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Clinical utility of the Wechsler Memory Scale — Fourth Edition (WMS-IV) in patients with intractable temporal lobe epilepsy

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ABSTRACT

Introduction: The Wechsler Memory Scale (WMS) is one of the most widely used test batteries to assess memory functions in patients with brain dysfunctions of different etiologies. This study examined the clinical validation of the Dutch Wechsler Memory Scale — Fourth Edition (WMS-IV-NL) in patients with temporal lobe epilepsy (TLE).
Method: The sample consisted of 75 patients with intractable TLE, who were eligible for epilepsy surgery, and 77 demographically matched healthy controls. All participants were examined with the WMS-IV-NL.
Results: Patients with TLE performed significantly worse than healthy controls on all WMS-IV-NL indices and subtests ($p < .01$), with the exception of the Visual Working Memory Index including its contributing subtests, as well as the subtests Logical Memory I, Verbal Paired Associates I, and Designs II. In addition, patients with mesiotemporal abnormalities performed significantly worse than patients with lateral temporal abnormalities on the subtests Logical Memory I and Designs II and all the indices ($p < .05$), with the exception of the Auditory Memory Index and Visual Working Memory Index. Patients with either a left or a right temporal focus performed equally on all WMS-IV-NL indices and subtests ($F(15, 50) = .70, p = .78$), as well as the Auditory–Visual discrepancy score ($t(64) = -1.40, p = .17$).
Conclusion: The WMS-IV-NL is capable of detecting memory problems in patients with TLE, indicating that it is a sufficiently valid memory battery. Furthermore, the findings support previous research showing that the WMS-IV has limited value in identifying material-specific memory deficits in presurgical patients with TLE.

1. Introduction

The Wechsler Memory Scale (WMS) is one of the most widely used memory batteries to assess different memory functions in patients with brain dysfunctions of different etiologies [1]. The latest edition of the WMS, the Wechsler Memory Scale — Fourth Edition (WMS-IV) [2], has especially been improved in its sensitivity to memory impairment compared with the Wechsler Memory Scale — Third Edition (WMS-III) [3,4]. Moreover, the WMS-IV is considered to be more accurate in lateralizing material-specific memory problems (i.e., auditory verbal vs. visual nonverbal memory problems) because of a more clear-cut division of the auditory and visual memory components [5]. Therefore, the purpose of the current study was to examine the validity of the Dutch version of the WMS-IV (WMS-IV-NL) [6] in patients with intractable temporal lobe epilepsy (TLE).

The medial temporal lobes are crucial for episodic memory formation and retrieval [7–11]. Not surprisingly, subjective memory complaints are common in patients with TLE, and memory deficits are often established using neuropsychological testing [8,12,13]. Moreover, there is evidence that memory deficits are more often observed in patients with TLE with mesiotemporal abnormalities than in those with lateral abnormalities in temporal structures [14,15].

Whether patients with TLE have disruptions in working memory as well is still a matter of debate. Traditionally, it has been suggested that working memory was completely dependent on the fronto–parietal network [16]. Some research has supported this view, showing that working memory is unaffected in patients with TLE [16–18]. However, others have found working memory to be also dependent on the temporal lobes [19–23]. Several studies revealed working memory deficits in patients with TLE using the Wechsler Memory Scale — Revised (WMS-R) [24,25] and WMS-III [26].

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Due to the memory complaints reported by patients with TLE, the assessment of memory functioning is a crucial element in neuropsychological evaluations of these patients [27]. A wide variety of neuropsychological tests and batteries is available for the assessment of episodic memory problems, such as the WMS-IV. This memory battery assesses visual working memory and both visual and verbal episodic short-term and long-term memory, which could facilitate the discrimination between patients with either left TLE or right TLE [5].

Research using previous versions of the WMS compared patients with left and right TLEs. However, results are mixed. Some studies revealed an association between a left-hemisphere localization and verbal memory performance [25,28–33], whereas other studies related visual memory performance to right-hemisphere localization [26,29,30,33]. In contrast, other studies did not find any differences between patients with left and right TLE and WMS performance [34,35]. So far, limited research has been conducted on the discriminative power of the WMS-IV to distinguish patients with left TLE from those with right TLE. One study did not find a relationship between the lateralization of the epileptic focus and material-specific memory problems [5], whereas others demonstrated that the WMS-IV could discriminate between left and right TLE [2,36].

In the present study, we examined the clinical utility of the WMS-IV-NL in presurgical patients with TLE by examining their performance on the WMS-IV-NL compared with group-matched healthy controls. We expected that the patients with TLE would perform significantly worse on the WMS-IV-NL indices and subtests than healthy controls. In addition, we expected that patients with mesiotemporal abnormalities would perform significantly worse on the WMS-IV-NL indices and subtests than patients with lateral temporal abnormalities. Furthermore, we examined whether the WMS-IV-NL was able to determine the lateralization of the epileptic focus.

2. Method

2.1. Participants

The study sample consisted of 75 candidates for epilepsy surgery with TLE (35 men, mean age = 38.95, *SD* = 13.68) and 77 matched healthy controls (36 men, mean age = 39.10, *SD* = 13.69). The patient diagnosis was based on the findings of EEG monitoring and MRI scans. Only patients with seizures of temporal origin with a clearly identified and localized focus within the temporal lobes were selected. Patients were divided into two groups according to the lateralization of the abnormalities: 44 patients with left TLE and 31 patients with right TLE. Additionally, 57 patients showed structural abnormalities on the MRI scan. These patients were divided into a group with mesiotemporal abnormalities ($n = 31$; all patients had mesiotemporal sclerosis) and a group ($n = 26$) with a variety of lateral abnormalities in temporal structures (consisting of tumor $n = 11$; cavernous hemangioma $n = 5$; cyst $n = 3$; cortical dysplasia $n = 2$; others or unspecified $n = 5$). Table 1 summarizes the participant characteristics.

The patients with TLE and healthy controls did not differ with respect to age ($t(150) = -.07$, $p = .94$), sex distribution ($\chi^2(1) = .00$, $p = .99$), and educational level ($\chi^2(2) = .05$, $p = .98$). Overall, patients with TLE had a significantly lower verbal intelligence level than healthy controls (Dutch version of the National Adult Reading Test [NART] [37,38]: $t(136) = 3.56$, $p < .01$). Low correlations were found between the NART-IQ and the WMS-IV-NL subtest scores (Pearson product–moment correlation coefficients ranging from .25 to .44); therefore, no covariates were included in the analyses. Furthermore, the patients with left and right TLE did not differ with respect to age ($t(73) = -.30$, $p = .76$), sex distribution ($\chi^2(1) = .48$, $p = .49$), education level ($\chi^2(2) = .16$, $p = .92$), intelligence level ($t(59) = .31$, $p = .76$), seizure onset age ($t(73) = -.12$, $p = .91$), duration of epilepsy ($t(73) = -.34$, $p = .74$), or antiepileptic drug use (no/mono/polytherapy: $\chi^2(2) = 2.34$, $p = .31$). Also, the patients with mesiotemporal or lateral temporal abnormalities on MRI scan did not differ with respect to age ($t(55) = .59$, $p = .56$), sex distribution ($\chi^2(1) = .37$, $p = .54$), education level ($\chi^2(2) = 2.71$, $p = .26$), intelligence level ($t(44) = .71$, $p = .49$), and antiepileptic drug use (no/mono/polytherapy: $\chi^2(2) = 4.55$, $p = .10$). Moreover, they did differ with respect to seizure onset age ($t(55) = 3.86$, $p < .001$) and duration of epilepsy ($t(55) = -3.05$, $p = .003$).

Patients with TLE were recruited from two different clinical practices, namely Kempenhaeghe Academic Centre for Epileptology, Heeze and Oosterhout, the Netherlands ($n = 70$), and Ghent University Hospital, Belgium ($n = 4$). All patients with TLE met the following inclusion criteria: completion of the full-length WMS-IV-NL adult battery, completion of an MRI scan of the brain, candidates for epilepsy surgery, able to speak/understand the Dutch language, and no hearing or visual impairment which made normal test administration impossible. The healthy controls were selected from the WMS-IV-NL standardization sample [6] and met the following inclusion criteria: ability to speak/understand the Dutch language, no significant hearing or visual impairment, no psychiatric or neurologic disorder, no substance abuse affecting cognitive functioning, and no use of medicines affecting cognitive functioning.

The Institutional Review Board of Radboud University in Nijmegen approved the WMS-IV-NL standardization study, and the patient study was approved by the Institutional Review Board of Kempenhaeghe.

2.2. Materials

The WMS-IV-NL was administered to measure memory performance in both the patients with TLE and the healthy controls. The WMS-IV-NL consists of an adult battery for participants aged 16–69 and an older adult battery for participants aged 65–90. All participants in this study completed the adult battery, which consists of one optional subtest, the Brief Cognitive Status Exam (BCSE), and six primary

Table 1
Participant characteristics.

	Patients with TLE							Healthy controls
	Mesiotemporal MRI+		Lateral MRI+		MRI−			
	Right	Left	Right	Left	Right	Left	Total	
N	13	18	11	15	7	11	75	77
Age (mean, *SD*)	37.9 (12.6)	37.8 (15.6)	41.8 (12.9)	38.7 (14.6)	38.9 (13.9)	39.6 (13.8)	39.0 (13.7)	39.1 (13.7)
Sex (M/F)	5/8	8/10	5/6	8/7	¾	6/5	35/40	36/41
Education level (low/average/high)	6/4/3	8/8/2	5/4/2	5/3/7	3/4/7	4/5/2	28/27/20	28/29/20
NART-IQ (mean, *SD*)	97.7 (9.9)	95.1 (14.9)	96.9 (12.2)	100.2 (8.2)	94.8 (14.7)	98.7 (6.9)	97.3 (11.2)	103.5 (9.3)
Seizure onset age (mean, *SD*)	12.9 (8.2)	12.4 (7.0)	26.1 (17.1)	26.5 (19.2)	18.0 (8.3)	16.7 (12.7)	18.5 (14.0)	–
Duration of epilepsy (mean, *SD*)	23.9 (11.4)	24.4 (16.1)	16.5 (13.5)	11.5 (9.4)	17.6 (5.5)	19.3 (13.0)	19.2 (13.2)	–
Antiepileptic drugs (no/mono/poly)	0/1/12	1/1/16	0/2/9	1/5/9	0/1/6	0/3/8	2/13/60	–

Note: MRI+: patients who showed structural abnormalities on MRI scan. MRI−: no abnormalities found on MRI scan. Education level was assessed by classifying formal schooling in the Netherlands according to the grouping of the Central Office for Statistics of the Netherlands (CBS, 2011), which is based on the International Standard Classification of Education (ISCED): United Nations Educational, Scientific and Cultural Organization Institute for Statistics (UNESCO-UIS. 2011).