metro and non-metro), education (less than high school, high school, and more than high school education), and poverty status (poor, near poor, middle income, and high income).

2.7. Statistical analyses

T-tests were used to examine the differences in average total, inpatient, outpatient, emergency room, pharmacy, home healthcare, and other expenditures between PD and no PD groups. Ordinary Least Square (OLS) regressions were conducted on logged expenditures (2009 dollars) controlling for different co-occurring conditions. All analyses accounted for the complex survey design of the MEPS and were conducted in SAS 9.3. As the current study pooled multiple years (2000–2009), the HC-036 file was used which contains the proper variance structure to obtain appropriate estimates from MEPS data that

have been pooled over multiple years and where one or more years are from 1996 to 2001 [20]. The percentage change in expenditure was calculated using the formula $\exp^{\beta}-1$ [21].

3. Results

Table 2 presents the average total and type of expenditures (inpatient, outpatient, emergency room, prescription drugs, home healthcare, and other) and standard errors among individuals with and without PD. The average total expenditures were $15,404 and $13,333 for individuals with and without PD respectively. The average prescription drug expenditures were higher among individuals with PD ($3787) compared to those without PD ($2515). The average home healthcare expenditures for individuals with PD ($2559) were more than double compared to individuals without PD ($1017). Bottom panel of Table 2 presents average expenditures by service type based on users of specific services. Among users of specific services, the average prescription drug and home health-care expenditures were higher for the individuals with PD ($3843 and $9229 respectively) compared to individuals without PD ($2628 and $6254 respectively). When comparing the ratio of means, it can be seen that the home healthcare expenditures (2559/1017) and prescription drug expenditures (3787/2515) were 2.5 times and 1.5 times higher among individuals with PD compared to those without PD respectively. We did not observe statistically significant differences in inpatient, emergency room, outpatient and other expenditures.

We also examined the rates of co-occurring chronic physical and mental health conditions among individuals with PD and without PD. Except for depression and diabetes, rates of other co-occurring conditions were not statistically significantly between the two groups after propensity score matching. The proportion of individuals with depression were higher (26.1%) among individuals with PD as compared to individuals without PD (13.1%) whereas, the proportion of individuals with diabetes was lower among individuals with PD (19.1% vs. 24.9%) compared to individuals without PD (data not shown in tabular form). Overall, the average number of chronic physical conditions was slightly lower (2.4) among individuals with PD as compared to individuals without PD (2.7).

As the differences in home healthcare and prescription drug expenditures between those with and without PD were very high as measured by the ratio of means, we further examined the difference in home healthcare and prescription drug expenditures for specific chronic conditions among individuals with and without PD. Table 3, presents average home healthcare and prescription drug expenditures for each co-occurring chronic condition for PD and no PD groups. The ratios of the means (average expenditures for PD group divided by average expenditures of no PD group) are also presented to represent the relative differences in expenditures. For all conditions, except cancer, the average home healthcare expenditures were higher for individuals with PD as compared to those without PD. Specifically, among individuals with anxiety, diabetes, and thyroid conditions, home healthcare expenditures among those with PD were about 5 times those of individuals without PD. Further exploration of individual co-occurring conditions revealed that diabetes, anxiety and depression were most influential and positively associated with home healthcare expenditures among individuals with PD compared to those without PD (data not presented).

Similarly, for each specific condition, prescription drug expenditures among individuals with PD were higher compared to the matched controls without PD.

Table 4 displays the intercept and parameter estimates for individuals with PD from separate OLS regressions on logged total and types of healthcare expenditures. Although comparisons of average expenditures between PD and no PD group did not reveal statistically significant differences in inpatient, emergency room and outpatient expenditures, unadjusted OLS regressions on logged expenditures revealed that the total, inpatient, emergency room, prescription drugs, and home healthcare expenditures were significantly higher among individuals with PD compared to matched-controls without PD (Model 1). The parameter estimates indicated that for total expenditures, those with PD had 111% greater expenditures ($\beta = 0.745$) compared to those without PD; for home healthcare expenditures those with PD had 438% greater expenditures ($\beta = 1.683$) compared to those without PD. After controlling for gender, race, marital status, metro status, education, poverty status, and MEPS year, we found that individuals with PD had 109% greater total expenditures compared to those without PD (Model 2). Similar results were observed for inpatient, home healthcare, prescription drug, and other expenditures. When the number of chronic conditions and presence of depression and anxiety were included in the model (Model 3), it was observed that individuals with PD had higher total (84%), inpatient (70%), emergency room (92%), prescription drugs (139%), and home healthcare (379%) compared to matched controls without PD.

4. Discussion

This study examined excess healthcare expenditures associated with PD and the extent to which various co-occurring conditions contributed to the increased expenditures among individuals with PD. We found that in the model without co-occurring conditions, the average total expenditures among individuals with PD was 109% higher compared to matched controls without PD, when only demographic and socioeconomic variables were entered in the model. After adjusting for co-occurring conditions, depression and anxiety, the average total expenditures among individuals with PD was 84% higher as compared to those without PD. Taken together these two findings suggest that the increased expenditures among individuals with PD compared to those without PD can be partially explained by burden from the co-occurring conditions. These findings emphasize the importance of reducing the comorbidity burden through co-management of PD and other chronic conditions among individuals with PD. Our findings have implications for healthcare delivery. Given that evidence-based approaches to the management of co-occurring disorders are scarce, providers caring for PD patients need to recognize the complexities in treating co-occurring conditions, particularly the risk of polypharmacy and may need to adopt a “holistic” approach.

Results from this study are consistent with a previous study based on Medicare beneficiaries in which the average total expenditures for individuals with PD was 70% higher compared to individuals without PD [5]. Our study extended this prior study, by using a matched case–control design and more recent data. Furthermore, our study makes unique contribution by

providing information on the extent to which co-occurring conditions contributed to the excess expenditures among individuals with PD compared to matched controls.

We also observed that inpatient, home healthcare, and prescription drug expenditures were higher for individuals with PD compared to those without PD. Noteworthy finding was that home healthcare expenditures among individuals with PD and diabetes was five times higher compared to those without PD and with diabetes. Individuals with diabetes have greater home healthcare expenditures compared to those without diabetes [22], perhaps due to morbidity burden and/or greater assistance with activities of daily living and medication management compared to those without diabetes [23]. Additionally, the presence of PD may exacerbate the morbidity burden [5]. Therefore, we speculate that the combination of these two conditions may lead to greater need for assistance [24], which in turn can lead to higher home healthcare utilization and expenditures. In terms of prescription drug expenditures, higher expenditures among the individuals with PD compared to those without PD may be attributed to higher rates of polypharmacy among individuals with PD [25]. With the advent of new drugs and progress of the disease, polypharmacy use is widespread among individuals with PD [25].

Co-occurring diabetes, anxiety, and depression among individuals with PD compared to those without PD was found to be the major drivers of excess home healthcare expenditures. Depression [26] and anxiety [27] has been shown to be associated with elevated psychosocial disabilities such as mobility issues and ADL impairment among individuals with PD. Therefore, co-occurring diabetes, anxiety, and depression may amplify the negative health outcomes among individuals with PD. These findings underscore the need to adopt a multidisciplinary and collaborative care approach with access to specialists such as endocrinologists and mental health specialists in addition to neurologists.

Finding from this study also indicated that inpatient expenditures were the major component of the total expenditures comprising of 35% of average total expenditures. While these findings are consistent with the existing literature [11,28], future studies need to examine the reasons behind greater inpatient use. Some reasons for higher inpatient expenditures may include higher severity of PD, associated co-occurring conditions like trauma due falls, vascular disease, and increased motor symptoms [29].

The strengths of this study included the use of nationally representative data on community-dwelling individuals with PD, use of comprehensive set of variables and utilization of propensity score matching which furnishes more accurate and equitable appraisal by eliminating the non-comparable subjects in both groups [30].

Limitations of this study included that all variables were self-reported and subject to recall bias. However, MEPS conducts regular interviews at an interval of 4–5 months (total of five rounds) to minimize recall bias. As with any other cross-sectional study, this study also can only point to associations but cannot establish the cause-effect relationship. Information on severity and duration of PD, severity and duration of other co-occurring conditions was not available; such information could have further explained the differences in expenditures between the two groups.

5. Conclusion

Despite the limitations, our study highlighted the excess expenditures associated with PD compared to matched controls without PD. Although prevalence of chronic conditions between the PD and no PD group were comparable, some of the excess expenditures could be explained by the burden of co-occurring conditions. Collaborative care models might be helpful to reduce the complications of PD and thereby reduce the economic burden of Parkinson's disease.

Acknowledgments

Mr. Bhattacharjee received research assistance and Dr. Sambamoorthi was partially supported for infrastructure from the West Virginia Collaborative Health Outcomes Research of Therapies and Services (WV CoHORTS) Center.

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Table 1

Description of sample before and after propensity score matching. Medical Expenditure Panel Survey (2000–2009).

	Before matching			After matching		
	PD	Non-PD	Sig	PD	Non-PD	Sig
	Wt%	Wt%		Wt%	Wt%	
	100.0	100.0		100.0	100.0	
Gender			**			
Women	45.5	57.8		45.5	48.7	
Men	54.5	42.2		54.5	51.3	
Race						
White	86.0	81.5		86.0	86.6	
Others	14.0	18.5		14.0	13.4	
Health status			***			
Excellent/very good	16.0	43.3		16.0	16.2	
Good	30.1	33.0		30.1	27.1	
Fair/poor	53.9	23.7		53.9	56.7	
Mental health status			***			
Excellent/very good	28.7	57.6		28.7	31.4	
Good	38.0	31.4		38.1	34.6	
Fair/poor	33.2	11.1		33.2	34.0	
Body mass index[a]			*			
Under or normal weight	45.5	37.3		45.5	43.7	
Overweight or obese	54.5	62.7		54.5	56.3	

Note: Based on 351 individuals with PD and 33,474 individuals without PD before matching; and 350 individuals with PD and 1050 individuals without PD after matching among elderly people aged 65 or older. Matching was conducted on gender, race/ethnicity, health status, mental health status, and body mass index. Asterisks represent statistical significance between women and men based on chi-square tests.

Wt%: Weighted percentage, HS: High School.

*** $p < 0.001$;

** $0.001 \leq p < 0.01$.

[a]Numbers do not add up to total numbers due to missing data.

Table 2

Average total and type of expenditures and standard errors. Elderly individuals with and without PD. Medical Expenditure Panel Survey (2000–2009).

	Parkinson's disease (N = 350)		No Parkinson's disease (N = 1050)	
	Average	**S.E.**	**Average**	**S.E.**
Among all users				
Total *	15,404	999	13,333	631
Inpatient	5354	731	5528	441
Emergency room	303	34	275	44
Outpatient	2748	198	3412	416
Prescription ***	3787	197	2515	78
Home healthcare ***	2559	385	1017	104
Other	654	66	586	34

	Parkinson's disease			No Parkinson's disease		
	N	**Average**	**S.E.**	***N***	**Average**	**S.E.**
Among users of specific services[a]						
Inpatient	90	21,438	2449	271	21,312	1200
Emergency room	106	1030	89	262	1069	150
Outpatient	339	2871	193	992	3582	437
Prescription ***	345	3843	200	1002	2628	78
Home healthcare ***	92	9229	927	172	6254	352
Other	206	1035	90	565	1018	57

Note: Based on 350 individuals with PD and 1050 matched controls without PD, aged 65 years or older and were alive during particular calendar year. Asterisks represent significant group differences by the presence of PD using *t*-tests.

SE: Standard Error.

*** $p < 0.001$;

** $0.001 \leq p < 0.01$;

* $0.01 \leq p < 0.05$.

[a]Type of expenditures among users will not add to average total expenditure because of the denominators.

Table 3

Average total and type of expenditures by co-occurring condition. Elderly individuals with and without PD. Medical Expenditure Panel Survey (2000–2009).

	Home healthcare			Ratio of means	Prescription drugs			Ratio of means
	PD	Non-PD	Sig		PD	Non-PD	Sig	
Anxiety	5731	1108	***	5.17	4932	3430	**	1.44
Arthritis	2514	1517	**	1.66	4643	2955	***	1.57
Cancer	1402	1130		1.24	3965	3053	**	1.30
Emphysema	3916	1821	*	2.15	6029	3828	***	1.58
Diabetes	4756	939	***	5.06	5602	3631	***	1.54
Heart disease	3935	1657	***	2.37	4752	3197	***	1.49
Hypertension	2271	1069	**	2.13	4579	3140	***	1.46
Depression	3595	1587	***	2.26	5022	3845	**	1.31
Stroke	4686	1556	***	3.01	5472	3671	***	1.49
Thyroid	5072	999	***	5.08	4584	2815	***	1.63

Note: Based on 350 individuals with PD and 1050 matched controls without PD, aged 65 years or older and were alive during particular calendar year. Asterisks represent significant group differences by the presence of PD using *t*-tests. Ratio of means is computed as the ratio of expenditures for PD group divided by average expenditures of no PD group.

SE: Standard Error,

*** $p < 0.001$;

** $0.001 \leq p < 0.01$;

* $0.01 \leq p < 0.05$.

Table 4

Intercept and parameter estimates for PD from separate Ordinary Least Square regressions on logged healthcare expenditures (2009 Dollars). Medical Expenditure Panel Survey, 2000–2009.

	Model 1			Model 2			Model 3		
	Beta	**SE**	**Sig**	**Beta**	**SE**	**Sig**	**Beta**	**SE**	**Sig**
Total									
Intercept	8.343	0.011	***	8.680	0.058	***	7.699	0.048	***
PD	0.745	0.070	***	0.741	0.071	***	0.611	0.054	***
No PD									
Inpatient									
Intercept	1.644	0.021	***	2.781	0.124	***	1.611	0.117	***
PD	0.747	0.244	**	0.700	0.248	**	0.533	0.223	*
No PD									
Emergency room									
Intercept	1.107	0.016	***	1.599	0.085	***	0.961	0.084	***
PD	0.770	0.159	***	0.763	0.156	***	0.652	0.150	***
No PD									
Outpatient									
Intercept	6.736	0.016	***	6.877	0.085	***	5.806	0.079	***
PD	0.254	0.135		0.248	0.131		0.146	0.120	
No PD									
Prescription drugs									
Intercept	6.659	0.018	***	6.961	0.088	***	5.389	0.081	***
PD	1.061	0.071	***	1.079	0.073	***	0.870	0.080	***
No PD									
Home healthcare									
Intercept	0.688	0.018	***	1.231	0.103	***	0.685	0.097	***
PD	1.683	0.231	***	1.708	0.235	***	1.567	0.227	***
No PD									
Others									
Intercept	3.701	0.032	***	3.360	0.113	***	2.937	0.116	***

	Model 1			Model 2			Model 3		
	Beta	**SE**	**Sig**	**Beta**	**SE**	**Sig**	**Beta**	**SE**	**Sig**
PD	0.228	0.239		0.254	0.236		0.153	0.231	
No PD									

Note: Based on 350 individuals with PD and 1050 individuals without PD, aged 65 years or older and were alive during particular calendar year. Asterisks represent significant group differences by the presence of PD using *t*-tests.

Model 1 included Parkinson's disease as the independent variable.

Model 2 included Parkinson's disease, gender, race, marital status, metro status, education, region, and MEPS year as independent variables.

Model 3 included Parkinson's disease, gender, race, marital status, metro status, education, region, chronic disease number, depression-anxiety, and MEPS year as independent variables.

SE: Standard Error.

*** $p < 0.001$;

** $0.001 \leq p < 0.01$;

* $0.01 \leq p < 0.05$.