Tele assessment of Communicative effectiveness among persons with Parkinson's disease

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ABSTRACT

Purpose: Parkinson's disease can exhibit neuro-communication disorders which can negatively impact the quality of life. The current study aimed to investigate communicative effectiveness among individuals with mild and moderate Parkinson's disease and matched controls via tele mode. **Method:** This cross-sectional study comprised of 20 Marathi-speaking individuals with Parkinson's disease (mild = 10 & moderate = 10) and 20 matched controls who fulfilled the inclusion criteria. All participants underwent tele assessment comprising the Clinical Dementia Rating Scale, Montreal Cognitive Assessment in Marathi (MoCA-M), motor -speech subsection of MDS-Unified Parkinson's Disease Rating Scale (MDS-UPDRS), speech intelligibility subsection of Frenchay Dysarthria Assessment-2 (FDA-2) and Instrument to Assess Communicative Effectiveness (IACE). **Results**: Statistical analysis revealed a significant difference ($p < 0.05$) across individuals with Parkinson's disease (mild, moderate) and control groups on the communicative domains (IACE). Tele assessment was helpful in identifying communicative morbidity and facilitate accessibility among PD patients who face disabling physical challenges to avail SLP services. Across severity levels, performance in verbal comprehension and expression, reading, and writing was observed to be impacted. **Conclusion:** The communicative capabilities were seen to decline with an increase in severity of Parkinson's disease. Both the mild and moderate Parkinson's disease groups demonstrated significant hypokinetic dysarthria and communicative impairments in various domains of IACE such as gestural communication, reading, writing, verbal comprehension, and expression, which had a direct impact on their overall communicative abilities. Tele assessment can be useful mode in rehabilitation of PD and improve communication related quality of life if timely identified and intervened.

KEYWORDS- Parkinson's disease, Communicative effectiveness, Speech intelligibility

INTRODUCTION

Communication is viewed as an important quality bestowed upon human beings by nature since infancy to later adulthood. Throughout an individual's life their communication abilities are acquired, shaped, assimilated, adapted, regressed, and retained. A variety of cognitive processes such as attention, executive function, motor planning & programming, alertness, resource allocation & responses, long term memory, recognition and decision making play a crucial role in the achievement of effective communication abilities. Effective communication requires communicative competence and performance adequately executed at verbal as well as non-verbal forms. It comprises of things like asking for what we need; exchanging information and ideas; communication is vital for our sense of who we are and what we want; communication is how we build, maintain, and

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nurture relationships with other people verbally and nonverbally; communication is how we make our likes, dislikes, needs, and wishes known to others [1,2]. Communication is highly fundamental to human interaction, the development, maintenance of human relationships and is frequently affected in Parkinson's disease (PD)[3]. Changes in communicative abilities are seen to be almost inevitable for individuals with Parkinson's disease (PD). Almost 80–90% of Parkinson's disease population face changes in vocal quality and almost 45–50% face articulatory alterations. Deficits in memory are also seen to be a common occurrence in Parkinson's disease patients, characterized by impaired temporal ordering, delay in recall and conditional associate learning [4]. Other common reporting symptoms of individuals with PD include word-finding difficulties[5,6] and deterioration of performance on language tasks with increased cognitive load[5,7,8]. These changes lead to a disabling effect on speech execution which results in a communicative breakdown. A direct impact of these alterations is seen to be on the socialization skills of an individual with PD, ranging from fear of interaction to complete social withdrawal[9]. These impairments usually lead to a communication breakdown between the Parkinson's disease patients and the listener. However, there are many inter and intra individual factors which influence overall communicative performance positively or negatively. Majority of the times it is negative, adding burden and social isolation, which affects the overall quality of life of an individual with PD. Literature and clinical practice have mostly focused on impairment due to intelligibility and PD related disabling outcomes rather than their communication related life participation aspects[9]. Functional communication has been demonstrated to be more imperative to individuals with Parkinson's disease than motoric impairment of speech. Additionally, although it is a significant indicator of quality of life, functional communication has generally received limited research consideration as compared to motor speech impairment[10]. Movement disorders patients often exhibit various accessibility related challenges, constraints which give arises difficulty in seeking rehabilitation of communication, safe swallowing, cognitive and other physical functions.

Tele rehabilitation is an ideal option if used for timely assessment and rehabilitation services. Worldwide professionals and patients are seeking help from virtual platforms, tele medicine and telerehabilitation. However, there are lots of technical constraints in successful implementation of telemedicine and telerehabilitation in an Indian clinical context. Ample evidence is present which suggests that persons with Parkinson's disease exhibit neuro-communication disorders which influence quality of life related to communication. However communicative effectiveness across verbal, non-verbal, reading, writing and bilingual domains is still a less explored area of Parkinson's disease. As PD progresses being neurodegenerative disorder, it presents with continua of varied consequences affecting facets of cognition and communication domains. The current study is of relevance as it aimed to investigate communicative effectiveness among individuals with mild and moderate Parkinson's Disease and their age, gender, education matched controls. Present study hypothesized that there will be no significant impairment across cognitive as well as communication effectiveness domains among individuals with PD and their matched controls across severity.

METHODOLOGY

The current study included a total of 40 native Marathi-speaking individuals. 20 participants included in the experimental group comprised of individuals diagnosed with Parkinson's disease (IWPD) within the age range of 50-75 years. The control group comprised of 20 cognitively and neurologically healthy aging individuals who were matched for age, gender and education of that of IWPD. The total data collection was carried out from native Marathi speakers across Pune and Mumbai who agreed to participate via tele mode. The individuals with Parkinson's disease were selected from movement disorder registry of department of Neurology, Bharati hospital as well as several well diagnosed PD referrals from consulting neurologists across Pune.

The procedure was carried out through a tele-assessment mode over Zoom or Google meet platform. An informal and written consent was obtained from all the participants regarding

recording of the tele-assessment session via audio-video recording keeping in mind the ethical issues. A detailed case history of all the participants was obtained, including brief history, medical history, reports of any previous neurological examination and speech language cognition communication history. Cognitive abilities of the individual were assessed using the Montreal Cognitive Assessment Marathi[11] (MoCA-M) to screen for any mild cognitive impairment. The rating of speech intelligibility of subjects was carried out using the section 8: Speech Intelligibility section of FDA-2[12] consisting of three domains namely word repetition, sentences/description, and general spontaneous conversation task. These were assessed using word repetition and 2 sentence repetition tasks from MoCA along with 3 sentences reading aloud tasks and general conversation. The speech intelligibility was rated as per the FDA grades A, B, C, D and E. Clinical dementia rating scale was used to determine the severity of dementia in participants if any, using the 6 dementia rating domains and the total Global CDR score. If the score of CDR <2 (severe dementia), the participant was excluded from the study. A sub-section of MDS-Unified Parkinson's Disease Rating Scale (MDS-UPDRS) (part 3 motor-speech) was administered to confirm the severity of Parkinson's disease (mild, moderate) (Table 1). Instrument to Assess Communicative Effectiveness (IACE)[13] was administered to assess the communication effectiveness abilities, level of participation and level of impairment in the participants.

Table 1- Descriptive characteristics of the patients with movement disorder recruited in the study.

	PD mild (n=10) Mean (SD)	PD moderate (n=10) Mean (SD)	HCs (n=20) Mean (SD)
Variable			
Age	62.6 (+/-8.37)	69.3 (+/-5.64)	61.05 (+/-7.858)
Education	17.3 (+/-2.21)	17.5 (+/-2.59)	15.7 (+/-2.89)
MoCA Total	24.70 (+/-2.263)	18.50 (+/-5.401)	26.95 (+/-2.164)
CDR	0.450 (+/-0.4378)	0.400 (+/-5.164)	n/a
UPDRS-III (motor-speech)	6.40 (+/-6.004)	8.30 (+/-5.034)	n/a

MoCA- Montreal Cognitive Assessment
CDR- Clinical Dementia Rating Scale
UPDRS- Unified Parkinson's Disease Rating Scale

It is a five-point rating scale tool (0 to 4) with 50 questions which are used to assess domains such as Attention, Communication, Comprehension (Verbal & Non-verbal), Expression (Verbal & Non-verbal), Reading, Writing, Communication abilities with respect to spiritual activities and performance in other languages. The minimum score that can be acquired by a participant is 0 and the maximum score that can be acquired is 200 with a lower score indicative of a poor performance and a higher score is indicative of a good performance.

STATISTICAL ANALYSIS

Statistical analysis scores obtained from subjects were tabulated and subjected to appropriate statistical analysis using Statistical Package for the Social Science (SPSS) version 20.0 software. To determine if the data was normally distributed or not, Shapiro-Wilk test was performed. Since it showed significant values, it indicated that the data was not normally distributed, hence non-parametric tests were used for further statistical analysis to test hypotheses. Mean, median and interquartile range scores were calculated for MoCA-M and IACE domains, for mild and moderate Parkinson's disease groups separately. Mann-Whitney U test was performed to check if there was any significant difference among various domains of tests across both groups. Spearman's correlation was used to find whether there was any association between cognitive skills and communicative effectiveness in across IWPD groups.

RESULT

The study aimed at exploring the communicative effectiveness among individuals with Parkinson's

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Disease across the mild and moderate group and matched controls via tele mode. The present study considered grouping the persons with Parkinson's disease into two groups based on severity, namely, mild and moderate for comparison of communicative effectiveness among individuals with mild and moderate PD and healthy controls. After administering the tasks according to the methodology of the study to both the groups - experimental group participants [20 persons with Parkinson's disease categorized into two groups: mild (10 individuals) & moderate (10 individuals)] and matched controls [20 healthy individuals], scores were tabulated and subjected to descriptive as well as statistical analysis. Frenchay Dysarthria Assessment- 2 (Section 8: Speech intelligibility subsection) was carried out on all the participants to grade the dysarthric component, if any. The performance of Montreal Cognitive Assessment (MoCA) & Instrument to Assess Communicative Effectiveness (IACE) were descriptively explored (Table 2). The box plots IACE was plotted domain wise to further explore the descriptive statistics (Figure 4-13). The scores of Instruments to Assess Communicative Effectiveness (IACE) were then compared between Parkinson's Disease group (mild and moderate) and age matched healthy controls.

Cumulative intelligibility rating (FDA-2, Speech intelligibility subsection) across both the groups (mild and moderate PD)

All the control participants received grade A whereas individuals with PD received varied grades based on their presence or absence of dysarthria dysexecutive component on word, sentence and general conversation levels. However there was a striking difference on perceptual speech intelligibility rating task across word, sentence and conversation level between mild PD v/s moderate PD (Figure 1, 2 & 3)

Comparison of communicative effectiveness skills in individuals with mild and moderate Parkinson's disease vs healthy controls
There was a slightly greater decline observed in the median scores of communicative test domains (IACE) in the mild and moderate PD group as compared to the control group. Hence, Mann-Whitney test was performed to check if there is any significant difference in the communication impairment between both the groups.

The results of Mann-Whitney U test revealed that, there was a significant difference observed in the scores of communicative effectiveness domains between mild Parkinson disease and control group and also between moderate Parkinson disease and control group, as the p value was less than 0.05. The current study exhibited that the total score of all the domains of communicative effectiveness combined showed a significant difference (p = 0.001) in mild Parkinson disease when compared with the control group. Individuals with mild Parkinson's disease showed significant change in verbal comprehension (p=0.004), expression verbal (p= 0.013), reading (p=<0.001), writing (p=<0.001) and performance in other languages post Parkinson's disease (p=0.001) compared with the control group whereas attention for communication, non-verbal comprehension, gestural expression and spiritual activities related to communication domains showed a better performance (Table 3).

On the other hand, in individuals with moderate Parkinson's disease the communicative abilities were seen to be more strongly affected when compared with the control group (p = <0.001). All the communicative effectiveness domains such as attention (p= 0.004), verbal comprehension (p = 0.001), non-verbal comprehension (p = 0.004), verbal expression (p= 0.001), gestural expression (p = 0.049), reading (p = <0.001), writing (p= 0.003), spiritual activities related to communication domains (p=0.003) and performance in other languages post Parkinson's disease (p=<0.001) were significantly affected (Table 4).

Table 2: Descriptive statistics of communicative effectiveness test domains (Instrument to Assess Communicative Effectiveness)

IACE domains	PD mild (n=10) Mean (SD)	PD moderate (n=10) Mean (SD)	HCs (n=20) Mean (SD)
Attention for communication	7.30 (+/-1.059)	6.20 (+/-1.619)	7.65 (+/-0.933)
Comp. Verbal	10.50 (+/-1.716)	10.00 (+/-2.055)	11.75 (+/-0.639)
Comp. Non-Verbal	12.10 (+/-1.449)	10.10 (+/-2.025)	11.75 (+/-0.550)
Exp. Verbal	67.10 (+/-6.839)	54.90 (+/-14.843)	72.20 (+/-3.397)
Exp. Gestural	7.50 (+/-0.850)	6.50 (+/-1.841)	7.45 (+/-1.234)
Reading	20.50 (+/-3.240)	17.20 (+/-6.443)	23.80 (+/-0.410)
Writing	18.40 (+/-4.648)	12.80 (+/-10.665)	25.25 (+/-1.803)
Spiritual activities related communication	3.90 (+/-0.316)	3.30 (+/-1.059)	4.00 (0.000)
Other Language Performance (L1 &L2)	23.50 (+/-2.677)	17.10 (+/-7.695)	26.70 (+/-2.867)
Total	170.80 (+/-18.195)	138.10 (+/-43.514)	190.55 (+/-7.409)

L1- Language 1 L2- Language 2

Table 3: Comparison of communicative effectiveness in mild Parkinson's disease group and control group (Instrument to Assess Communicative Effectiveness domains)

	Attention for communication	Comp. Verbal	Comp. Non-Verbal	Exp. Verbal	Exp. Gestural	Reading	Writing	Spiritual	Other Lang Performance (L1 & L2)	Total
Mann-Whitney U	79.000	45.500	99.500	44.500	95.000	10.000	1.000	90.000	27.500	21.500
Z	1.191	2.868	.028	2.478	.283	4.368	4.483	1.414	3.416	3.459
p	.234	.004*	.977	.013*	.777	<0.001*	<0.001*	.157	.001*	.001*

Note: values with * mark shows significance at level of p<0.05 based on Mann-Whitney U test

L1- Language 1 L2- Language 2

Table 4: Comparison of communicative effectiveness in moderate Parkinson's disease group and control group (Instrument to Assess Communicative Effectiveness domains)

	Attention for communication	Comp. Non-Verbal	Comp. Verbal	Exp. Verbal	Exp. Gestural	Reading	Writing	Spiritual	Other Lang Performance (L1 & L2)	Total
MWU	43.500	34.000	44.00	28.500	61.500	8.000	35.000	60.00	14.500	15.500
Z	2.884	3.373	2.868	3.191	1.967	4.443	2.966	2.979	4.022	3.723
p	.004*	.001*	.004*	.001*	.049*	<0.001*	.003*	.003*	<0.001*	<0.001*

Note: values with * mark shows significance at level of p<0.05 based on MWU- Mann-Whitney U test

L1- Language 1 L2- Language 2

Figure 1: Speech intelligibility rating (FDA-2 subsection 8) in word task in individuals with mild v/s moderate PD
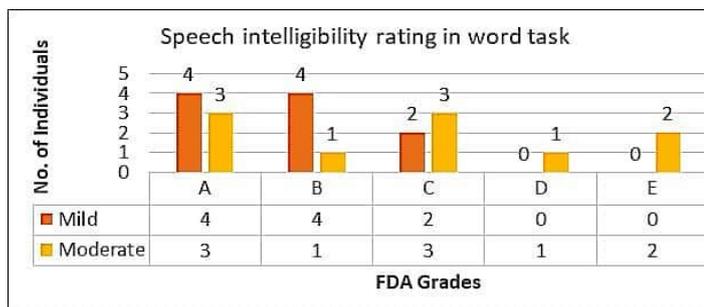

Figure 2: Speech intelligibility rating (FDA-2 subsection 8) in sentence task in individuals with mild v/s moderate PD
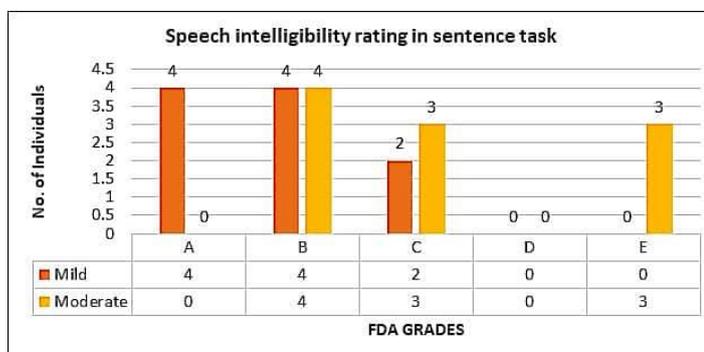

Figure 3: Speech intelligibility rating (FDA-2 subsection 8) in general conversation task in individuals with mild v/s moderate PD
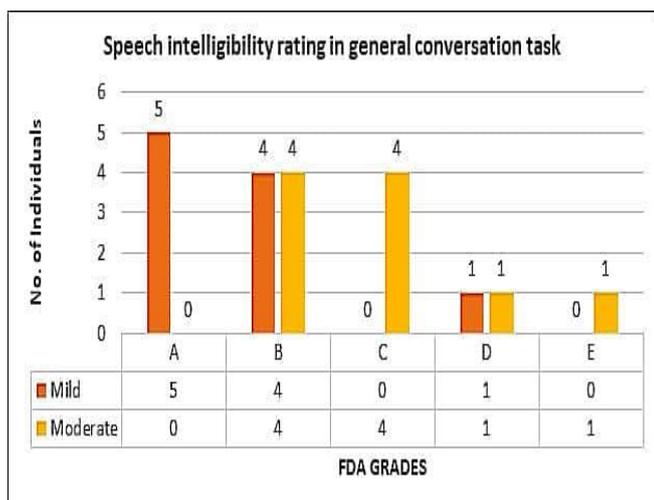

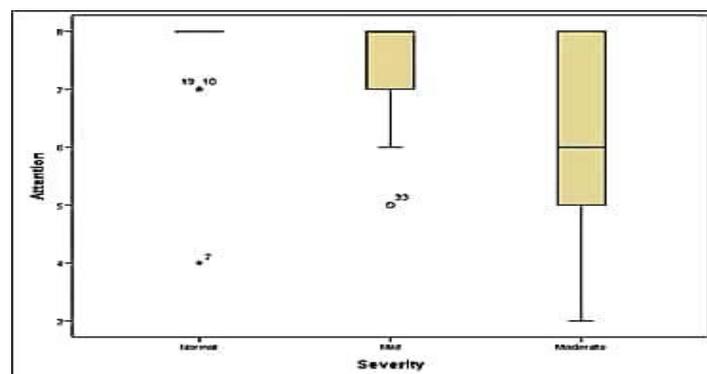**Figure 4:** Box plot showing score of attention for communication domain (IACE) across severity

Figure 5: Box plot showing score of comprehension verbal domain (IACE) across severity
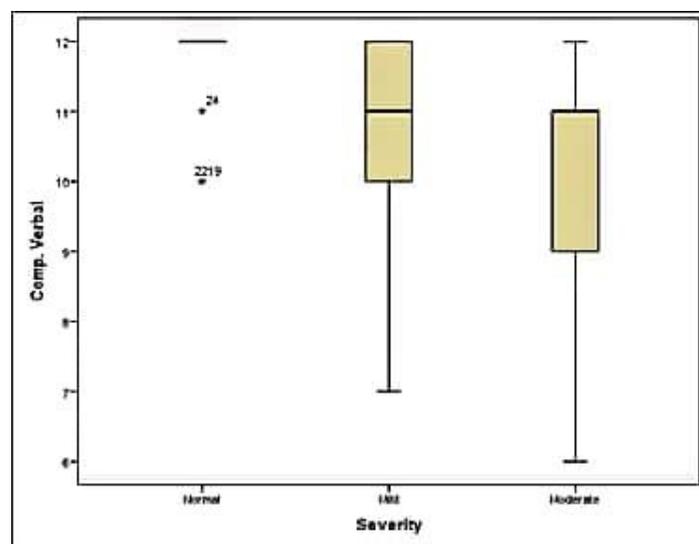
Figure 6: Box plot showing score of comprehension non-verbal domain (IACE) across severity
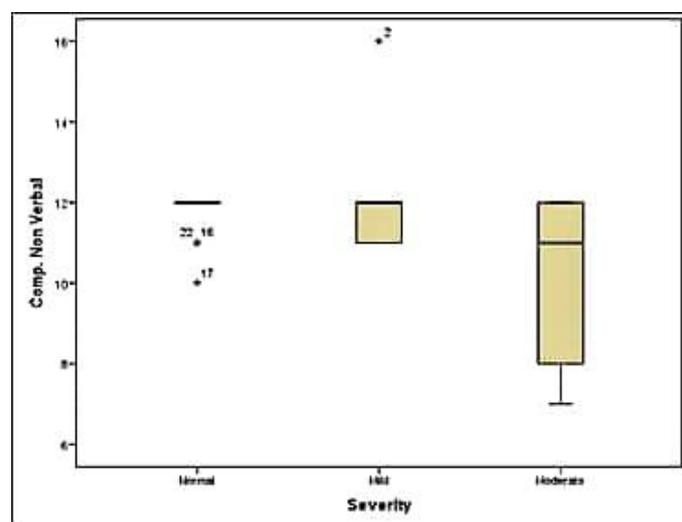
Figure 7: Box plot showing scores of verbal expression domain (IACE) across severity.
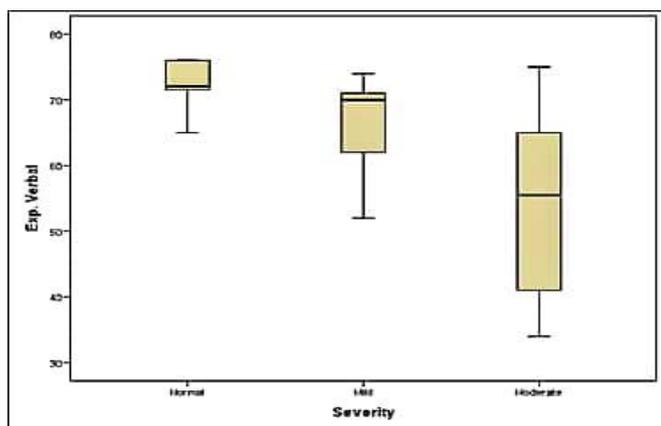
Figure 8: Box plot showing scores of expression-gestural domain (IACE) across severity
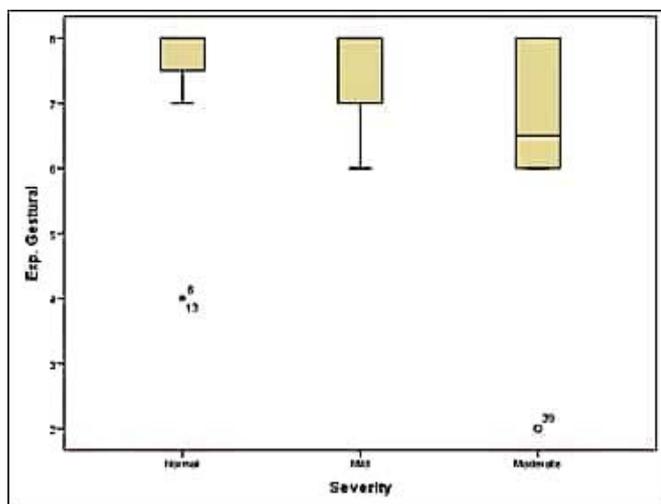
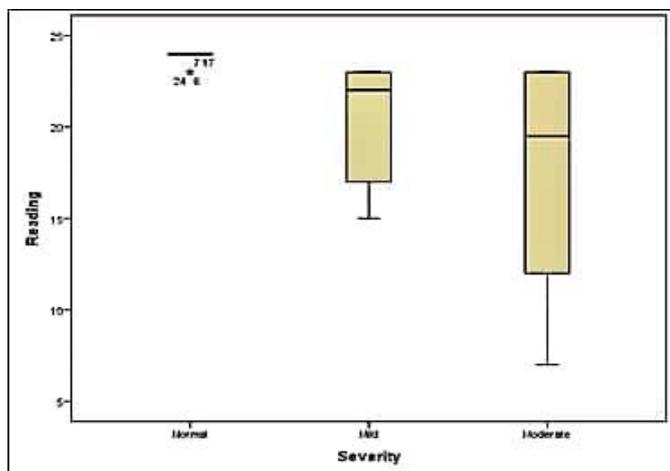**Figure 9:** Box plot showing scores of reading domain (IACE) across severity

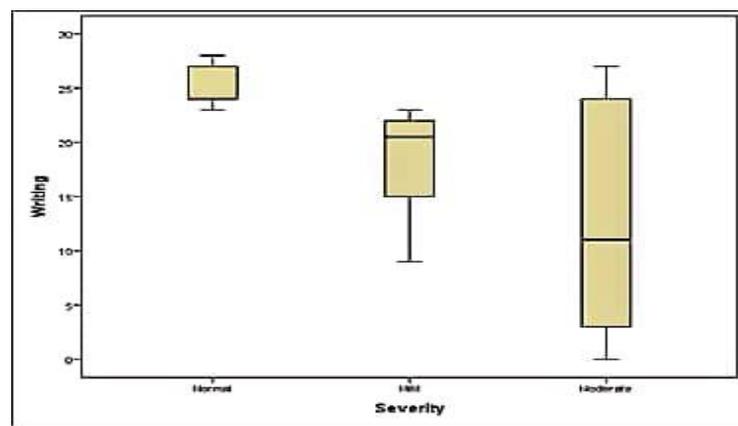**Figure 10:** Box plot showing scores of writing domain (IACE) across severity

Figure 11: Box plot showing scores of spiritual activities related communication domain (IACE) across severity
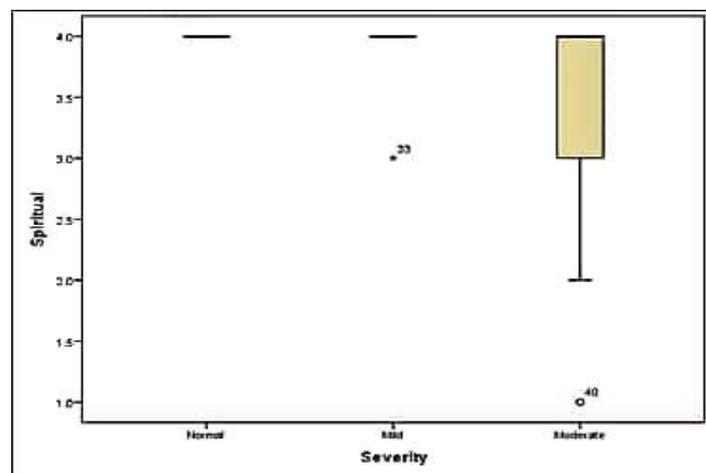

Figure 12: Box plot showing scores of other language performance domain (IACE) across severity
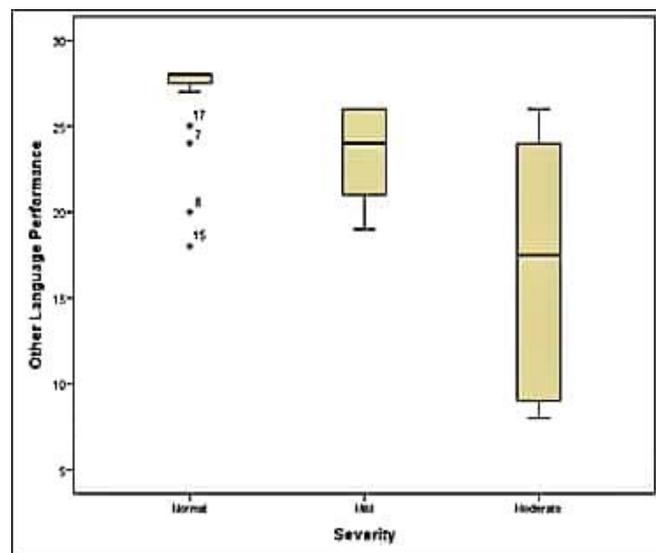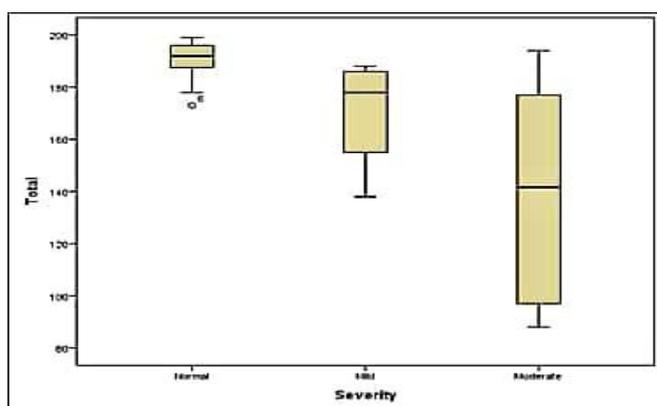

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Figure 13: Box plot showing total communicative effectiveness scores (IACE) across severity

DISCUSSION

The findings of the Instrument to Assess Communicative Effectiveness (IACE) indicated that 80% of the moderate disease group agreed that communication was a problem faced by them. Individuals with mild PD, on the other hand, felt they had no difficulty with word & phrase level speech intelligibility and denied overall difficulty in communication. Hypokinetic dysarthria, poor verbal agility and motoric cognitive fatigue are few of the classical symptoms of Parkinson's disease which have an impact on the communication abilities as the bulbar component of PD increases among neurodegenerative PDs. The presence and severity of hypokinetic dysarthria are seen to influence the communicative effectiveness in the verbal domains, whereas writing domains gets influenced by motoric cognition and tremors or rigidity. Cognition plays an important role in an individual with Parkinson's disease communicative abilities. Presence of perceived cognitive symptoms in individuals with PD is found to be a strong predictor of communicative engagement. Individuals with cognitive symptoms such as trouble in remembering where objects were stored, difficulty reading and understanding complex instructions or difficulty in planning and keeping appointments have significantly lower levels of communicative participation[14]. Cognitive status is seen to be a significant indicator of functional communication abilities in Parkinson's disease patients[10]. Communication skills are highly essential for day to day living and impairment in the same, can lead to social reclusiveness, frustration, and an overall decline in the quality of life of an individual. In the present study it was observed that there was a decrease in communication effectiveness with increase in severity of PD. Some common characteristics observed in individuals with PD (across severity) included weak voice and decrease in speech intelligibility and speech naturalness. The individuals with Parkinson's disease also seemed to be easily fatigued while speaking often leading to a loss of interest in speaking altogether[15]. Present study also revealed that both mild and moderate PD individuals had much preserved speech intelligibility at word level across simple high occurring nouns however at sentences and general conversation level majority of moderate PD had greater decline in speech intelligibility than mild group participants. The presence of dysarthria is seen to be linked to social anxiety and avoidance, as with increase in severity of dysarthria a deterioration in social activities and social network is seen to be a common occurrence in PD population[15]. The findings of the current study expressed a significant difference in communicative abilities among the individuals with mild and moderate Parkinson's disease when compared with normal controls[16]. The domains of verbal comprehension, verbal expression, reading, writing and performance in other languages post Parkinson's disease were seen to be affected in mild Parkinson's disease patients, however individuals with moderate PD were seen to be affected in all the domains of communication. The hypokinetic dysarthric component as well as palilalia as well increased apathy, deteriorating cognition were all seen to have an influence on the regressing communicative competency and performance of an individual with Parkinson's disease[17].

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