

# Serum Protein Level Is Related to ADL in Patients with Parkinson's Disease

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## Abstract

**Objectives:** To establish an ADL prediction model for Parkinson's inpatients as an auxiliary evaluation scheme. **Methods:** The data of Parkinson's patients hospitalized in the Department of Neurology of Affiliated Brain Hospital of Guangzhou Medical University from 2019 to 2022, which suited the criteria were collected, and a multiple linear regression model was established with serum total protein, serum albumin, age, BMI and education level as independent variables and BI scores as dependent variables. **Results:** A total of 95 PD patients were included (mean  $70.05 \pm 10.87$  years): 53 males and 42 females. The correlation analysis showed that the serum total protein ( $r = 0.398$ ,  $P < 0.001$ ), serum albumin ( $r = 0.217$ ,  $P = 0.035$ ), age ( $r = -0.434$ ,  $P < 0.001$ ), BMI ( $r = 0.269$ ,  $P = 0.008$ ) were respectively linearly correlated with BI total score, and education level is negatively correlated with BI scores (Kendall's tau-b =  $-0.2$ ,  $P = 0.011$ ). A multiple linear regression model which established with serum total protein, serum albumin, age, BMI and education level as independent variables and BI scores as dependent variables, is statistically significant ( $F = 9.041$ ,  $P < 0.001$ , adjust  $R^2 = 0.3$ ). **Conclusion:** The ADL multiple linear regression model can be used as an important means to evaluate the ADL ability of PD patients in hospital.

## Keywords

Parkinson's Disease, Nursing, Serum Total Protein, Serum Albumin, Activities of Daily Living

## 1. Introduction

Parkinson's disease (PD) is a neurodegenerative disease characterized by rest tremor, bradykinesia, rigidity and abnormal posture and pace [1]. Globally, the prevalence of Parkinson's disease is expected to double in the next two decades

as the population ages [2]. As the symptoms of Parkinson's disease will gradually worsen, its activities of daily living (ADL) will also be significantly affected [3]. Nurses often use Barthel Index (BI) to evaluate the activities of daily living of inpatients such as Parkinson's disease [3]. The Barthel Index (BI), with 10 items for mobility and ADL areas, is considered the most convenient measure of competency in basic ADL in neurological and musculoskeletal disorders [4]. However, the BI is easy to use, but often with a certain degree of subjectivity.

Some studies have found that there is a significant correlation between serum protein level and ADL ability in patients with Parkinson's disease, and with the decrease of albumin level, the BI score increased [5]. Therefore, we speculate that serum protein levels can predict the ADL ability of patients with PD to some extent. The purpose of this study is to construct a prediction model of ADL ability of PD patients by analyzing serum total protein, serum albumin and some basic physiological indexes, in order to help judge the ADL ability of Parkinson's patients.

## 2. Patients and Methods

### 2.1. Patients

Patients with Parkinson's disease hospitalized in the Department of Neurology of the Affiliated Brain Hospital of Guangzhou Medical University from 2019 to 2022. Inclusion criteria: 1) Meet the diagnostic criteria of PD of the International Parkinson and Movement Disorder Society [6]. 2) No severe cognitive impairment. 3) No mental illness. 4) At present, the symptoms of Parkinson's disease are stable and the medication pattern is regular. Exclusion criteria: 1) Secondary Parkinsonism such as drug-induced, vascular and traumatic Parkinson's syndrome. 2) Parkinsonism-plus syndrome such as multiple system atrophy and progressive supranuclear palsy. 3) Severe respiratory and cardiovascular diseases. 4) Severe cognitive, mental illness.

### 2.2. Methods

The Parkinson's patients hospitalized in the Department of Neurology of our hospital from 2019 to 2022 were reviewed by professionals, and the patients who met the admission criteria were further selected. The general data such as sex, age, BMI, serum total protein, serum albumin and the scores of BI were collected.

### 2.3. Related Clinical Data

The serum protein level is a good index to reflect the recent nutritional status of patients. Serum total protein is a complex mixture of various proteins, which can be separated by different methods. Plasma albumin,  $\alpha$  1-globulin,  $\alpha$  2-globulin,  $\beta$ -globulin, fibrinogen, prothrombin and other coagulation factors are synthesized from the liver [7]. Albumin is the most abundant serum protein, produced by hepatocytes, up to 9 - 12 g/days, accounting for about 50% of the total human protein, and the normal serum range is 3.5 - 5 g/L. It is generally considered that

albumin lower than 35 g/L is considered to be hypoalbuminemia [8] [9].

The BI was routinely used to evaluate the ADL of inpatients in the department of neurology of our hospital, which consists of 10 items (bowels, bladder, grooming, toilet use, feeding, transfer, mobility, dressing, stairs, and bathing) [10]. Scores are categorized into 5 levels: 100 (no dependency), 61 - 99 (mild dependency), 41 - 60 (moderate dependency), 20 - 40 (severe dependency), 0 - 19 (complete dependency).

## 2.4. Statistical Analysis

Data were analyzed using SPSS26.0 (SPSS Inc., Chicago, IL, USA). The enumeration data are expressed as numbers and percentages, and the measurement data are expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ). Correlation analysis between the measurement data (serum total protein, serum albumin, age, BMI) and the BI scores was conducted using Pearson correlation analysis. The correlation between gender and the total score of BI was examined with independent sample t-test. Kendall's tau-b correlation analysis was used to analyze the correlation between education level and BI total score. Finally, the statistically significant variables are obtained as independent variables and incorporated into the multivariate linear regression equation with BI as the dependent variable for statistical processing. A value of  $P < 0.05$  was considered significant.

## 3. Results

### 3.1. General Data

A total of 95 PD patients were included (mean  $70.05 \pm 10.87$  years): 53 males and 42 females. Other information is shown in **Table 1**.

### 3.2. Univariate Correlation

As showed in **Table 1**. The serum total protein, serum albumin, age, BMI and BI total scores showed normal distribution as indicated by the P-P plot, and the Pearson correlation analysis showed that the serum total protein ( $r = 0.398$ ,  $P <$

**Table 1.** Univariate correlation.

Variables	$\bar{x} \pm s/n$	r/t/Kendall's tau-b	P
TP	$64.84 \pm 5.95$	0.398	0.001
ALB	$38.19 \pm 5.35$	0.217	0.035
Age	$70.05 \pm 10.87$	-0.434	0.001
BMI	$20.46 \pm 2.55$	0.269	0.008
Education level (illiterate/primary/junior high/senior high school/college and above)	8/26/24/19/18	-0.2	0.011

Abbreviations: TP: serum total protein; ALB: serum albumin; BMI: body mass index.

0.001), serum albumin ( $r = 0.217$ ,  $P = 0.035$ ), age ( $r = -0.434$ ,  $P < 0.001$ ), BMI ( $r = 0.269$ ,  $P = 0.008$ ) were respectively linearly correlated with BI total score. The results of independent sample t-test indicated that there was no statistical difference in BI scores between men and women, which means there was no correlation between gender and BI scores. The correlation between education level and BI scores was conducted by Kendall's tau-b correlation analysis, and it is concluded that education level is negatively correlated with BI scores (Kendall's tau-b =  $-0.2$ ,  $P = 0.011$ ).

### 3.3. Multiple Linear Regressions

A multiple linear regression model was established with serum total protein, serum albumin, age, BMI and education level as independent variables and BI scores as dependent variables. The target sample size for this study was calculated based on the recommendation of five to ten outcome events per predictor variable (EPV) [11]. In this study, there are 5 variables of regression, so the number of people included in regression ( $n = 95 > 50$ ) is sufficient. By drawing the partial regression scatter plot and the scatter plot of biochemical residual and predicted value, we can judge that there is a linear relationship between independent variable and dependent variable. It has been verified that the variables are independent of each other, and the Durbin-Watson test value is 1.5%. By drawing the scatter diagram between the biochemical residual and the unstandardized predicted value, it is proved that the variance of the residual is homogeneous. The variance inflation factors (VIF) of the regression are all less than 10, suggesting that there is no multicollinearity. And the standardized residual P-P plot of regression suggests that the residual is close to normal distribution. In summary, the regression model is statistically significant ( $F = 9.041$ ,  $P < 0.001$ ,  $\text{adjust } R^2 = 0.3$ ) (showed in **Table 2**). And the effects of the five independent variables included in the model on BI scores were statistically significant ( $P < 0.05$ ).

## 4. Discussion

In this study, the univariate correlation analysis revealed that total protein, albumin, and BMI were positively correlated with BI scores. It may be that these indicators often represent the nutritional status of PD patients. Such as in patients with poor nutritional status, their exercise ability will be further impaired, and their ADL ability will also decrease accordingly, which is consistent with the conclusions of some recent studies [12] [13] [14]. In addition, we found that the educational level of PD patients was negatively correlated with BI. The lower the educational level, the higher their ADL ability. This finding is not consistent with Palacios's study [15]. However, some studies have shown that there is no significant correlation between education level and ADL ability [16] [17]. So far, no additional research has been found to support our findings, thus we speculate that AD patients with low education level may be more involved in physical activity in the past, so that their motor ability and ADL ability are better preserved.

Furthermore, our multiple linear regression model has been proved to be

**Table 2.** Multiple linear regression.

Variables	$\beta$	SE	$B'$	t	P
Constant	45.931	411.383		1.110	0.027
TP	-0.115	0.526	-0.023	-0.218	0.028
ALB	1.313	0.624	0.238	2.104	0.038
Age	-0.913	0.253	-0.336	-3.610	0.001
BMI	-5.008	2.038	-0.212	-2.457	0.016
Education level	2.247	1.024	0.194	2.196	0.031

Abbreviations: TP: serum total protein; ALB: serum albumin; BMI: body mass index.

statistically significant, which proves that we can predict the ADL ability of PD patients by their serum protein levels and simple physiological indexes. In the past, the BI was used to evaluate the ADL ability of PD patients when they were hospitalized, which is often subjective [14]. Also, different nurses evaluate them in different periods of time during hospitalization, and the results may be inconsistent. Accordingly, our prediction model is often more convenient for ADL assessment of hospitalized PD patients, and the results are more consistent. Aside from that, plasma protein level is often an item that must be checked when PD patients are hospitalized. While evaluating the nutritional status of PD patients, they can also evaluate their ADL ability, which makes nursing work more convenient and more suitable to implement nursing programs and ADL tracking of PD patients.

In this study, we still have some shortcomings that should be improved in the future. For instance, the model is mainly applied to inpatients, but not to home patients.

## 5. Conclusion

The ADL multiple linear regression model based on serum total protein, serum albumin, age, BMI and education level can be used as an important means to evaluate the ADL ability of PD patients in hospital, and can provide reference for nurses' evaluation plan.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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