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Deficits in naming and auditory comprehension of terms in individuals with vascular dementia

Deficiti imenovanja i auditivnog razumevanja pojmova kod osoba sa vaskularnom demencijom

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Abstract

Background/Aim. Although deficits in naming and understanding named terms are characteristic of dementia, they have seldom been investigated in individuals with vascular dementia (VaD). The aim of the study was to determine deficits in naming objects and actions in individuals with VaD and the ability to understand the meanings of words used to name objects and actions. **Methods.** The study included 30 participants with VaD, who represented the clinical group, while the control group consisted of 30 neurologically healthy participants. Participants with VaD were first assessed using the Mini-Mental State Examination to determine the severity of dementia. The Northwestern Naming Battery was used to assess naming and auditory comprehension of terms. Descriptive and inferential statistical methods were used for data analysis. Group comparisons were conducted using the Chi-squared (χ^2) test of independence, while for 2 × 2 contingency frequency tables, continuity correction according to Yates was applied, and the *phi* (ϕ) coefficient was calculated as an indicator of effect size. The relationships between continuous variables were expressed using Spearman's rank correlation coefficient *rho* (ϱ). **Results.** Participants with VaD demonstrated significantly lower performance on the subtest of naming and auditory comprehension of named objects and actions compared to neurologically healthy participants. The severity of dementia significantly influenced the performance on the administered test. Specifically, participants with moderate dementia exhibited significantly lower scores on all subtests of naming and comprehension of named objects compared to participants with milder dementia. **Conclusion.** Individuals with VaD exhibit pronounced deficits in naming and understanding named terms. The ability to name and understand named terms significantly declines with the progression of dementia.

Key words:
auditory perceptual disorders; cerebrovascular disorders; cognition; dementia, vascular; neuropsychological tests.

Apstrakt

Uvod/Cilj. Mada su deficiti imenovanja i razumevanja imenovanih pojmova karakteristični za demenciju, oni su veoma malo istraživani kod osoba sa vaskularnom demencijom (VaD). Cilj rada bio je da se utvrdi deficit imenovanja predmeta i radnji kod osoba sa VaD, kao i sposobnost razumevanja značenja reči kojima se imenuju predmeti i radnje. **Metode.** U studiju je bilo uključeno 30 ispitanika sa VaD koji su predstavljali kliničku grupu dok je kontrolnu grupu činilo 30 neurološki zdravih ispitanika. Ispitanici sa VaD su najpre testirani korišćenjem *Mini-Mental State Examination* upitnika radi utvrđivanja težine demencije. Za procenu imenovanja i auditivnog razumevanja pojmova primenjena je Severozapadna baterija testova za imenovanje. U statističkoj obradi podataka korišćene su metode deskriptivne i inferencijalne statistike. Za poređenje grupa primenjen je Hi-kvadrat (χ^2) test nezavisnosti, dok je za bivarijantne frekvencijske nacrte tipa 2 × 2 uračunata korekcija neprekidnosti prema Jejtsu, a koeficijent *phi* (ϕ) izračunat je kao pokazatelj veličine uticaja. Odnosi između neprekidnih varijabli izraženi su koeficijentom Spirmanove korelacije ranga *rho* (ϱ). **Rezultati.** Ispitanici sa VaD imali su značajno niža postignuća na subtestu imenovanja i auditivnog razumevanja imenovanih objekata i radnji u poređenju sa neurološki zdravim ispitanicima. Težina demencije značajano je uticala na rezultate na primenjenom testu. Posebno, ispitanici sa umerenim stepenom demencije imali su značajno niža postignuća na svim subtestovima imenovanja i razumevanja imenovanih pojmova u poređenju sa ispitanicima sa lakšim stepenom demencije.

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Zaključak. Osobe sa VaD imaju izražene deficite u imenovanju i razumevanju imenovanih pojmova. Sposobnost imenovanja kao i razumevanja imenovanih pojmova značajno slabi sa napredovanjem demencije.

Ključne reči:
slušna percepcija, poremećaji; cerebrovaskularni poremećaji; saznanje; demencija, vaskularna; testovi, neurofiziološki.

Introduction

Vascular dementia (VaD) is a cognitive function disorder caused by vascular brain lesions [1]. Cognitive deficits are observed in the domain of complex attention, executive functions, and language. Although language disorders in VaD clinically manifest clearly, they receive little attention in scientific literature. Regarding linguistic abilities, naming has been the focus of most research [2–4], and disturbances in this aspect of language are most frequently described in the literature [5, 6].

Naming objects or abstract entities is a multimodal process of cortical networks involving visual processing and recognition, semantic processing, abstract representation, and verbal word production [7, 8]. Various cortical areas are involved in the naming process, including the temporal, temporoparietal, temporooccipital, and frontal regions of the left hemisphere [8–11]. Considering that the naming process involves multiple brain regions [11, 12] and that VaD represents a heterogeneous group of disorders, including multi-infarct dementia and dementia due to strategically placed infarcts, it is expected that patients with this dementia exhibit a deficit in finding lexical units [5].

Since most studies on dementia state naming deficits as a significant symptom of language impairment, assessing nominative function may be particularly important for diagnosing cognitive disorders of vascular etiology [13, 14]. Previous studies have shown that individuals with VaD exhibit deficits in confrontation naming (CN) and word finding during spontaneous speech [5, 6, 15–17].

A review of the literature indicates that individuals with aphasia and progressive language disorders exhibit differences in the ability to name specific categories of terms, including differences in naming objects and actions [11]. For instance, in some studies, patients with Broca's and Wernicke's aphasia were more successful in naming objects than actions [18]. However, some studies show that patients with aphasia are more successful in naming and understanding actions compared to naming and understanding objects [19]. Differences in the ability to name these two categories of terms have also been observed in patients with primary progressive aphasia. For instance, it has been found that patients with the semantic variant of primary progressive aphasia have more pronounced deficits in naming objects than actions, while patients with non-fluent primary progressive aphasia exhibit greater deficits in naming actions than objects [20, 21].

Interesting data also come from studies that examined differences in naming ability and auditory comprehension (AC) of different semantic categories. For example, Silveri et al. [22] found that verbs in patients with semantic dementia were more preserved than nouns. The authors also note that patients with semantic dementia are more successful in naming artificial objects compared to natural items. Similar differences were observed in the domain of understanding named terms, where patients achieved higher performance in understanding words naming artificial objects compared to natural objects.

Given that previous studies indicate the presence of naming disorders in individuals with VaD, the aim of this study was to determine differences in the ability to find words naming objects (nouns) and words naming actions (verbs). We also aimed to determine the abilities of AC of words naming objects and actions.

Methods

Sample

The study was conducted from 2022 to 2023. The sample consisted of 30 participants with VaD who represented the clinical group and 30 neurologically healthy adults without data on language development disorders in the control group. All the patients signed an informed consent to participate in the research. The study was approved by the Ethics Committee of the Faculty of Special Education and Rehabilitation (No. 8911). Respondents of both sexes, aged 67 to 94, with at least eight years of formal education, were included in the sample.

The inclusion criteria for the clinical group were the following: patients with VaD, which was established based on the International Classification of Diseases, Tenth Revision (ICD-10) [23] and the National Institute of Neurological Disorders and Stroke – *Association Internationale pour la Recherché et l'Enseignement en Neurosciences* (NINDS-AIREN) for the diagnosis of VaD [24]; patients who are able to be tested; patients whose mother tongue is Serbian.

The exclusion criteria were a severe degree of dementia (i.e., the subject was not testable), the presence of another form of dementia, or a psychiatric illness.

Instruments and procedures

In the study, the Mini-Mental State Examination (MMSE) [25] and the Northwestern Naming Battery (NNB) [26] were administered. The MMSE was used to assess the degree of cognitive impairment in persons with VaD and to exclude cognitive deficits in participants in the control group. Based on the overall MMSE score, participants with VaD were divided into two groups. The first group consisted of 20

participants with mild dementia (scores from 20 to 24). The second group consisted of 10 participants with moderate dementia (scores from 11 to 19) [10, 11].

The NNB was used to assess the ability to name objects and actions, as well as to understand words naming objects and actions. This provides insight into the ability to produce and comprehend nouns and verbs. The NNB consists of seven subtests: 1) Auditory discrimination; 2) Auditory lexical decision; 3) Confrontation naming; 4) Auditory comprehension; 5) Semantic associations; 6) Non-word repetition; 7) Word repetition. In this study, CN and AC (CNAC) subtests were used. These subtests assessed the ability to produce and understand nouns in the following categories: artificial objects (tools and clothing) and natural objects (animals and fruits/vegetables). Additionally, the ability to name and understand body parts and colors was tested.

CN is assessed by showing the participant one picture/drawing at a time. The correct response is marked in the designated template. In this part of the test, the participant can achieve a maximum of 90 points, where each correct answer receives 1 point. The distribution of the maximum number of points according to semantic categories is as follows: animals (8 points), fruits and vegetables (8 points), tools (8 points), clothing (8 points), body parts (8 points), colors (8 points), and "other objects": syringe, chimney, pen, nail, crown, wreath, binoculars, pliers, left-handed, and rocket (10 points). Additionally, this subtest includes the assessment of the ability to name actions. Actions named with one argument (14 points), two arguments (14 points), and three arguments (4 points) are included.

In the AC subtest, participants are asked to point to an object or action in a drawing that the examiner has named. In this subtest, participants can achieve a maximum of 50 points. The AC subtest also includes the following semantic categories: animals (5 points), fruits and vegetables (5 points), tools (8 points), clothing (5 points), other objects (5 points), body parts (5 points), and colors (5 points). Additionally, participants are asked to point to actions named with a verb with one argument (5 points), a verb with two arguments (5 points), and a verb with three arguments (5 points).

Statistical analysis

Both descriptive and inferential statistical methods were utilized in the study. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) for Windows, version 23.0, 2015. Descriptive statistical measures included absolute frequency, percentage, median, mean, range (minimum-maximum), interquartile range, standard deviation, and standard error. Inferential statistical techniques employed for group comparisons included the Chi-squared (χ^2) test of independence. For 2x2 contingency frequency tables, Yates continuity correction was applied, and the *phi* (φ) coefficient was calculated as an indicator of effect size, classified as small effect (0.10), moderate effect (0.30), or large effect (0.50). The relationships between continuous variables were expressed using Spearman's rank correlation coefficient *rho* (ρ). The strength of the relationship was determined according to guidelines: small or low (0.10–0.29), moderate (0.30–0.49), and large or high (above 0.50).

Results

VaD group and control group each included 9 (15%) male participants and 21 (35%) female participants. By applying the χ^2 test of independence (with Yates continuity correction), there was no statistically significant difference in the sample distribution according to participants' gender ($\chi^2 = 0.000$, $df = 1$, $p = 1.000$, $\varphi = 0.00$).

The mean age of participants with VaD was 79.83 years, and in the control group, it was 76.83 years. There was no statistically significant difference in age between the clinical and control groups ($p = 0.097$).

The mean years of education for participants with VaD were 13.20 [standard deviation (SD) = 2.50] years, and for participants in the control group, it was 13.07 (SD = 3.00) years. There was no statistically significant difference in years of education between the tested groups of participants ($p = 0.554$).

Regarding cognitive status, the total score on MMSE averaged 19.87 (SD = 3.66) in the VaD group, ranging from 11 to 23. On the other hand, the control group achieved a mean score of 29.00 (SD = 0.87) on the same variable, ranging from 28 to 30. The groups differed significantly in MMSE performance ($p < 0.001$).

The average score for the participants with mild dementia was 22.20 (SD = 0.83), while participants with moderate dementia scored 15.20 (SD = 2.30) on average. The two groups differed significantly in MMSE ($p < 0.001$).

Table 1 shows the achievements of participants with VaD and the control group on the CN subtest.

Based on the analysis of the obtained results, it was determined that participants in the control group achieved significantly higher scores on tasks naming objects and actions compared to participants with VaD. By applying the Mann-Whitney *U*-test, it was shown that participants with VaD performed significantly worse than the participants in the control group in the following categories: animals ($U = 165.00$, $z = -5.12$, $p < 0.001$), fruits and vegetables ($U = 75.00$, $z = -6.21$, $p < 0.001$), total natural items ($U = 60.00$, $z = -6.21$, $p < 0.001$), tools ($U = 285.00$, $z = -3.62$, $p < 0.001$), clothing ($U = 240.00$, $z = -4.21$, $p < 0.001$), total artificial items ($U = 180.00$, $z = -4.94$, $p < 0.001$), other objects ($U = 30.00$, $z = -6.75$, $p < 0.001$), total objects ($U = 15.00$, $z = -6.93$, $p < 0.001$), body parts ($U = 255.00$, $z = -4.01$, $p < 0.001$), total nouns ($U = 15.00$, $z = -6.93$, $p < 0.001$), total colors ($U = 255.00$, $z = -4.00$, $p < 0.001$), verbs with one argument ($U = 105.00$, $z = -5.84$, $p < 0.001$), verbs with two arguments ($U = 15.00$, $z = -6.94$, $p < 0.001$), verbs with three arguments ($U = 105.00$, $z = -5.86$, $p < 0.001$), total verbs ($U = 0.00$, $z = -7.12$, $p < 0.001$), total CN ($U = 45.00$, $z = -6.56$, $p < 0.001$).

Table 1

Achievements of the VaD group (n = 30) and control group (n = 30) participants on the Confrontation Naming subtest

Parameters	M ± SD	SE	Mdn	IQR	Min–Max	*r*
Animals						
VaD	6.63 ± 1.56	0.29	7.00	2.00	2–8	0.66
control	8.00 ± 0.00	0.00	8.00	-	8–8	
Fruits and vegetables						
VaD	6.00 ± 1.36	0.25	6.00	2.00	4–8	0.80
control	8.00 ± 0.00	0.00	8.00	-	8–8	
Total natural items						
VaD	12.63 ± 2.47	0.45	13.00	3.25	6–16	0.82
control	16.00 ± 0.00	0.00	16.00	-	16–16	
Tools						
VaD	7.33 ± 1.03	0.19	8.00	1.00	5–8	0.47
control	8.00 ± 0.00	0.00	8.00	-	8–8	
Clothing						
VaD	7.30 ± 0.99	0.18	8.00	1.00	4–8	0.54
control	8.00 ± 0.00	0.00	8.00	-	8–8	
Total artificial items						
VaD	14.63 ± 1.73	0.32	15.00	2.00	9–16	0.64
control	16.00 ± 0.00	0.00	16.00	-	16–16	
Other objects						
VaD	5.83 ± 2.78	0.51	5.50	4.25	1–10	0.87
control	10.00 ± 0.00	0.00	10.00	-	10–10	
Total objects						
VaD	33.10 ± 5.89	1.07	33.50	8.50	20–42	0.89
control	42.00 ± 0.00	0.00	42.00	-	42–42	
Body parts						
VaD	7.03 ± 1.22	0.22	8.00	2.00	4–8	0.52
control	8.00 ± 0.00	0.00	8.00	-	8–8	
Total nouns						
VaD	40.13 ± 6.78	1.24	41.00	8.50	24–50	0.89
control	50.00 ± 0.00	0.00	50.00	-	50–50	
Total colors						
VaD	7.07 ± 1.34	0.24	8.00	2.00	3–8	0.52
control	8.00 ± 0.00	0.00	8.00	-	8–8	
Verbs with one argument						
VaD	10.43 ± 2.69	0.49	10.00	3.50	5–14	0.75
control	14.00 ± 0.00	0.00	14.00	-	14–14	
Verbs with two arguments						
VaD	8.57 ± 2.79	0.51	7.50	5.25	5–14	0.90
control	14.00 ± 0.00	0.00	14.00	-	14–14	
Verbs with three arguments						
VaD	2.57 ± 1.04	0.19	2.50	1.25	1–4	0.76
control	14.00 ± 0.00	0.00	14.00	-	14–14	
Total verbs						
VaD	21.73 ± 5.91	1.08	21.00	11.25	12–30	0.92
control	32.00 ± 0.00	0.00	32.00	-	32–32	
Total CN						
VaD	68.93 ± 12.33	2.25	68.50	18.25	39–87	0.92
control	90.00 ± 0.00	0.00	90.00	-	90–90	

VaD – vascular dementia; CN – confrontation naming; M – mean; SD – standard deviation; SE – standard error; Mdn – median; IQR – interquartile range; Min – minimum; Max – maximum; *r* – strength of association.

Table 2 shows the results of the participants' achievements on the AC subtest.

Results of the AC subtest also show that participants with VaD performed significantly worse in understanding named objects and actions compared to the participants from the control group in tasks: animals (U = 270.00, z = -3.82, p < 0.001), fruits and vegetables (U = 180.00, z = -4.78, p < 0.001), total natural items (U = 150.00, z = -5.15, p < 0.001), tools (U = 285.00, z = -3.40, p < 0.001), clothing (U = 300.00, z = -3.42, p < 0.001), total artificial items (U = 255.00, z = -3.80, p < 0.001), other objects (U = 225.00, z = -4.39, p < 0.001), total objects (U = 105.00, z = -5.70, p < 0.001), body parts (U = 285.00, z = -3.63, p < 0.001), total nouns (U = 105.00, z = -5.70, p < 0.001), total colors (U = 225.00, z = -4.39, p < 0.001), verbs with one argument (U = 150.00, z = -5.30, p < 0.001), verbs with two arguments (U = 75.00, z = -6.23, p < 0.001), verbs with three arguments (U = 135. 00, z = -5.48, p < 0.001), total verbs (U = 75.00,

z = - 6.20, p < 0.001), total AC (U = 45.00, z = -6.56, p < 0.001).

Tables 3 and 4 show the results of the comparison of achievements on CNAC subtests among participants with different degrees of VaD severity.

Participants with mild dementia were statistically significantly better compared to those with moderate dementia in naming the following categories: animals (U = 35.00, z = -2.98, p = 0.003), total natural items (U = 45.40, z = -2.43, p = 0.015), tools (U = 61.00, z = -1.99, p = 0.046), clothing (U = 58.50, z = -2.03, p = 0.043), total artificial items (U = 52.00, z = -2.22, p = 0.027), other objects (U = 39.50, z = -2.68, p = 0.007), total objects (U = 34.59, z = -2.89, p = 0.004), body parts (U = 21.00, z = -3.91, p < 0.001), total nouns (U = 25.50, z = -3.29, p = 0.001), verbs with one argument (U = 42.00, z = -2.59, p = 0.010), verbs with two arguments (U = 47.00, z = -2.37, p = 0.018), total verbs (U = 42.00, z = -2.56, p = 0.010), total CN (U = 28.00, z = -3.18, p = 0.001) (Table 3).

Participants with mild dementia achieved statistically significantly better results compared to those with moderate dementia on the following categories of the AC subtest: animals (U = 66.50, z = -1.98, p = 0.048), total objects (U = 55.50, z = -1.98, p = 0.048), verbs with three arguments

Table 2

Participants' achievements on the Auditory Comprehension subtest

Parameters	M ± SD	SE	Mdn	IQR	Min–Max	*r*
Animals						
VaD	4.40 ± 0.86	0.16	5.00	1.00	2–5	0.49
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Fruits and vegetables						
VaD	3.97 ± 1.07	0.19	4.00	2.00	2–6	0.62
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Total natural items						
VaD	8.37 ± 1.73	0.32	9.00	2.26	5–11	0.66
control	10.00 ± 0.00	0.00	10.00	-	10–10	
Tools						
VaD	4.53 ± 0.73	0.13	5.00	1.00	3–6	0.44
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Clothing						
VaD	4.57 ± 0.68	0.12	5.00	1.00	3–5	0.44
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Total artificial items						
VaD	9.10 ± 1.24	0.23	10.00	2.00	7–11	0.49
control	10.00 ± 0.00	0.00	10.00	-	10–10	
Other objects						
VaD	4.27 ± 0.94	0.17	4.50	1.00	1–5	0.57
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Total objects						
VaD	21.73 ± 3.10	0.57	23.00	5.00	15–26	0.74
control	25.00 ± 0.00	0.00	25.00	-	25–25	
Body parts						
VaD	4.50 ± 0.86	0.16	5.00	1.00	1–5	0.47
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Total nouns						
VaD	26.23 ± 3.52	0.64	27.00	6.00	16–31	0.74
control	30.00 ± 0.00	0.00	30.00	-	30–30	
Total colors						
VaD	4.27 ± 0.94	0.17	4.50	1.00	1–5	0.57
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Verbs with one argument						
VaD	3.73 ± 1.20	0.22	4.00	2.00	1–5	0.68
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Verbs with two arguments						
VaD	3.27 ± 1.20	0.22	3.00	1.00	0–5	0.80
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Verbs with three arguments						
VaD	3.30 ± 1.56	0.28	4.00	3.00	0–5	0.71
control	5.00 ± 0.00	0.00	5.00	-	5–5	
Total verbs						
VaD	10.30 ± 3.24	0.59	10.00	4.25	4–15	0.80
control	15.00 ± 0.00	0.00	15.00	-	15–15	
Total AC						
VaD	40.80 ± 6.09	1.11	40.50	7.00	28–50	0.85
control	50.00 ± 0.00	0.00	50.00	-	50–50	

AC – auditory comprehension. For other abbreviations, see Table 1.

(U = 40.50, z = -2.68, p = 0.007), total verbs (U = 35.00, z = -2.89, p = 0.004), and total AC (U = 37.00, z = -2.79, p = 0.005) (Table 4).

The Spearman correlation was used to examine the relationship between achievements on the MMSE and the NNB. A statistically significant positive and strong correlation was observed between the total CN score and the overall score on the MMSE, indicating that higher scores on the total CN were associated with higher overall scores on the MMSE (ρ = 0.626, p < 0.01), and *vice versa*. Similarly, a statistically significant positive and strong correlation was found between the total AC score and the overall score on the MMSE, with higher scores on the total AC associated with higher overall scores on the MMSE (ρ = 0.683, p < 0.01), and *vice versa*.

Table 3

Achievements on the Confrontation Naming subtest to determine severity of dementia

Parameters	M ± SD	Mdn	IQR	Mean rank	*p*	*r*
Animals						
mild	7.25 ± 1.02	7.50	1.00	18.75	0.003	0.54
moderate	5.40 ± 1.78	5.50	3.00	9.00		
Fruits and vegetables						
mild	6.20 ± 1.36	6.00	2.00	16.78	0.250	0.21
moderate	5.60 ± 1.35	6.00	2.25	12.95		
Total natural items						
mild	13.45 ± 1.90	14.00	3.50	18.23	0.015	0.44
moderate	11.00 ± 2.75	10.50	3.75	10.05		
Tools						
mild	7.60 ± 0.82	8.00	0.75	17.45	0.046	0.36
moderate	6.80 ± 1.23	7.00	2.25	11.60		
Clothing						
mild	7.55 ± 0.76	8.00	1.00	17.58	0.043	0.37
moderate	6.80 ± 1.23	7.00	2.00	11.35		
Total artificial items						
mild	15.15 ± 1.23	15.50	1.00	17.90	0.027	0.40
moderate	13.60 ± 2.17	14.00	3.25	10.70		
Other objects						
mild	6.80 ± 2.55	7.50	4.00	18.53	0.007	0.49
moderate	3.90 ± 2.23	4.00	3.50	9.45		
Total objects						
mild	35.40 ± 4.64	35.50	6.75	18.78	0.004	0.53
moderate	28.50 ± 5.56	30.50	10.00	8.95		
Body parts						
mild	7.65 ± 0.75	8.00	0.00	19.45	< 0.001	0.71
moderate	5.80 ± 1.03	6.00	1.00	7.60		
Total nouns						
mild	43.05 ± 4.91	42.00	6.75	19.23	0.001	0.60
moderate	34.30 ± 6.34	36.00	10.25	8.05		
Total colors						
mild	7.30 ± 1.17	8.00	1.75	17.18	0.102	0.30
moderate	6.60 ± 1.58	7.00	2.25	12.15		
Verbs with one argument						
mild	11.35 ± 2.21	11.50	4.00	18.40	0.010	0.47
moderate	8.60 ± 2.72	9.00	3.50	9.70		
Verbs with two arguments						
mild	9.40 ± 2.70	9.00	5.00	18.15	0.018	0.43
moderate	6.90 ± 2.23	7.00	2.50	10.20		
Verbs with three arguments						
mild	2.75 ± 1.02	3.00	2.00	16.95	0.185	0.24
moderate	2.20 ± 1.03	2.00	2.00	12.60		
Total verbs						
mild	23.75 ± 5.24	24.00	9.75	18.40	0.010	0.47
moderate	17.70 ± 5.23	16.50	8.25	9.70		
Total CN						
mild	74.10 ± 9.56	72.50	15.75	19.10	0.001	0.58
moderate	58.60 ± 10.91	56.00	14.75	8.30		

CN – confrontation naming. For other abbreviations, see Table 1.

Table 4

Participants' achievements on the Auditory Comprehension subtest to determine severity of dementia

Parameters	M ± SD	Mdn	IQR	Mean rank	*p*	*r*
Animals						
mild	4.65 ± 0.59	5.00	1.00	17.48	0.048	0.36
moderate	3.90 ± 1.10	4.00	2.00	11.55		
Fruits and vegetables						
mild	4.15 ± 1.04	4.00	2.00	16.90	0.200	0.23
moderate	3.60 ± 1.07	4.00	1.50	12.70		
Total natural items						
mild	8.80 ± 1.40	9.00	2.00	17.28	0.110	0.29
moderate	7.50 ± 2.07	8.00	4.20	11.95		
Tools						
mild	4.70 ± 0.66	5.00	1.00	17.25	0.082	0.32
moderate	4.20 ± 0.79	4.00	1.25	12.00		
Clothing						
mild	4.65 ± 0.67	5.00	0.75	16.63	0.234	0.22
moderate	4.40 ± 0.70	4.50	1.00	13.25		
Total artificial items						
mild	9.35 ± 1.17	10.00	1.00	17.00	0.155	0.26
moderate	8.60 ± 1.35	8.50	3.00	12.50		
Other objects						
mild	4.45 ± 0.76	5.00	1.00	16.95	0.163	0.25
moderate	3.90 ± 1.20	4.00	1.25	12.60		
Total objects						
mild	22.60 ± 2.48	23.50	3.75	17.73	0.048	0.36
moderate	20.00 ± 3.59	19.50	6.25	11.05		
Body Parts						
mild	4.60 ± 0.60	5.00	1.00	15.85	0.717	0.07
moderate	4.30 ± 1.25	5.00	1.00	14.80		
Total nouns						
mild	27.20 ± 2.71	27.50	4.75	17.60	0.063	0.34
moderate	24.30 ± 4.27	24.50	5.75	11.30		
Total colors						
mild	4.40 ± 0.75	5.00	1.00	16.33	0.427	0.14
moderate	4.00 ± 1.24	4.00	1.25	13.85		
Verbs with one argument						
mild	4.00 ± 0.97	4.00	1.75	17.08	0.150	0.26
moderate	3.20 ± 1.48	3.00	3.00	12.35		
Verbs with two arguments						
mild	3.60 ± 0.88	3.00	1.00	17.58	0.057	0.35
moderate	2.60 ± 1.51	2.50	2.25	11.35		
Verbs with three arguments						
mild	3.90 ± 1.07	4.00	2.00	18.48	0.007	0.49
moderate	2.10 ± 1.73	1.50	2.50	9.55		
Total verbs						
mild	11.50 ± 2.26	11.00	3.75	18.75	0.004	0.53
moderate	7.90 ± 3.67	7.50	5.25	9.00		
Total AC						
mild	43.10 ± 4.02	41.50	6.75	18.65	0.005	0.51
moderate	36.20 ± 7.07	38.50	10.50	9.20		

AC – auditory comprehension. For other abbreviations, see Table 1.

Discussion

This study aimed to determine deficits in naming objects and actions and understanding the meanings of words used to name those objects and actions, as well as to explore how these abilities relate to the severity of dementia.

Our findings indicate that participants with VaD achieved significantly lower scores compared to neurologically healthy participants, which is consistent with the results of other authors [20, 25]. When assessing the ability to name natural items, we found that participants with VaD performed better in naming animals compared to naming fruits and vegetables, while individuals without neurological disorders accurately named all items in the listed categories. In assessing the ability to name artificial items, it was shown that individuals with VaD were equally (un)successful in naming tools and clothing. Further analysis of the obtained results showed that individuals with VaD were more

successful in naming artificial items compared to naming natural items, consistent with previous research indicating that dementia patients are more successful in naming artificial items compared to natural items [22]. Additionally, studies show that some individuals with semantic dementia have a preserved ability to find verbs compared to nouns in CN tasks [22]. However, our findings suggest that participants with VaD have a better ability to find nouns than verbs, as they were more successful in naming objects than actions. Regarding the action naming results, it is interesting to note that participants with VaD were more successful in finding verbs with one argument compared to verbs with two or three arguments. On the other hand, participants in the control group successfully named all actions regardless of the structure of the verb arguments. This finding suggests that individuals with VaD experience difficulties in finding verbs with complex argument structures, similar to individuals with aphasia [12, 26].

Regarding AC of the meanings of words used to name objects and actions, the results of our study show that participants with VaD were poorer in some categories compared to neurologically healthy participants. Specifically, participants with VaD were better at AC of words naming objects (nouns) compared to words naming actions (verbs). Additionally, a dissociation was found regarding the participants' ability to understand verbs with a different number of arguments, where participants with VaD had slightly higher achievements in understanding verbs with three arguments compared to verbs with two arguments. These findings indicate the importance of further investigating the AC of verbs in individuals with VaD.

The degree of cognitive deficit or dementia significantly influences naming ability. Patients with milder VaD had higher achievements in CNAC of words naming objects and actions compared to participants with moderate dementia. The impact of dementia severity on naming ability and AC of terms has been demonstrated in other studies as well. For instance, some authors find that individuals with mild dementia are more successful in CN tasks compared to individuals with more severe cognitive impairment [27]. The influence of dementia severity on the ability to find words in naming tasks is also evident in the results of previous research [28, 29]. Finally, the results of our study indicate a statistically significant correlation between the severity of dementia and the ability of CNAC of named terms in individuals with VaD. Individuals with milder dementia have better abilities to name objects and actions, as well as to understand the meanings of named terms.

Conclusion

Based on the analysis and discussion of the obtained results, it can be concluded that individuals with vascular dementia have significantly pronounced deficits in visual confrontation naming. This finding indicates that vascular dementia leads to impairments in the ability to find nouns and verbs. It was also concluded that individuals with vascular dementia had pronounced deficits in auditory comprehension of certain semantic categories. The severity of cognitive impairment, i.e., dementia, correlates with performance on naming and understanding named term tasks. Patients with more severe dementia performed poorly in confrontation naming and auditory comprehension of words used to name objects and actions compared to patients identified with milder dementia. This finding suggests that as dementia progresses, naming and auditory comprehension abilities significantly worsen.

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