



## Featured Article

## The Vascular Impairment of Cognition Classification Consensus Study

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**Abstract**

**Introduction:** Numerous diagnostic criteria have tried to tackle the variability in clinical manifestations and problematic diagnosis of vascular cognitive impairment (VCI) but none have been universally accepted. These criteria have not been readily comparable, impacting on clinical diagnosis rates and in turn prevalence estimates, research, and treatment.

**Methods:** The Vascular Impairment of Cognition Classification Consensus Study (VICCCS) involved participants (81% academic researchers) from 27 countries in an online Delphi consensus study. Participants reviewed previously proposed concepts to develop new guidelines.

**Results:** VICCCS had a mean of 122 (98–153) respondents across the study and a 67% threshold to represent consensus. VICCCS redefined VCI including classification of mild and major forms of VCI and subtypes. It proposes new standardized VCI-associated terminology and future research priorities to address gaps in current knowledge.

**Discussion:** VICCCS now proposed a consensus-based updated conceptualization of VCI intended to facilitate standardization in research.

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**Keywords:**

Vascular cognitive impairment; Vascular dementia; Guidelines; Criteria; Consensus; Delphi

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## 1. Introduction

Cerebrovascular pathology, including microinfarcts, lacunar infarcts, larger infarcts (of embolic or thrombotic origin), and white matter lesions, is moderately to strongly associated with cognitive decline [1–4]. Risk factors include hypertension, diabetes mellitus, smoking, atrial fibrillation, positive family history, age, and hypercholesterolemia [5–7], with some risk from *APOE* (epsilon 4 allele) and *MTHFR* variants [8]. From the time Hachinski et al. [9] proposed the term multi-infarct dementia, numerous subsequent proposals have tried to capture the clinical and etiologic complexity of cognitive impairment caused by heterogeneous cerebrovascular disease (CVD) and pathologies [10–21]. These include vascular dementia (VaD), vascular cognitive impairment (VCI), subcortical (ischemic) VaD, and vascular cognitive disorder (VCD), which have given rise to multiple criteria and research guidelines [13,17,19,21] that are not readily interchangeable [22,23]. These factors contribute to variable prevalence estimates in the literature, as do descriptions of clinical manifestations. However, VaD, used to describe a severe form in the continuum of VCI, is probably the second commonest cause of dementia after Alzheimer's disease (AD), although as populations' age this is likely to increase [13,17,21,24]. Yet, incidence of dementia is now decreasing in high-income countries, which may partly relate to better CVD management [25]. CVD commonly contributes to many forms of dementia, including AD [26–28], and may be targeted with some success [29], although further research into possible associations and causal relationships is needed. Studies into causes and treatments of AD have greatly outnumbered those for VaD, partly by the availability of widely used diagnostic criteria that continue to evolve [30] and partly because of relatively more funding opportunities.

The lack of consensus criteria for diagnosis of VaD and VCI has impeded sharing and comparison of data on a larger scale, together with different specialties conducting narrow focused research [31]. Greater harmony of approach within the research community is needed [23,32]. A work group convened by the NINDS-CSN made some progress [33], producing detailed research recommendations for VCI. However, their subsequent implementation and adoption remains unclear.

The Vascular Impairment of Cognition Classification Consensus Study (VICCCS) was designed to achieve a broader consensus on the conceptualization of impairment in cognition contributed by vascular pathology, for clinical diagnosis and research. The aim was to provide criteria that could be widely adopted within the field, to underpin future research. VICCCS elaborated previous work to inform the way forward, with input from a broad spectrum of participants from the international research community.

## 2. Methodology

### 2.1. Participant selection

Previous attempts to develop consensus criteria were largely based on comparatively smaller pools of opinion leaders as part of organized meetings, conferences, or symposia [33]. The intention for VICCCS was to draw on the expertise of as many participants from as wide an array of disciplines as possible. Participants for VICCCS were identified through unbiased review of published articles relating to the concept or diagnosis of VaD/VCI in Pubmed, up to August 2010. Several relevant research networks, including the British Association for Stroke Physicians, Alzheimer's Disease Neuroimaging Initiative, and the European Alzheimer's Disease Consortium were also invited.

Nine hundred five individuals were initially identified, although it was not possible to find the contact details of all these most likely because of the fact that some of the source studies were published more than 20 years ago. Further efforts to source these missing contact details were made by inviting all potential participants who were contacted to nominate and provide contact details for potentially interested colleagues. This led to 789 invitations initially sent that generated a potentially 367 (46%) initially interested pool of international participants. Unlike previous endeavors, VICCCS used periodic internet-based surveys to facilitate greater involvement and promote contributions through providing sufficient time for reflection and responses that were given with anonymity and parity. The study required considerable relevant clinical and research knowledge and time commitment to complete multiple surveys. Nonetheless, on average 122 participants contributed to each round (range 98–153). Of these, a mean of 72% (range 66%–76%) were clinicians with direct involvement in clinical decision-making. The remainder were nonclinical researchers. Average continental distributions were as follows: Europe 63%, North America 19%, South America 6%, Asia 9%, Africa 2%, and Australia 1%. Representation in each round is detailed in [Supplementary Table 1](#). Bar graphs summarizing the professions and affiliations of the authors are also provided in [Supplementary Fig. 1](#). The most common profession was Neurologist (45%) and the most common affiliation was academic researcher (69%).

### 2.2. VICCCS Delphi process

We used a Delphi approach, an iterative structured process involving a series of questionnaires with progressive refinement of questions to achieve consensus among respondents [34]. Only the independent moderator (O.A.S., who did not herself participate in the survey) had access to identification details of the respondents. The anonymity of responses facilitated free expression of opinion throughout the study. Structured feedback of responses after each round informed the nature of subsequent questions, allowing unbiased evolution of group judgments that may be difficult face

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