

# Reliability and Validity of the Persian version of the Clock Drawing Test in Iranian Patients with Idiopathic Parkinson's Disease

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## Abstract

**Introduction:** The evaluation of cognitive impairment in people with Parkinson's disease is important for timely use of medical and rehabilitation services. To achieve this goal, this study was conducted to verify the reliability and validity of the Persian Version of the clock drawing test (CDT). **Materials and Methods:** In the first session, the cognitive function of 180 subjects with Parkinson's disease and mean age ( $\pm$ SD) of 57.6 ( $\pm$ 7.8) were evaluated using the CDT. The test was redone within 7 to 10 days. The test-retest and inter-tester reliability were evaluated by the IntraClass Correlation Coefficient (ICC). The concurrent validity was also measured through the relationship between the CDT and the Clinical Dementia Rating scale (CDR), the Parkinson Disease Questionnaire-8 (PDQ-8) and the Mini-Mental Status Examination (MMSE). **Results :** An acceptable level of reliability between the raters (ICC=0.94 (95% CI, 0.92–0.97)) and test-retest (ICC=0.92 (95% CI, 0.90–0.95)) was obtained among these patients. There was also a moderate to high correlation between the CDT with CDR, and the PDQ and MMSE. **Conclusion:** The results of this study showed that the clock drawing test has a high reliability and an acceptable validity for measuring cognitive function in Iranians with idiopathic Parkinson's disease.

**Keywords:** Clock Drawing Test, Cognitive Function, Parkinson's disease, Validity and Reliability

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## Introduction

Parkinson's disease is one of the most common neurodegenerative disorders after Alzheimer's disease (1). According to global statistics, Parkinson's disease incidence varies from 10 to more than 400 people. In addition to motor symptoms, which affect the daily activities and quality of life in affected patients, cognitive impairment and dementia have also been reported in these individuals. In demographic studies, 23.5% to 55% of patients showed mild impairment in the early stages of the disease. The prevalence of progression toward dementia is between 24% and 31%. In Iran, it is 19–41%, which is six times more than normal people (2).

To improve the quality of healthcare services, the assessment of cognition as a symptom of Parkinson's disease, which should

be managed over time, is an important principle for measuring the effects of treatment (pharmaceutical and non-medical) that can be achieved through the use of clinically relevant tools.

Rehabilitation is a part of the health system, which by assessing the cognitive function of people with Parkinson's disease and providing interventions on time, can delay the cognitive and functional decline of people with Parkinson's disease. Hence, the consequences of cognitive impairment and dementia on people with Parkinson's disease, their caregivers, and the community will be moderated, having a significant role in improving their quality of life and their functional independence (3). The availability of simple and inexpensive screening tools, which can be used in clinical settings, seems necessary to achieve this goal.

**Table 1.** Demographics (n=180)

|                         |                         |                              |
|-------------------------|-------------------------|------------------------------|
| <b>Gender (n, %)</b>    | <b>Male</b>             | <b>155 (86.1%)</b>           |
|                         | <b>Female</b>           | <b>25 (13.9%)</b>            |
| <b>Education (n, %)</b> | <b>Secondary school</b> | <b>34 (18.9%)</b>            |
|                         | <b>Primary school</b>   | <b>30 (16.7%) 74 (41.1%)</b> |
|                         | <b>Diploma</b>          | <b>24 (13.3%)</b>            |
|                         | <b>Post diploma</b>     | <b>13 (7.2%)</b>             |
|                         | <b>License</b>          | <b>5 (2.8%)</b>              |
| <b>Age [mean(SD)]</b>   | <b>57.64 (8.7)</b>      |                              |

**Table 2.** Correlation between total scores of the clock drawing test in people with idiopathic Parkinson's disease (n=180)

| <b>Scales</b> |                | <b>PDQ-8</b>  | <b>MMSE</b>   | <b>CDR</b>   |
|---------------|----------------|---------------|---------------|--------------|
| <b>CDR</b>    | <b>R (Sig)</b> | -0.56 (0.000) | -0.64 (0.000) | 0.83 (0.000) |

\*CDT: Clock drawing test; \*PDQ-8: Parkinson's disease Questionnaire-8; \*CDR: Clinical Dementia Rating; \*MMSE: Mini-Mental State Examination

Various evaluation tools have been used in the cognitive assessment of people with Parkinson's disease (4). One of the simplest and most inexpensive tools for screening cognitive disorders is the clock drawing test (CDT) (4). In recent decades, CDT has attracted many researchers who have been trying to elaborate a criterion for interpreting the results. Consequently, more than 15 formal scoring methods have been proposed for this test so far (5). Also, its reliability and validity have been evaluated for use in different cultures and languages (4, 6–8). In a systematic review, Aprahamian *et al.* considered CDT as a good tool for screening cognitive impairment in the elderly (9). It is noteworthy that the psychometric properties assessment of CDT in Iranian elderly has already been performed (10).

Since the development and use of comprehensive screening tools at healthcare centers are difficult and expensive, there is a need for simpler and less expensive tools. Therefore, this study aims to prove the reliability and validity of the Persian version of the clock drawing test, which is proposed in many studies due to its ease of implementation and more favorable characteristics (11, 12).

## Materials and Methods

In this methodological study, 180 individuals with idiopathic Parkinson's disease (155 males and 25 females with a mean age of ( $\pm$ SD) 57.64 ( $\pm$ 8.7) were non-randomly assigned to the study. The entry criteria included the following: *i*) having idiopathic Parkinson's disease based on the UK Brain Bank Criteria and diagnosed by a neurologist; *ii*) not having another neurological disease (stroke, multiple sclerosis, etc.) or an orthopedic condition other than Parkinson's disease; *iii*) not having a major depression based on the Beck Depression Inventory (gaining a score of less than 31 based on Beck Depression Inventory); *iv*) fluency in Farsi;

*v*) following a fixed drug program (levodopa and its antagonists) until retest day (within an average time interval of 10 days).

The clock drawing test (CDT), Mini-Mental Status Examination (MMSE), Parkinson's disease Questionnaire-8 (PDQ-8), and Clinical Dementia Rating Scale (CDR) were conducted by two experienced occupational therapists in the On-drug phase [one hour after taking levodopa (13)]. Finally, these tests were conducted by the original therapist in the retest session, i.e. within 7 to 10 days later. The average time for the evaluations to be done was 30 to 50 minutes.

This study was approved by the Department of Occupational Therapy of the Iran University of Medical Sciences and all patients signed a consent form to participate in the study.

## Instruments

### Clock Drawing Test (CDT)

This test is done in two free and pre-designed methods without time limitations. The subject is asked to set the numbers on the clock and draw the hands to show 10 minutes after 11. The performance of the person is rated at six levels and a score of  $\geq 3$  is considered as cognitive impairment (14). The standard validity of this test was carried out by Nishiwaki *et al.* who obtained 77% sensitivity and 87% of the attributes (4).

### Parkinson's disease Questionnaire (PDQ-8)

The Persian version of the Parkinson's Patients Quality of Life Questionnaire has eight questions in eight separate dimensions (PDQ-39). These dimensions include 1-mobility, 2-activities of daily living 3-emotional well-being, 4-stigma, 5-social support, 6-cognitions, 7-communication, and 8-bodily discomfort. Each questionnaire has five options on the Likert scale, with only one checked option. The first alternative is the best condition (zero score) and the fifth option is the sign (worst case) (14).

### Mini-Mental Status Examination (MMSE)

MMSE is an instrument for assessing the cognitive status in the elderly. This tool examines the abilities of bias, memory (short-term), reading, writing, calculating, seeing and drawing, and linking an object or image to another. The implementation of this test is not time-consuming and it is quickly scored, enabling each member of the rehabilitation team to perform it. It has 30 points in total, with a score of 23 or lower indicating cognitive impairment (15). This tool has been validated by Solis et al., with a sensitivity and specificity of 86% in normal people (16).

### Clinical Dementia Rating Scale (CDR)

CDR is a universal evaluation tool for dementia, which can distinguish normal cognitive status (CDR=0), suspected dementia (CDR=0.5), and dementia (CDR=3-1). This scale evaluates six domains, including memory, navigation, judgment and problem solving, community affairs, and personal care (17). The validity of this scale was evaluated by Chávez et al. (2007) and 80% sensitivity and 100% attributes were reported (18).

### Statistical Method

The demographic characteristics were calculated based on descriptive statistics. Moreover, the normal distribution evaluation of data was carried out by Shapiro Wilk, which showed that data does not have a normal distribution (22).

The test-retest reliability and inter-testers concordance were calculated by the intraclass correlation coefficient (ICC) Two Way Random (95% confidence interval). This variable was used for the degree of agreement between the repetition of the test in mixed sessions and evaluations performed by two raters on the same subject. An ICC above 0.8 indicates a high reliability (19, 20).

Minima Detectable Change (MDC) and Standard Error of Measurement (SEM) with  $SEM \times MDC = 1.96 \times \sqrt{2}$  and also  $SEM = SD \sqrt{1 - ICC}$  were calculated. A SEM of  $< 1.2SD$  was considered acceptable in this study (21).

The Spearman correlation test was used to examine the relationship between CDT with CDR, MMSE and PDQ-8 tests. The correlations analyzed in this test were based on the Munro Scale (very high=1-0.9; high=0.89-0.7; moderate=0.69-0.5; low=0.49-0.26).

## Results

### Descriptive Statistics

Based on the results of the demographic analysis, 33 (18.3%) individuals were at the first level, 35 (19.4%) subjects belonged to level 1.5, 46 (25.6%) people were at level 2, 23 (12.8%) individuals were at level 2.5, 25 (13.9%) subjects were at level 3, 12 (6.7%) subjects belonged to level 4, and finally, 6 (3.3%) individuals were at the 5th level according to the Modified Hoehn and Yahr scale in this study (Table 1).

### Reliability

The ICC for the CDT in the test-retest and inter-testers was 0.92 (95% CI, 0.90-0.95), and 0.94 (95% CI, 0.92-0.97), respectively, which indicates a high reliability.

The MDC (SEM) for this scale in the test-retest examination was 1.11 (0.49), which is less than 1.2 times standard deviation.

### Concurrent validity

The correlation between the CDT score and the CDR and MMSE were 0.83 and 0.82, respectively, indicating a high agreement. Furthermore, the correlation between the CDT score with PDQ-8 was 0.66, which showed an average relation (Table 2)

## Discussion

The purpose of this study was to determine the reliability and validity of the Persian version of the Clock Drawing Test in Iranian subjects with idiopathic Parkinson's disease. The results of this study showed that this test has high reliability and acceptable validity.

The CDT has some major advantages over other cognitive tests: it is easy to administer and has the advantage that it can be used in people who speak a different language or are illiterate. Also, the cultural background of the test persons has a little influence on the CDT (25, 26).

According to the results of the test-retest reliability analysis, the CDT score has shown a high level of reliability, which is similar to previous studies (7, 8, and 23). The results of this study indicate a high inter and intra reliability for the CDT score, which is similar to previous studies in elderly and Alzheimer's patients (7, 23, 27).

The SEM obtained in this study is less than the measurement error obtained in the 2016 study of Mazankova (7), this can be attributed be due to differences in the scoring system of this test. The MDC levels were found to be 1.11 in the present study suggesting that in clinical use, changes equal or greater than 1.11 with 95% confidence are not due to the measurement error of this test and must be interpreted as the result of a real recovery. Therefore, in therapeutic interventions, variations less than 1.11 are due to some kind of measurement error while changes beyond this threshold are valid. In this study, for the first time, SEM and MDC were calculated in Iranian idiopathic Parkinson's disease patients.

The results of this study showed a high correlation between CDT scores, CDR, and MMSE, the three of which can be used to measure cognitive function in people with Parkinson's disease. The CDT score and the PDQ-8 scale showed moderate correlation indicating that cognition impairments can affect the quality of life of these individuals, which is consistent with the findings of previous studies (8, 24).

The limitation of this study was the selection of available samples, which is suggested to be considered for better generalization of the results in subsequent studies.

## Conclusion

The results of this study suggest that the CDT has an acceptable reliability and validity for assessing cognitive function in the On-drug phase in the Iranian idiopathic Parkinson's disease population. Also, the results of this study showed that this scale could be used for clinical decision making and intervention planning.

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## Conflict of interest:

None

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## Authors' contributions:

All authors made substantial contributions to conception, design, acquisition, analysis and interpretation of data.

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