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A ten year retrospective cohort study of inpatients with younger-onset dementia

Running title: Younger-onset dementia, an Australian context – aetiology and demographics

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A ten year retrospective cohort study of inpatients with younger-onset dementia

Abstract

Objectives: Younger-onset dementia (YOD) refers to a dementia where symptom onset occurs when the patient is less than 65 years of age. YOD is far less common than late-onset dementia (occurring when patients are over 65 years old) and more challenging to diagnose due to its heterogenous presentation. There have been relatively few studies describing demographic and diagnostic characteristics of patients with YOD in the community, particularly with follow-up information.

Methods: A retrospective cohort study was performed of inpatients admitted to a tertiary neuropsychiatry service, located in metropolitan Victoria, Australia from 2009 to 2019. Inpatients with a YOD diagnosis were identified and data regarding diagnosis, demographics and investigations was obtained.

Results: There were 849 individual inpatients who were admitted to the service in the 10-year period and received comprehensive assessment. There were 306 individuals who received a YOD diagnosis, using contemporaneous diagnostic criteria (frequency 36%). The most common diagnoses were Alzheimer's disease (24.2%), frontotemporal dementia (23.1%), Huntington's disease (16.7%) and vascular dementia (7.8%). More than half of these inpatients were followed up and 6.5% had a diagnostic change when reviewed.

Conclusions: This study reports on the largest cohort of YOD to date, with diagnostic breakdown similar to previous retrospective file reviews. The neuropsychiatry service is funded to follow up its patients, thus allowing re-assessment and continuity of care. While there are limitations in this study such as the lack of neuropathological outcomes, the findings emphasise the strengths of follow-up and appropriate service provision for these patients.

Keywords: younger-onset dementia, dementia, neuropsychiatry

Key points: 1. There was a 36% frequency of younger-onset dementia over 10 years, with Alzheimer's disease and frontotemporal dementia being the most common causes of dementia.

2. Repeat assessment of younger-onset patients is important in terms of reviewing diagnostic stability.

3. Despite comprehensive assessment, people were diagnosed with a dementia of unknown aetiology.

Words: 3116

A ten year retrospective cohort study of inpatients with younger-onset dementia

Introduction

There are approximately 27,247 people living with younger-onset dementia (YOD) in Australia [1]. YOD has a heterogenous range of presentations and aetiologies, and is associated with significant delays in diagnosis [2,3]. As symptoms occur before the age of 65, people with YOD are often employed with young families and providing financial support, and the diagnostic delay and uncertainty result in distress and adverse emotional effects on the individual and their families [4].

The prevalence and diagnostic make-up of YOD in Australia remains unclear with no Australia-wide epidemiological data available. The available data is restricted to local [5] and international epidemiological [6,7] and retrospective file reviews. Most recently, Withall et al. [5] reported a prevalence of 68.2 per 100000 in the eastern Sydney region and alcohol-related dementia was cited as the most frequent YOD (18.4%), followed by Alzheimer's disease (AD) (17.7%). Previous prevalence studies have reported a lower rate[6,7] and AD and vascular dementia (VaD) were the most commonly occurring YODs.

Retrospective file reviews contribute to the scientific evidence base by evaluating the clinical disease characteristics and course over time [8]. While not epidemiological samples, they have yielded crucial information on clinical assessment and frequency of the different aetiologies of YOD. The diagnostic "mix" of YOD has varied, with AD and frontotemporal dementia (FTD) being the two most commonly reported YOD diagnoses [9,10]. As well as dementia aetiology, risk factors such as family history of dementia and cerebrovascular risk factors have been investigated [11].

Internationally, there have been no further epidemiological or file review studies in YOD since 2014. There is an urgent need to revise the frequency of the different types of YOD, obtain demographic details and evaluate the need for services. In addition, the studies which have included longitudinal

follow-up of patients reported on diagnostic change [9,11]. This suggests that for the highly heterogeneous YOD group, close follow-up of patients is crucial to monitor diagnostic stability as this can have significant implications on management [12].

The main aim of this paper is to describe the characteristics of YOD patients attending a neuropsychiatry service in metropolitan Victoria, Australia. Specifically, we report on the clinical experience of a dedicated YOD service in order to provide a contemporaneous description of the diagnostic and demographic characteristics of a YOD cohort. A secondary aim was to provide information regarding longitudinal diagnostic changes.

Materials and methods

A retrospective file review of all inpatients who attended Neuropsychiatry, a tertiary specialist service in Melbourne, Australia between 2009 and 2019 was undertaken. This service provides diagnostic input to people with a range of neuropsychiatric presentations and comprises of a six-bed diagnostic inpatient unit and provides outpatient follow-up through several YOD clinics (including specialist Huntington's disease and predictive genetic clinics). Patients receive comprehensive clinical assessments including neuropsychiatry, neurology, allied health and nursing observations. Investigations typically include neuroimaging, blood and cerebrospinal fluid (CSF) analysis. Multidisciplinary clinical reviews are held bi-weekly and diagnoses are made using contemporaneous consensus criteria. Formal feedback and discharge planning is provided to the patient and their family at the end of the assessments. A comprehensive summary is provided to referring clinicians.

The study was approved on 14 November 2017 by the Melbourne Health hospital research ethics committee (2016.038).

Data sources:

1. Comprehensive discharge summaries. An initial list of inpatient admissions who had a discharge diagnosis of dementia was obtained by searching the electronic discharge summaries of all admissions admitted to the inpatient unit from January 1 2009 to September 7 2019 (n=1097). The Hospital International Classification of Diseases Adapted codes for discharge diagnoses of "dementia" and for other neurodegenerative disorders were used. These terms included "cognitive impairment", "Alzheimer's disease", "frontotemporal dementia" and "Huntington's disease" (see Table 1 Supplementary materials).
2. A database (maintained weekly) listing all the inpatients and their discharge diagnoses. SL searched this database manually to ascertain whether the electronic search had missed any additional dementia diagnoses, obtaining the details of individual patients who had their "index" admission to the unit from the above dates.

Detailed clinical information was collected.

The relevant contemporaneous consensus criteria for dementia was used to establish the diagnosis of dementia. This included for AD, the NINCDS-ADRA or NIA-AA for AD [13]; consensus criteria for behavioural-variant FTD [14]; the McKeith criteria for dementia with Lewy Bodies [15]; and NINDS-AIREN criteria for VaD [16]. Neuromaging details such as results of structural magnetic resonance imaging (MRI), positron emission tomography (PET) and single photon computed tomography (HMPAO-SPECT). Other investigations such as CSF biomarkers such as α-βeta 1-42, total tau and phosphorylated tau levels and genetic testing.

Psychiatric diagnoses were made/confirmed/refuted by the treating psychiatrist (depending on what diagnosis had made previously) and according to the DSM-IV or V criteria depending on the year. It was noted if a "new" diagnosis of a psychiatric disorder had occurred, with "new" being defined as within 10 years of the eventual dementia diagnosis [17]. Cognitive testing using the Neuropsychiatry Unit Cognitive Assessment tool (NUCOG). This assesses the five major cognitive domains: attention,

memory, visuospatial, executive function and language. Scores are out of 100, with higher scores indicating better cognitive function [18]. Function was assessed using the Global Assessment of Functioning (GAF), which rates function from a scale of 1 to 100 [19].

Neurological examination findings as undertaken by a neurologist and the multidisciplinary services used during the inpatient assessment such as allied health (neuropsychology, social work, occupational therapy, speech therapy) were noted. In addition, demographic information and potential risk factors such as family history of dementia and presence of vascular risk factors was collected.

In order to review diagnostic change, we reviewed the inpatients who were followed up by the service (this could have been another inpatient admission, or through outpatients), who had their most recent diagnosis reviewed to determine if there was a change in diagnosis. Conversely, if the patients had previous inpatient admissions (ie. prior to 2009) or previous outpatient appointments (for example, one patient had their index inpatient admission in 2018, but had been seen in the outpatient setting seven years before this inpatient admission), their files were also reviewed to ascertain whether they had a different diagnosis rather than the one which was given during their index admission.

All identifying information was removed before usage and analysis for this manuscript.

Statistical analysis

Statistical Package for the Social Sciences (SPSS), version 24 (IBM Corporation) was used for analyses. Chi-squared analyses were used to compare proportions of categorical variables, with t-tests used for differences in means. Kruskal-Wallis tests were used to compare all continuous data such as age of onset. ANOVA was used to compare continuous data for different groups. Descriptive analyses were used for demographics. Normality was tested using Kolmogorov-Smirnov test and non-parametric tests were used for measures which were not normally distributed.

Results

There were 1097 admissions to the neuropsychiatry inpatient unit from January 1 2009 to September 7 2019. Of these there were 369 repeat admissions of 121 individual inpatients. Of the 849 individual inpatients, 373 had a discharge diagnosis of "dementia". Fifty-two of these 373 patients had symptom onset older than 65 years old and were excluded from further analysis, leaving 321 with a discharge diagnosis of a YOD. After detailed examination of the records of these 321 patients, 15 were found to have been diagnosed with a primary psychiatric diagnosis rather than a dementia and thus excluded, resulting in 306 of the 849 (36%) individual patients diagnosed with YOD (see Figure 1 flow chart).

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Demographics (Table 1)

The mean age at admission was 55.8 years old (SD=9.2, range 31-69 years). Of the 306 YOD inpatients, 51% were men, and 75% came from home prior to being admitted. Sixty percent obtained secondary school education. Almost 60% lived in metropolitan Victoria (58%). The majority of these inpatients were Caucasian (91.4%). The median length of stay in the inpatient unit was 10 days (IQR 7.8-14 days, range 3-109 days).

----------INSERT TABLE 1 HERE----------

Younger-onset dementia diagnostic breakdown (Table 2)

The most common YOD diagnosis was AD (24.2%), followed by FTD (23%), HD (16.7%) and VaD (10.8%). The mean age of symptom onset was 51.0 years old (SD= 13.4; range 20-65 years old), with no differences between men and women (p=0.412). The average duration of diagnostic delay was 3.7 years (SD=2.6). Inpatients diagnosed with Niemann-Pick type C (NPC) had the youngest age of

onset (p<0.0001). The GAF score was most commonly rated as between 31-40 (25%) and 41-50 (31.3%), suggesting that approximately half the inpatients had "some/moderate impairment" and "serious symptoms", respectively. Chi-squared analysis did not reveal any significant differences between the GAF scores for the different YOD groups $\chi(60)=77.945$, p=0.060.

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Clinical assessments

Clinical reviews: All patients were reviewed by a neuropsychiatrist, 96.8% had neurology review and 75.5% had a neuropsychological assessment. Other allied health involvement included occupational therapy (82.4%), social work (66.7%) and speech therapy (32.7%).

Cognitive screening: Using the NUCOG, this was moderate, with an average total score of 68.9 (SD=17.9). There was a significant difference between the total score of inpatients with language-variant frontotemporal dementia (mean score 49.2, SD= 21.2, p=0.0001), with these patients having the most severe cognitive impairment on the NUCOG.

Investigations*:* Ninety-nine patients (32.4%) had a lumbar puncture for CSF analysis. 102 (33.3%) had genetic testing of which 72 (HD=51, NPC=11) (71.3%) yielded a positive result. The majority of inpatients had structural imaging (92.7%) and functional imaging (90.1%).

Risk factors for dementia*:* 26.7% of inpatients had a previous or current history of heavy alcohol intake (n=88). Vascular risk factors (table 2) were present in 63.4% (n=194) of patients. People with VaD had the highest average number of risk factors, 2.8 (SD=1.3), which was significant (p<0.0001), $F(10,205)=9.508$, p<0.0001.

Family history*:* Similar proportions (65%) of inpatients had a family history of dementia or psychiatric disorders. In terms of a "new" psychiatric diagnosis, 39% (n=120) had a new diagnosis of depression, 21.6% (n=66) a new diagnosis of psychosis and 3.6% (n=11) had a new diagnosis of mania or bipolar affective disorder.

Follow up and diagnostic change

More than half (56%, n=170) of the 306 inpatients were followed up in the neuropsychiatry outpatient clinic (end date 7 September 2019) Almost one third of these patients had additional follow-up by other services such as a private specialist or community mental health team. There was a median of four follow-up appointments (IQR 2-9) over a mean period of 366 days (range 1 – 3184 days). For patients who were not followed up by the service, similar proportions were followed up by the community mental health team (16.6%) or private specialists, such as a private psychiatrist or private neurologist (15.8%).

There were 20 inpatients (20/306 = 6.5%) who had a diagnostic change during the 10-year period (Table 3). Seventeen were re-diagnosed from one subtype of dementia to a different subtype of dementia and three were re-diagnosed from a psychiatric disorder to dementia. Eleven of the 20 had a change in dementia diagnosis due to repeat assessments of neuropsychiatry, neuropsychology, allied health and structural and functional imaging. There were three inpatients whose dementia diagnosis was changed to a psychiatric condition after the repeat assessment. With the addition of genetics, four inpatients received a definitive diagnosis (*C9orf72*, *MAPT*, HD and *SPG1* spastic paraplegia). Two patients had repeat assessments, including a lumbar puncture for CSF Alzheimer's proteins, had a subsequent change in diagnosis to AD. Conversely, CSF negative for proteins excluded the diagnosis of AD in two inpatients. One patient was to be included in a trial for behavioural variant-FTD and had an amyloid PET scan as part of the trial. This scan came back positive for amyloid and he was subsequently diagnosed with frontal AD.

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Discussion

This retrospective cohort study aimed to report on the diagnoses of YOD over a 10 year period. We found that 36% of all inpatients referred to a neuropsychiatry service received a diagnosis of a YOD.

This is less than reported by Fujihara et al. [20] and Panygeres et al. [11] who reported frequencies of YOD at 45.3% and 49.5%, respectively. Shinagawa et al. [21] compared YOD and older-onset dementia presenting to their memory clinic, and found a lower frequency of YOD at 27.7%. The differences may be due to the types of patients referred and the service models of the clinics. Fujihara et al. (2004) reviewed consecutive files for six years of patients attending a cognitive clinic, whereas the clinic where Panygeres et al. (2007) and Ferran et al. [9] reviewed files of patients who attended clinics run by neurologists. The neuropsychiatry service is a psychiatry-led clinic and thus receives many more referrals of patients who have psychiatric conditions with possible cognitive and behavioural change. Psychiatric conditions such as schizophrenia can have cognitive change, but this may not be diagnosed as a dementia per se [22].

With regards to YOD aetiology, similar to previous studies (see Table 4), we found the three most common to be AD, FTD (behavioural- and language-variants) and VaD. HD is a relatively rare disorder but was a common aetiology in this study, reflecting this Neuropsychiatry's specialist expertise in the assessment, diagnosis and treatment of HD, with established relationships with Huntington's Victoria, the peak consumer organisation for HD.

We found age of symptom onset to be 51 years old (SD= 13.4), with Ferran et al. [9] and Fujihara et al. [20] also reporting mean age of onset in the early 50s. A prevalence study of YOD in Eastern Sydney found age of onset to be 55 years old (SD=9.5) [5] and a Japanese study reported age of onset of YOD to be 53.4 years old (SD=7.9) [7]. None of the previous studies reported on the age of symptom onset of the different types/diagnoses of YOD.

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An almost 50:50 gender split between men and women diagnosed with YOD was found in this study, similar to others [10,11] and the Eastern Sydney prevalence study [5], but was slightly less compared to Ferran et al. [9] and Fujihara et al. [20]. These two studies have gender results consistent with

epidemiological reports that more men are affected by YOD, compared to more women are affected by older-onset dementia [23].

The second aim was to report on diagnostic stability resulting from follow-up of these inpatients. The changes in diagnoses over the 10 year period presents an interesting scenario. Panegyres et al. (2007) reported on 5 changes; 3 who had an initial diagnosis of FTD were shown to have a psychiatric disorder and one vice versa, and one patient initially diagnosed with AD who was later re-diagnosed with a psychiatric disorder. Ferran et al. (1996) described 183 patients (out of their total of 200) who were re-assessed after 12 months. There were changes in dementia diagnoses, with 22 patients who had AD, VaD and alcohol-related dementia, re-diagnosed with a different type of dementia and depression. There were also 42 patients who had an "unknown" diagnosis and after 12 months, 2 of these continued to have the "unknown" diagnosis.

Similarly, our study reiterates the importance of follow-up assessments for diagnostic stability. We had 6.5% of inpatients who had a diagnostic change, mostly from one type of dementia to another, demonstrating that repeat assessment of neuropsychiatry, cognition and neuroimaging can be helpful in confirmation of or reformulating diagnosis, which has implications for patients, families, and ongoing clinical management and research options. For example, patients who received a re-diagnosis of AD were started on a cholinesterase inhibitor and were referred to a relevant AD clinical trial. We also found 15 patients who initially had a dementia diagnosis, but were re-assessed to have a psychiatric disorder (subsequently excluded from analysis). This emphasises the importance of appropriate diagnosis and service provision in order to be able to follow-up patients over time.

Further adding weight to the need for longitudinal repeat assessments is that our study *still* had 17 inpatients (5.6%) with a diagnosis of dementia NOS, similar to Ferran et al. (1996) who reported 6 patients (6%) who had unspecified dementia. More longitudinal studies of YOD with rigorous follow-up of neuropsychiatry, neuroimaging, biomarkers and cognition will shed more light on the progression and prognosis of YOD has been recommended (Loi et al. 2020). Further research would

include harmonisation of assessment methods in YOD in order to create a national YOD registry. This will yield much more rich data about YOD in order to more easily, timely and accurately diagnose YOD and to monitor epidemiology in order to facilitate best practice guidelines. The utility of new investigative processes such as amyloid-PET and neurofilament light chain is likely to assist in more definitive diagnoses of YOD and accurately distinguishing YOD from non-neurodegenerative and psychiatric disorders [24]. Following these patients over time may also provide information regarding mortality rates in the different types of YOD.

The strengths of this study included the use of updated consensus criteria and a high follow-up rate of the inpatients, however, there were methodological limitations. The search process was dependent on the dementia diagnosis which was annotated and while we attempted to examine as many admissions as possible, some may have been missed. Similarly to previous studies, there were small numbers people with YOD from different ethnicities, so there continues to be a lack of information in YOD in culturally and linguistic diverse populations. In addition, this study was based in a neuropsychiatry service and referral bias may affect the proportions of diagnoses. Although all patients received comprehensive multidisciplinary assessments, multimodal investigations, and diagnoses were based on established diagnostic criteria, other limitations include the lack of follow-up data for the remainder of inpatients we diagnosed with YOD and thus the potential change of diagnosis may be under- or over-estimated. We also lacked a definitive diagnosis from neuropathological confirmation. Additionally, in a retrospective study, not all relevant risk factors have been identified and recorded, potentially affecting any reported associations between risk factor and outcomes. Finally, another limitation is that many health professionals have been involved in patient care, making the measurement of risk factors and outcomes less consistent than that achieved with a prospective study design.

This study reports on the aetiology of YOD and demographic details, with the largest number of YOD cases in the literature. We used comprehensive evaluation, which included neuropsychiatric

examinations, cognitive testing, biomarkers and neuroimaging and current diagnostic criteria. The study also has the additional strength of follow-up which few have reported on. Our findings highlight the multiple types of YOD and the extensive assessment required, using a multidisciplinary team, and the need for follow-up. Findings also support the need for improvement of specialised service provision and policy for people with a suspected YOD to access investigations (including imaging and CSF biomarkers), with the ability to repeat assessments to review diagnosis and provide information about progression of disease.

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The data that support the findings of this study are available from the corresponding author upon reasonable request.

There are no conflicts of interest to declare.

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List of figures and tables

A ten year retrospective cohort study of inpatients with younger-onset dementia

Figure 1. Flow chart of 1097 inpatients from 1 Jan 2009 – 7 September 2019

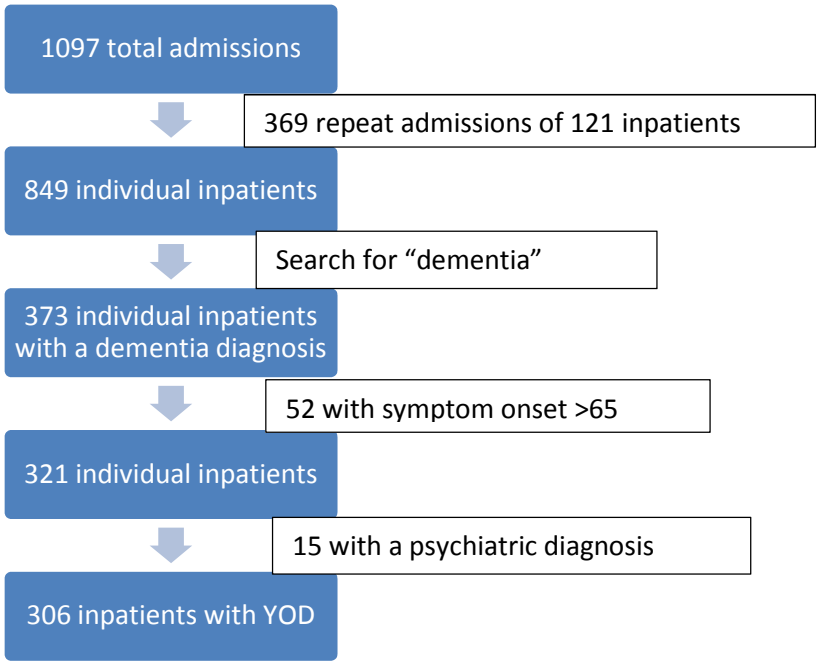

Table 1. Demographics of 306 inpatients diagnosed with younger-onset dementia

	Number (%)	Missing data (%)
Men	156 (51.0)	
Location		3 (1.0)
- Metropolitan	178 (58.2)	
- Rural/regional	101 (33.0)	
- Interstate	24 (7.8)	
Location prior to admission		4.0 (1.3)
- Home	229 (74.8)	
- Hospital	20 (6.5)	
- Psychiatric inpatient unit	27 (8.8)	
- Residential facility	26 (8.5)	
Education		31 (10.1)
- Primary	2 (0.7)	
- Secondary	182 (59.5)	
- Tertiary	90 (29.4)	
- Other (special school)	1.0 (0.3)	

Table 2. Aetiology of younger-onset dementia (YOD) in 306 inpatients

	No. (% of total YOD)	Genetic findings no. (%)	No. males (% of total)	NUCOG mean total score(SD)‡	Mean no. Vascular risk factors (SD)
Alzheimer's disease	74 (24.2)		31	60.5 (16.7)	1.5 (0.8)
- AD	55 (18.0)	*PSEN1* 1 (0.6)	21 (38.2)		
- AD PCA	17 (5.6)		8 (47)		
- Frontal variant AD	2 (0.7)		2 (100)		
Frontotemporal degeneration	71 (23)	6	36 (50.7)		
- Behavioural-variant FTD	46 (15.0)	*HSAN1* 1 (0.6)	22 (47.8)	65.5 (19.3)	1.6 (0.8)
- FTD MND	14 (4.5)	*C9orf72* 5 (1.6)	8 (57.1)	67.5 (15.6)	1.5 (1.0)
- FTD PNFA	5 (1.6)		1 (20)	49.2 (21.2)	2.1 (1.7)
- FTD semantic	6 (2.0)		5 (83.3)		
Huntington's disease	51 (16.7)		19 (37.2)	68 (14.1)	0.7 (0.6)
Vascular dementia	27 (10.8)	*Notch3* 1 (0.6)	17 (62.9)	69 (15.7)	2.8 (1.3)
Asynucleinopathy†	16 (5.2)		8 (50)	72.2 (13.9)	1.5 (0.6)
Alcohol-related dementia	13 (4.2)		11 (84.6)	75.4 (14.3)	1.3 (0.5)
Niemann-Pick type C	11 (3.6)		5 (45.4)	60.1 (20.2)	0.4 (0.5)
Cerebellar degeneration	4 (1.3)		3 (75)		
Corticobasal syndrome	3 (1.0)		2 (66.7)		
PSP	2 (0.7)		0		

Other[§]	17 (5.6)	*CSF1R, SPG1*	13 (76.5)		
Dementia NOS	17 (5.6)		11 (64.7)	66.1 (17.4)	1.5 (1.1)

‡includes Parkinson's disease dementia (n=12) and dementia with Lewy bodies (n=4)

[†]mean NUCOG scores not calculated for cerebellar degeneration, corticobasal syndrome and PSP due to small numbers

[§] includes adrenoleukodystrophy (n=2) multiple sclerosis (n=2) and HIV-related dementias (n=2)

AD Alzheimer's disease; CBS corticobasal syndrome; FTD frontotemporal dementia; MND motor neuron disease; PCA posterior cortical atrophy; PNFA progressive non-fluent aphasia; PSP progressive supranuclear palsy; VaD vascular dementia; NOS not otherwise specified

Table 3. Reallocation of diagnoses from initial to final diagnoses

Initial diagnoses (n)	Follow-up diagnoses							
	AD	VaD	bv-FTD	Other FTD‡	Genetic	DLB, PDD, MSA	Other dementia¶	Dementia NOS
AD (5)				1		2	1	1
bv-FTD (6)	2	1		1	(*SPG1, C9orf72*)		1	1
DLB, PDD, MSA (1)			1		(*MAPT*)			
Other dementia[†] (2)			1			1		
Dementia NOS (3)	1	1					1	
Psychiatric[§] (3)			1	1			1	

[†]includes corticobasal syndrome (n=1), progressive supranuclear palsy (n=1)

‡ includes FTD semantic (n=1), FTD motor neuron disease (n=2)

[§] includes psychotic depression (n=1) and depression (n=2)

¶ includes spastic paraplegia (n=1), vasculitis (n=1), Huntington's disease (n=1), corticobasal syndrome (n=1)

AD Alzheimer's disease, ; bvFTD behavioural-variant frontotemporal dementia; DLB dementia with Lewy bodies; FTD frontotemporal dementia; MSA multiple system atrophy; NOS not otherwise specified' PDD Parkinson's disease dementia; VaD vascular dementia

Table 4. Comparison of aetiologies and demographics to other YOD file reviews

	This study¶	Panegyres & Frencham 2007¶	Shinagawa et al. 2006	Fujihara et al. 2004	McMurtray et al. 2006	Ferran et al. 1996†¶	Kelley et al. 2008
Location	Australia	Australia	Japan	Brazil	United States	United Kingdom	United States
Number	306	112	185	141	278	200	235
% YOD	36.0	49.5	27.7	45.3	29.3		31.1
Age range	33-69	<65	<65	21-65	<65	25-71	17-45
Age onset (mean, SD)	51.0 (13.4)	NR	NR	51 (11.4)	51.5 (10.8)	52.6 (9.4)	34.7 (7.9)
Age at admission (mean, SD)	55.8 (9.2)	NR	58.3 (11.0)	53.3 (12.1)	56.5 (9.8)	56 (9.3)	36.7 (7.8)
Aetiology, raw no. (%)							
AD	74 (24.3) ‡	29 (25.9)‡	(38.5)	31 (21.3)	48 (17.3)	54 (27.0)	4 (1.7)
FTD (bv+lang)	62 (20.2)	43 (38.4)	(21.4)	7 (5.0)	7 (2.5)	7 (4.0)	31 (13.2)
VaD	24 (7.8)	7 (6.3)	(12.6)	52 (36.9)	80 (28.8)	33 (17.0)	3 (1.3), 14 (5.9)§
HD	51 (16.7)	Excluded	NR	NR	4 (1.4)	NR	18 (7.7)
ARD	13 (5.6)	6 (5.4)	NR	7 (5.0)	15 (5.4)	12 (6.0)	1 (0.4)
DLB	4 (1.3)	1 (0.9)	(0.5)	NR	NR	4 (2.0)	1 (0.4)

†reviewed 200 consecutive files

‡includes posterior cortical atrophy and frontal-AD

§Three patients with VaD and total of 14 had vascular disease

¶ studies which followed up some patients with YOD

YOD younger-onset dementia; AD Alzheimer's disease; FTD frontotemporal dementia; VaD vascular dementia; HD Huntington's disease, ARD alcohol-related dementia; DLB dementia with Lewy bodies; NR not reported