Primary Diagnosis and Length of Hospital Stay of Person with Parkinson's Disease in a Teaching Hospital: A Cross-Sectional Study

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ABSTRAK

Penyakit parkinson (PD) adalah keadaan neurodegeneratif kronik yang progresif dan mempunyai perkaitan dengan mortaliti dan morbiditi yang signifikan, terutamanya pada populasi berumur 65 tahun dan ke atas. Oleh itu, peningkatan jangka hayat juga akan menyebabkan peningkatan prevalens PD. Majoriti pengurusan PD dilakukan secara pesakit luar, namun komplikasi berkaitan dengan perkembangan penyakit mungkin menyebabkan keperluan untuk mendapatkan rawatan pesakit dalam. Kajian ini dilakukan untuk menentukan diagnosis utama bagi pesakit yang mempunyai PD (PwP) dan tempoh tinggal di hospital di sebuah hospital pengajar di Malaysia dari tahun 2010 hingga 2020. Data dari sistem maklumat hospital, termasuk diagnosis pesakit yang dikodkan mengikut ICD-10 digunakan dalam kajian ini. Kajian ke atas 1587 pesakit mendapati bahawa hanya 10.0% PwP yang dimasukkan ke hospital, mempunyai PD sebagai diagnosis utama dengan median tempoh tinggal selama empat hari. Penyakit sistem pernafasan merupakan diagnosis tertinggi bagi PwP yang dimasukkan ke hospital dengan bukan PD sebagai diagnosis utama. Empat kategori penyakit iaitu 'Chapter I: Certain infectious and parasitic disease', 'Chapter V: Mental and behavioral disorders', 'Chapter XII: Diseases of the skin and subcutaneous tissue' dan 'Chapter XIX: Injury, poisoning and certain other consequences of external cause' merupakan penyakit yang dijangka mempunyai tempoh tinggal di hospital lebih dari 18 hari. Kesimpulannya, pengesanan awal komplikasi penyakit dapat mencegah keperluan kemasukan ke wad yang mana akan menjimatkan perbelanjaan hospital.

Kata kunci: diagnosis utama, pengkelasan penyakit antarabangsa, penyakit parkinson, tempoh tinggal di hospital

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ABSTRACT

Parkinson's disease (PD) is a progressive, chronic neurodegenerative condition associated with significant morbidity and mortality, specially more prevalent at age 65 years and above. Hence, an increase in life expectancy will also result in an increased prevalence of PD. Most of the PD management was done in outpatient settings. However, complications related to the disease progression may warrant admission. The study was done to determine the primary diagnosis and length of hospital stay of person with Parkinson's (PwP) in a teaching hospital in Malaysia from 2010 to 2020. Data from the hospital information system, including patients' diagnoses coded according to ICD-10, were used in the study. According to a study of 1587 patients, only 10.0% of PwP were primarily diagnosed with Parkinson's disease, with a median length of stay of four days. 'Chapter X: Disease of the Respiratory System' was the most common among PwP which was not primarily diagnosed with PD. Four disease categories; 'Chapter I: Certain infectious and parasitic disease', 'Chapter V: Mental and behavioral disorders', 'Chapter XII: Diseases of the skin and subcutaneous tissue' and 'Chapter XIX: Injury, poisoning and certain other consequences of external cause' are the diseases' that predicted to have a length of stay of more than 18 days. In conclusion, earlier detection of the disease complications may prevent hospitalisation, which may save a lot of hospital resources.

Keywords: international classification of disease, length of stay, parkinson disease, primary diagnosis

INTRODUCTION

Parkinson's Disease (PD) is the second most common neurodegenerative disorder, currently affecting 6.1 million people worldwide (Bloem et al. 2021; GBD 2016 Parkinson's Disease Collaborators 2018). It is chronic and progressive in nature, characterised by combinations of multiple motor and non-motor symptoms. Patients in the initial stages of PD are usually managed in the outpatient setting. However, in due course of time, various complications and comorbidities associated with the disease progression may surface, necessitating hospitalisation (Kelly et al. 2016). It has also been shown that persons with Parkinson's (PwP) have a significantly increased need for institutional care. The hospitalisation rates of PwP are 1.45 times higher than for age-matched controls (Paul et al. 2017). The cause of the admission may be directly related to the disease progression, indirectly related, which may reflect complications of the disease, or may not be related to the disease at all (Oguh & Videnovic 2012; Paul et al. 2017). However, it was reported that the majority of admissions for PwP

were not directly related to the disease (Temlett & Thompson 2006).

It is estimated that there are 19,586 PD patients in Malaysia as of 2016 (GBD 2016 Parkinson's Disease Collaborators 2018). As life expectancy in Malaysia is reported to have increased from 77 years (female) and 72 years (male) in 2014 to 77.6 years (female) and 72.7 years (male) in 2018, the prevalence of people suffering from chronic illnesses and disabilities, including PD, is also expected to increase (Ministry of Health, Malaysia 2019). This situation will burden readily overcrowded government public hospitals, whose current bed occupancy rate (BOR) stands at 70.01% compared to 48.85% reported in 2011 (Ministry of Health, Malaysia 2019; Tahrani et al. 2012).

Besides being a factor that influences BOR, length of stay (LOS) is also an essential measure of hospital resource fulfilment (Freitas et al. 2012; Gates et al. 2018). Lesser LOS indirectly indicates the improved quality of treatment, including a decreased risk of infection and medication side effects (Baek et al. 2018). Meanwhile, an increase in inpatient days implies inefficient bed management, which consumes more hospital reserves (Ministry of Health, Malaysia 2019; Tahrani et al. 2012). The PwP were found to have 2.3 days longer acute hospital stays than non-PD patients (Oguh & Videnovic 2012). However, it was also found that PwP, who were admitted due to diagnoses which were not directly related to PD had three days longer LOS than PwP admitted due to PD, as revealed by a study in Punjab (Paul et al. 2017).

There is a paucity of information, especially in terms of hospital performance, despite many studies having been done pertaining to PD in Malaysia, as almost all of them focused on clinical aspects of PD (Azmin et al. 2014; Hooi et al. 2017). Thus, the aim of this study was to examine the primary diagnosis of patients admitted with a known diagnosis of PD between 2010 and 2020, and their LOS in a teaching hospital in Malaysia. Findings from this study will be beneficial, especially in regards to health planning and budgeting, as Malaysia slowly progresses into an ageing population.

MATERIALS AND METHODS

Study Design

This is a retrospective cross-sectional study done at Hospital Canselor Tuanku Muhriz (HCTM), one of the five teaching hospitals in Malaysia, utilising patients' records from the hospital's health information system, known as the Caring Hospital Enterprise System (CHEtS). The study has been approved by the Research Ethics Committee of the National University of Malaysia (UKM PPI/111/8/jep-2021-342). All admissions with a diagnosis of PD, either as primary or secondary, diagnosed between 1st January 2010 and 31st December 2020 were included in this study. Diagnoses of PD were identified by diagnosis code G20, based on the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10). Primary diagnosis can be defined as the diagnosis principally responsible for the episode of admitted patient

care (Kelly et al. 2016). Meanwhile, other existing diseases which also require management during the hospital stay will be referred to as secondary diagnoses. Data on patients' characteristics, including age and gender, as well as their admission and discharge date, were also extracted for each patient. Patients with incomplete data, secondary parkinsonism, and non-citizens were excluded from the study. We also excluded patients under 50 years of age to reduce the probability of coding error as Young Onset Parkinson Disease (YOPD) which is relatively rare (Low et al. 2015).

Patients were divided into two groups based on the final primary diagnosis given during the hospital admission. The first group was Group I, which was for PwP with a primary diagnosis of G20. In this study, we assumed that the patients in this group were admitted due to causes directly related to PD, such as motor complications and the side effects of anti-parkinsonian medication. The other group was Group II, which was for PwP admitted primarily due to other causes (non-G20). This may include diagnoses which are indirectly related to PD, such as aspiration pneumonia, urinary tract infection, electrolyte imbalance due to inadequate oral intake, falls, trauma, aspiration pneumonia and diagnoses which may not be related to PD at all, such as cerebrovascular accident and renal failure (Koay et al. 2018).

The outcome of the study was the number of PwP admissions from 2010 to 2020, PwP's age and gender were

analysed descriptively, according to Group I and II, and reported as a percentage and median. The PwP's age was categorised dichotomously as below 65 years or 65 years and above as the prevalence of PD is found to be higher in people aged 65 years and above (Kelly et al. 2016).

Another outcome was the LOS, which is the number of days calculated from hospital admission to the date of hospital discharge, which was also analysed as a category or a continuous variable, depending on the type of analysis (Aubert et al. 2020). The average length of stay (ALOS) was calculated. As the LOS was highly skewed, we chose median rather than mean as the average as it is more robust and practical (Lee et al. 2003). The LOS was categorised into three groups based on the ALOS; (i) short LOS (SLOS); (ii) normal LOS (NLOS); and (iii) long LOS (LLOS) (International Centre for Casemix and Clinical Coding 2019). The SLOS was admission that was 1/3rd of the ALOS, while LLOS was the admission that their length was three times longer than the ALOS (International Centre for Casemix and Clinical Coding 2019). The NLOS lies in between.

The proportion of PwP in Groups I and II was determined in percentage. For the primary diagnosis of patients in Group II, the principal diagnosis was determined and reported as a single ICD-10 code. After that, bivariate analysis, indicate an association between type of primary diagnosis, LOS and the PwP's characteristics by using the Chi-square test. The primary diagnosis (single ICD-10 code) was

further combined with other codes that fall into similar ICD-10 chapters to predict the relationship between the primary diagnosis and the LOS. The LOS category was categorised into two; SLOS and NLOS were combined as a group, while LLOS was maintained as another group to allow for binary logistic regression. All statistical analyses were performed using SPSS version 27.0 for Windows (IBM Corp, Armonk, NY, US) and conducted at a 95% confidence interval, using a *p*-value of 0.05.

RESULTS

In total, 1587 patients' data were included in the analyses. In Figure 1, the number of admissions involving PwP in the study duration was described. More than 100 admissions were consistently recorded for every year except for 2012, where only 92 PwP were hospitalised. Meanwhile, the highest number of admissions was seen in 2019, contributing to 13.9% of the total admissions. Throughout the

10 years, the number of PwP primarily admitted for non-G20 (Group II) diagnoses were consistently higher than those for G20 (Group I).

Table 1 showed the characteristics of the admitted PwP. Slightly more than half of the patients are male (54.4%), while more than two-thirds of them are more than 65 years old (76.3%). The median LOS for the population was six days. Only 10.6% of the percentages were in the SLOS and LLOS categories. The PwP with a primary diagnosis of G20 was observed in 10% of admissions, with a median LOS of four days (IQR 3-8). Meanwhile, the median LOS for PwP, primarily diagnosed as non-G20, was six days (IQR 4-10).

Table 2 summarised the top ten primary diagnoses in Group II, which contributed 44.0% of the total diagnosis. Various infections made up the top four diagnoses, led by unspecified pneumonia (J18.90) and aspiration pneumonia (J69.0) with 9.1% and 5.0%, respectively. Further combinations of single codes into
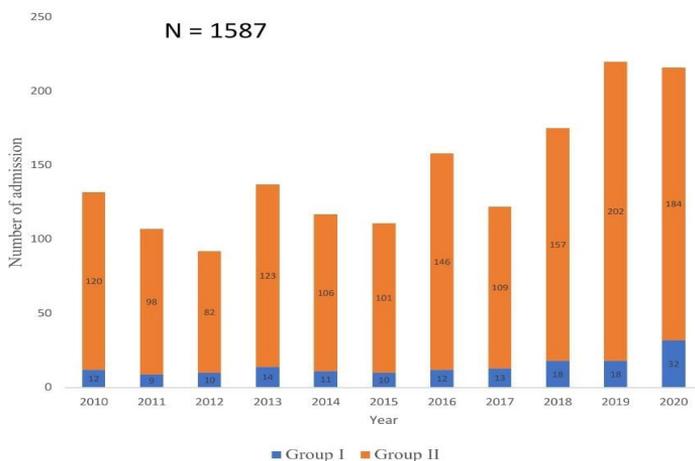

Figure 1: PwP admissions from 2010 to 2020

Table 1: Characteristics of PwP admitted from 2010 to 2020 in HCTM

Characteristics	Primary diagnosis		Total N (%)	χ^2	p-value
	Group I N (%)	Group II N (%)			
Age (Years)					
≤65	62 (39.0)	314 (22.0)	376 (23.7)	22.833	<0.001*
>65	97 (61.0)	1114 (78.0)	1211 (76.3)		
Gender					
Male	92 (57.9)	772 (54.1)	864 (54.4)	0.833	0.361
Female	67 (42,1)	656 (45.9)	723 (45.6)		
LOS					
Median (IQR)	4.0 (3.0-8.0)	6.0 (4.0 -10.0)	6.0 (3.0 - 10.0)	2.931	0.231
SLOS	5 (3.1)	31 (2.2)	36 (2.3)		
NLOS	146 (91.8)	1274 (89.2)	1420 (89.5)		
LLOS	8 (5.0)	123 (8.6)	131 (8.3)		
* indicated p-value less than 0.001					

ICD-10 chapters revealed 'Chapter X: Diseases of respiratory symptoms' as the disease category with the highest frequency (19.2%), followed by 'Chapter IX: Diseases of the Circulatory System' (13.4%) and 'Chapter XIX: Injury, poisoning and certain other consequences of external causes' (7.3%).

In Table 3, it was shown that PwP admitted primarily for 'Chapter I: Certain infectious and parasitic diseases' had the longest median LOS (10.50 days), followed by 'Chapter XII: Diseases of the skin and subcutaneous tissue' with a median LOS of nine days. Only three chapters had shorter LOS compared to G20, which are 'Chapter VIII: Diseases of the ear and mastoid process', 'Chapter XVIII: Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified', and 'Chapter XXI: Codes for special purposes', with a median LOS of three days.

Bivariate analysis revealed significant

Table 2: Top 10 primary diagnosis in Group II

ICD-10 code	Description	N	%
J18.90	Pneumonia, unspecified	144	9.1%
J69.0	Pneumonitis due to food and vomit	80	5.0%
A41.9	Sepsis, unspecified	69	4.3%
N39.0	Urinary tract infection, site not specified	66	4.2%
I20.0	Unstable angina	47	3.0%
I63.9	Cerebral infarction, unspecified	37	2.3%
E87.1	Hypo-osmolality and hyponatremia	26	1.6%
S72.00	Fracture of hip NOS	24	1.5%
J44.1	Chronic obstructive pulmonary disease with acute exacerbation, unspecified	23	1.4%
K92.2	Gastrointestinal hemorrhage, unspecified	23	1.4%

Table 3: Primary diagnosis of PwP according to ICD-10 chapters and their LOS characteristics

Primary Diagnosis	Frequency		Length of stay (LOS)							
	N	%	Mean	Median	Variance	SD	25th Centile	75th Centile	Min	Max
PD (G20)	159	10.0	7.40	4.00	158.736	12.599	3.00	8.00	1	118
Non-G20 (ICD-10 Chapter)										
I	110	6.9	13.33	10.50	191.396	13.835	6.00	16.25	1	122
II	91	5.7	8.52	6.00	74.253	8.617	3.00	10.00	1	60
III	21	1.3	5.62	4.00	15.448	3.930	3.00	8.00	2	17
IV	82	5.2	7.89	6.00	34.914	5.909	4.00	10.00	1	32
V	48	3.0	14.44	9.00	223.996	14.966	4.00	18.75	1	73
VI *	43	2.7	8.98	4.00	143.880	11.995	3.00	10.00	1	59
VIII	16	1.0	3.63	3.00	2.250	1.500	3.00	5.50	2	6
IX	212	13.4	6.82	5.00	72.890	8.538	3.00	8.00	1	88
X	305	19.2	8.67	7.00	48.801	6.986	5.00	10.00	1	64
XI	100	6.3	7.78	4.00	159.244	12.619	3.00	7.75	1	107
XII	69	4.3	11.55	9.00	64.016	8.001	6.50	15.00	2	41
XIII	54	3.4	9.89	6.50	201.874	14.208	4.00	10.00	2	96
XIX	111	7.0	7.96	7.00	49.162	7.012	4.00	9.00	1	51
XVI	1	0.1	-	-	-	-	-	-	-	-
XVIII	31	2.0	3.68	3.00	10.959	3.310	1.00	4.00	1	17
XIX	116	7.3	9.38	7.00	75.507	8.689	4.00	12.75	1	72
XXI	18	1.1	3.56	3.00	2.379	1.542	3.00	4.00	2	8

*Excluding G20

association between age and type of primary reason for admission as shown in Table 1. Although chi-square test for association between type of primary diagnosis and the three LOS categories showed no significant association (χ^2 = 2.931, p-value = 0.231), further binary logistic regression performed to ascertain the effects of reasons for admission using ICD-10 chapters on the likelihood that participants had LLOS, with G20 as the reference point was statistically significant, $\chi^2(4)$ = 53.072, p<0.001. Despite the model was only able to explain 7.7% (Nagelkerke R^2) of the variance in reasons for admission,

it was able to correctly classify 91.7% of cases (Table 4).

Of the available category, only four were statistically significant, which were shown in Table 4; 'Chapter I: Certain infectious and parasitic disease' (OR = 4.19, $CI_{95\%}$: [1.22, 2.47]), 'Chapter V: Mental and behavioral disorders' (OR = 6.29, $CI_{95\%}$: [2.40, 16.5]), 'Chapter XII: Diseases of the skin and subcutaneous tissue' (OR = 3.58, $CI_{95\%}$: [1.37, 9.35]), and 'Chapter XIX: Injury, poisoning and certain other consequences of external cause' (OR = 3.15, $CI_{95\%}$: [1.26, 7.89]), which had 4, 6, 3.5- and 2.5-times higher odds,

Table 4: Predictors of Primary diagnosis (ICD-10 chapters) to have LLOS

Reasons for admission	Predictors of LLOS		
	OR	(95%CI)	p-value
Primary diagnosis		< 0.001**	
Chapter I	4.194	1.774,9.917	<0.001**
Chapter II	1.573	0.551,4.49	0.397
Chapter III	0.000	0	0.998
Chapter IV	1.762	0.616,5.042	0.291
Chapter V	6.292	2.395,16.525	<0.001**
Chapter VI#	1.936	0.554,6.762	0.301
Chapter VIII	0.000	0	0.999
Chapter IX	0.934	0.36,2.424	0.889
Chapter X	1.325	0.57,3.078	0.514
Chapter XI	1.641	0.596,4.523	0.338
Chapter XII	3.580	1.371,9.347	0.009*
Chapter XIII	1.510	0.436,5.229	0.516
Chapter XIX	1.079	0.364,3.2	0.892
Chapter XVI	0.000	0	1.000
Chapter XVIII	0.000	0	0.998
Chapter XIX	2.591	1.049,6.399	0.039*
Chapter XXI	0.000	0	0.998
Parkinson's disease (G20)	Reference		

#Excluding G20; * indicated p-value less than 0.05; ** indicated p-value less than 0.001

respectively to be hospitalised longer than median LOS of 18 days (LLOS), compared to G20.

DISCUSSION

To the best of our knowledge, this is the first study to determine the primary diagnosis and length of hospital stay of PwP in Malaysia. Despite the fact that the PwP characteristics examined in this study are limited to gender and age group, the findings are consistent with those of other studies (Paul et al. 2017; Zhao et al. 2011). However, the findings of the male predominance of PD contradict the result of a study in Russia that reported a higher proportion of females (62% compared to males) diagnosed with PD, which may be attributed to the study's limited sample size (n=100) (von Campenhausen et al. 2011).

Our study also showed that the biggest contributor to the PwP inpatient admission was not due to the primary diagnosis of G20. Instead, 'Chapter X: Disease of the Respiratory System' was the commonest (19.2%) among hospitalised PwP, particularly the diagnosis of unspecified pneumonia (J18.90) and aspiration pneumonia (J69.0). This might be due to complications in PD progression such

as multiple autonomic dysfunctions, including dysphagia, which increase the risk of aspiration and other types of respiratory infection (Paul et al. 2017). This echoed the finding of another study that reported 24% of their admissions were also due to the same disease category (Kelly et al. 2016). 'Chapter IX: Disease of the Circulatory System' was found to be the second-highest cause of PwP admission in the current study. Although the aetiology of how PD affects circulatory symptoms was not well established, PD was associated with a higher risk of developing cardiovascular diseases (Hong et al. 2021; Park et al. 2020). 'Chapter XIX: Injury, poisoning, and certain other consequences of external causes' was the third major cause of admission.

Further investigation revealed that closed fracture of the neck of the femur (S72.00) was the primary contributor for the chapter, accounting for 1.5% of total admissions. The risk of falls is a well-known area of concern in the PD population. Research demonstrates 2.6 to 4.4-fold risk of sustaining fractures of the proximal femur in PD populations compared to age-matched controls (Kelly et al. 2016; Kleiner et al. 2018).

Meanwhile, 'Chapter I: Certain infections and parasitic diseases' was the disease with the longest median LOS in this study, contributed mainly by sepsis (A41.9). This can be explained by multi-modality management of the patient with sepsis, including optimisation of antibiotic administration, depending on severity and type of infection (Busch & Kadri 2020). 'Chapter XII: Diseases of

skin and subcutaneous tissue has a median LOS of nine days, which was the second-longest category in our study together with 'Chapter V: Mental and behavioural disorders'. As patients progressively become disabled, their mobility will be limited too. Prolonged immobility may lead to chronic pressure on the skin, leading to cellulitis and pressure ulcers, which take a long time to heal. Furthermore, skin disorders, which can be a non-motor symptom of PD and skin-related effects of dopaminergic medication, may worsen the conditions (Skorvanek & Bhatia 2017). Complicated management of PwP with mental and behavioural disorders contributed to the prolonged LOS. Patients need to be properly well and stabilised before discharge to reduce the caregiver's burden at home and reduce frequent emergency department visits.

Limited information on PwP's sociodemographic factors was one of the limitations of our study as it could help in further understanding other PwP populations. The study also made use of publicly available data; while these data provided valuable information, patient misclassification or coding errors cannot be ruled out. On the contrary, the large sample size used in this study may contribute to the high level of statistical significance observed in many comparisons.

CONCLUSION

In conclusion, the majority of PwP admissions in HCTM from 2010 to 2020 were not directly PD related. The LOS of non-G20 primary diagnoses

was generally longer than that of G20 primary diagnoses. Therefore, it is important to make extra efforts to recognise PD complications earlier before they worsen and require hospitalisation which can save a lot of hospital resources. The caregivers should be educated regarding potential infections so that the infections can be detected earlier and managed in outpatient settings. Potential causes of injury, especially due to falls, should also be taken care of, by enhancing safety features in their living home. In addition, a guidance for caregiver should also be developed to assist them in managing a PwP at home.

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REFERENCES

Aubert, C.E., Schnipper, J.L., Fankhauser, N., Marques-Vidal, P., Stirnemann, J., Auerbach, A.D., Zimlichman, E., Kripalani, S., Vasilevskis, E.E., et al. 2020. Association of patterns of multimorbidity with length of stay: A multinational observational study. *Medicine* **99**(34): e21650.

Azmin, S., Khairul Anuar, A.M., Tan, H.J., Nafisah, W.Y., Raymond, A.A., Hanita, O., Shah, S.A., Norlinah M.I. 2014. Nonmotor symptoms in a Malaysian parkinson's disease population. *Parkinsons Dis* 2014: 472157.

Baek, H., Cho, M., Kim, S., Hwang, H., Song, M., Yoo, S. 2018. Analysis of length of hospital stay using electronic health records: A statistical and data mining approach. *PLoS One* **13**(4): e0195901

Bloem, B.R., Okun, M.S., Klein, C. 2021. Parkinson's disease. *Lancet* **397**(10291): 2284-303.

Busch, L.M., Kadri, S.S. 2020. Antimicrobial treatment duration in sepsis and serious infections. *Journal of Infectious Diseases* **222**(Suppl 2): S142–55.

Freitas, A., Silva-Costa, T., Lopes, F., Garcia-Lema, I., Teixeira-Pinto, A., Brazdil, P., Costa-Pereira, A. 2012. Factors influencing hospital high length of stay outliers. *BMC Health Serv Res* **12**: 265.

Gates, M.L., Hunter, E.G., Dicks, V., Jessa, P.N., Walker, V., Yoo, W. 2018. Multimorbidity patterns and associations with functional limitations among an aging population in prison. *Arch Gerontol Geriatr* **77**: 115-23.

GBD 2016 Parkinson's Disease Collaborators. 2018. Global, regional, and national burden of Parkinson's disease, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol* **17**(11): 939-53.

Hong, C.T., Hu, H.H., CHan, L., Bai, C.H. 2021. Prevalent cerebrovascular and cardiovascular disease in people with Parkinson's disease: a meta-analysis. *Clin Epidemiol* 10: 1147-54.

Kelly, B., Blake, C., Lennon, O. 2016. Acute Hospital Admissions of Individuals with a known parkinson's disease diagnosis in Ireland 2009-2012: A Short Report. *J Parkinson Dis* **6**(4): 709-16.

Mnistry of Health Malaysia. 2019. *Laporan Tahunan Kementerian Kesihatan Malaysia, Putrajaya.*

Kleiner, J.E., Boulos, A., Eltorai, A.E.M., Durand, W.M., Daniels, A.H. 2018. Matched cohort analysis of elective lumbar spinal fusion in patients with and without parkinson's disease: in-hospital complications, length of stay, and hospital charges. *Global Spine J* **8**(8): 842-6.

Koay, L., Rose, J., Abdelhafiz, A.H. 2018. Factors that lead to hospitalisation in patients with Parkinson disease-A systematic review. *Int J Clin Pract* **72**(1): 1-5.

Lee, A.H., Fung, W.K., Fu, B. 2003. Analyzing hospital length of stay mean or median regression? *Medical Care* 41(5): 681-6.

Hooi L.L, Fitzrol, D.N., Rajapathy, S.K., Chin, T.Y., Halim, S.A., Kandasamy, R., Hassan, W.M.N.W., Idris, B., Ghani, A.R.I., Idris, Z., Tharakan, J., Nunta-Aree, S., Abdullah, J.M. 2017. Deep brain stimulation (DBS) for movement disorders: An experience in Hospital Universiti Sains Malaysia (HUSM) involving 12 patients. *Malays J Med Sci* 24(2): 87-93.

Low, V., Ben-Shlomo, Y., Coward, E., Fletcher, S., Walker, R., Clarke, C.E. 2015. Measuring the burden and mortality of hospitalisation in Parkinson's disease: A cross-sectional analysis of the English Hospital Episodes Statistics database 2009-2013. *Parkinsonism Relat Disord* **21**(5): 449-54.

Oguh, O., Videnovic, A. 2012. Inpatient Management of Parkinson Disease: Current Challenges and

Future Directions. *Neurohospitalist* **2**(1): 28-35.

Park, J.H., Kim, D.H., Park, Y.G., Kwon, D.Y., Choi, M., Jung, J.H., Han, K. 2020. Association of parkinson disease with risk of cardiovascular disease and all-cause mortality a nationwide, population-based cohort study. *Circulation* 1205-7.

Paul, B.S., Paul, G., Singh, G., Kaushal, S., Verma, U. 2017. Pattern of hospital admission and outcome in Parkinson's disease: A study from Punjab, India. *Neurol Asia* **22**(1): 33-9.

International Centre for Casemix and Clinical Coding (ITCC). *2019. Laporan Tahunan 2019.* Kuala Lumpur.

Tahrani P.K., Sivasampu, S., Goh, P.P., Faizah, A., Hisham, A.N. 2012. *National Healthcare Establishment and Workforce Statistics (Hospital)* 2010. Kuala Lumpur

Skorvanek, M., Bhatia, K.P. 2017. The skin and parkinson's disease: review of clinical, diagnostic, and therapeutic issues. *Mov Disord Clin Pract* 4(1): 21-31.

Temlett, J.A., Thompson, P.D. 2006. Reasons for admission to hospital for Parkinson's disease. *Intern Med J* **36**(8): 524-6.

von Campenhausen, S., Winter, Y., Rodrigues e Silva, A., Sampaio, C., Ruzicka, E., Barone, P., Poewe, W., et al. 2011. Costs of illness and care in Parkinson's Disease: An evaluation in six countries. *Eur Neuropsychopharmacol* **21**(2): 180-91.

Zhao, Y.J., Tan, L.C., Li, S.C., Au, W.L., Seah, S.H., Lau, P.N., Luo, N., Wee, H.L. 2011. Economic burden of Parkinson's disease in Singapore. *Eur J Neurol* **18**(3): 519-26.