

Data supplement to van der Linde et al. Longitudinal course of behavioural and psychological symptoms of dementia: systematic review. Br J Psychiatry doi: 10.1192/bjp.bp.114.148403

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Fig DS1 Overview of the search terms

DEPRES	ANXIETY	APATHY	SLEEP	IRRITABI	PSYCHO	WANDER	ELATION	AGITATI	BPSD
<p><b>MeSh</b> Depressive disorder Depression</p> <p><b>Text[ti ab]</b> dysphoria depression depressive  depressed</p>	<p><b>MeSh</b> Anxiety disorders Anxiety</p> <p><b>Text[tiab]</b> anxiety anxious</p>	<p><b>MeSh</b> Apathy</p> <p><b>Text[tiab]</b> Apathy "lack of interest"</p>	<p><b>MeSh</b> Sleep disorders Sleep Sleep Apnea, Obstructive Sleep Initiation and Maintenance Disorders</p> <p><b>Text[tiab]</b> Sleep</p>	<p><b>MeSh</b> Irritable mood</p> <p><b>Text[tiab]</b> irritability lability "mood change" "mood changes"</p>	<p><b>MeSh</b> Psychotic disorders Delusions Paranoid behavior Hallucinations</p> <p><b>Text[tiab]</b> psychosis psychotic delusion delusions delusional hallucination hallucinations misidentification</p>	<p><b>MeSh</b> Wandering behavior</p> <p><b>Text[tiab]</b> wandering stalking "getting lost" Aberrant motor behaviour</p>	<p><b>MeSh</b> Euphoria</p> <p><b>Text[tiab]</b> euphoria elation disinhibition laughter</p>	<p><b>MeSh</b> Psychomotor agitation Aggression Anger</p> <p><b>Text[tiab]</b> agitation agitated aggression rage "catastrophic reactions" anger angry complaining negativism screaming</p>	<p><b>Text[tiab]</b> "neuropsychiatric symptoms" "neuro-psychiatric symptoms" "psycho-behavioral symptoms" "psycho-behavioural Symptoms" "psychiatric symptoms" "Behavioral symptoms" "behavioural symptoms" "psychological symptoms" "disruptive behaviour" "disruptive behaviour" "noncognitive symptoms" "non-cognitive symptoms" "neuropsychological symptoms" "bpsd"</p>
<p><b>AND Dementia:</b> Dementia [Mesh] OR dementia* [tiab] OR alzheimer* [tiab] OR "lewy body" [tiab] OR "lewy bodies"[tiab] OR frontotemporal [tiab]</p>									
<p><b>AND Longitudinal study:</b> Longitudinal studies [Mesh] OR longitudinal[tiab] OR prospective[tiab] OR "follow-up study"[tiab]</p>									

Depres: Depressive symptoms; Sleep: sleep problems; Irritabi: Irritability; Psycho: Psychosis; Wander: Wandering; Agitati: Agitation; BPSD=Behavioural and Psychological Symptoms of Dementia

Note: Shown are the search terms used in Pubmed, the Mesh terms used in the other literature databases may differ slightly.

**Table DS1 Characteristics of included studies**

	Author	Year	Setting	Details setting	Reports	Months follow-up	n BPSD measures	Time between measures (months)	n at baseline	n with complete follow-up	Baseline MMSE	Dementia type	Age minimum	Age mean	BPSD instrument	Interview	BPSD
<b>Mild dementia (MMSE 21-26)</b>																	
22	Eustace	2002	DC	National referral centre for people with memory disorders, Ireland	Per, Inc	24	3	12	216	52	21.6	AD	NR (SD 7.8)	73.3	BEHAVE-AD	INF	Dep, Anx, Irr, Agi/Wan, Hal, Del, Sle
16	Clare	2012	DC	Memory clinics in North Wales, UK	Per	20	3	8-12	101	51	24.2 (18+)	AD, VD, mixed		78.7	HADS; NPI	INF	Dep, Anx, Total score
52	Tschanz	2011	PB	Cache County Study, USA	Per	Mean 3.8 yrs., max 12.9 yrs.	Mean 1.9	NR	328	33%	21.9	AD		85.9	NPI	INF	Total score
<b>Moderate dementia (MMSE 15-20)</b>																	
39	Levy	1996	NR	NR (clinical trial), USA	Per, Inc	12	5	3	215	181	20	AD	51	70.8	ADAS	INF	Dep, Agi/Wan, Psy
8	Berger	2005	DC	Outpatient Memory Clinic of university, Germany	Per, Inc	24	5	3-6	45	18	20	NR	48	70.6	BEHAVE-AD	CLIN?	Dep, Anx, Hal, Del, Irr, Agi/Wan, Sle
29	Holtzer <sup>1b</sup>	2005	DC	3 sites in USA and 2 sites in Europe (Paris and Greece) (1b)	Cog	max: 14 yrs.	max: 28	6	536	130 (5 yrs.)	NR	AD		74	CUSPAD	INF	Dep
51	Scarmeas <sup>1b</sup>	2007	DC	See 1b	Per, Cog	max:14 yrs.	max:25	6	497	NR	16+	AD	49	74	CUSPAD	NR	Agi, Irr, Wan
50	Scarmeas <sup>1b</sup>	2002	DC	See 1b	Inc	max: 9.3 yrs. (mean 5.5 yrs.)	NR	6	87	NR	NR	AD		70.7	CUSPAD	INF	Dep, Behavioural (Agi, Wan, Irr) , Hal, Del
20	Devanand <sup>1a</sup>	1997	DC	3 medical centres, USA (1a)	Per, Inc	5 yrs. (mean 3 yrs.)	7	6	235	137	NR	AD	82.1% 65+	73.1	CUSPAD	INF	Dep, Irr, Agi/Wan, Hal,Del, Mis
28	Holtzer <sup>1a</sup>	2003	DC	See 1a	Per, Inc, Cog	5 yrs.	11	6	236	102	NR	AD		72.7	CUSPAD	INF	Irr, Agi/Wan, Hal, Del
24	Garre-Olmo	2010	DC	Memory Clinic of hospital, Spain	Per	24	5	6	491	253	NR	AD	48	75.2	NPI	INF	Apa, Dep, Anx, Irr, Agi/Wan, Hal, Del, Sle, Eat, Dis
1	Aalten <sup>2</sup>	2005	DC	Outpatients of Memory Clinic of University Hospital, or psychiatry clinic, The Netherlands (2)	Per, Inc	24	5	6	199	99	18.1	AD, VD, LBD, mixed	53	76.4	NPI	INF	Apa, Dep, Anx, Irr, Agi/Wan, Hal, Del, Sle, Ela, Eat, Dis

2	Aalten <sup>2</sup>	2005	DC	See 2	Per, Cog	24	5	6	199	99	18.1	AD, VD, LBD, mixed	53	76.4	NPI	INF	Apa, Dep, Anx, Irr, Agi/Wan, Del, Hal, Sle, Ela, Eat, Dis
25	Gillette-Guyonnet	2011	DC	16 memory clinics in France, community dwelling	Inc	max 48	mean 5.1	6	686	207	20.0 (10-26/30)	AD		77.9	NPI	INF	Apa, Dep, Anx, Irr, Agi/Wan, Sle, Hal, Del, Ela
59	Zahodne	2013	DC	Outpatient clinics and clinical research centres at 3 sites in USA and 1 in France	Per, Cog	5.5 yrs.	mean 10.1	6	509	167	NR	AD		74.2	CUSPAD	INF	Dep
49	Rosen	1991	DC	Ambulatory care setting, living in the community, USA	Per, Inc	6 yrs.	7	1 yr.	32	7 at least 3 assessments	15.5	AD	NR (SD 7.9)	70.3	DSMIII	INF + PAR	Hal, Del
48	Paulsen	2000	DC	Alzheimer's Disease Research Centre of University, USA	Inc	Until death, reported for 5 yrs.	5	1 yr.	329	NR	NR	AD	NR (SD 6.4-7.7.7)	72.6	DIS for the DSMIII	INF	Hal, Del
56	Wilkosz	2006	DC	Alzheimer disease research centre of University, USA	Inc	mean: 25.8	NR	1 yr.	NR	288 at least 1 follow-up	20.09	AD or MCI	38	74.3	CERAD	INF	Hal, Del
<b>Moderately severe dementia (MMSE 10-14)</b>																	
19	Deudon	2009	CH	Nursing homes in 2 regions, France	Per	3	3	1 or 2	132	114	12.1	Not reported	NR (SD 6.7)	86	CMAI, NPI and Observation Scale	INF	Agi, Irr, Psy, Hyperactivity (Wan, Ela, Irr)
23	Fauth	2006	NR	Community outreach and in-home respite programs (control group only), USA	Per	3	4	1	85	NR	13.3	Not reported	NR (SD 8.8)	79.6	Daily record of behaviour (DRB)	OBS	Dep, Agi/Wan, Irr, Sle, Total score
6	Ballard <sup>3</sup>	1996	CLIN/DC	Old-age psychiatry services and a memory clinic, UK (3)	Per, Inc	12	12	1	124	89	NR	AD, VD, DLB	NR	79.7	Cornell scale	INF + PAR	Dep
5	Ballard <sup>3</sup>	1997	CLIN/DC	See 3	Per, Inc	12	12	1	125	87	NR	AD, VD, DLB	NR	79.9	Burn's symptom checklist	NR	Psy
35	Keene <sup>5</sup>	1999	CLIN	Recruited through local general practitioners, community psychiatric nurses and consultant old-age psychiatrists, UK (5)	Per	max: 10 yrs.	30	4	99	NR (n=88 followed until death)	NR	AD, VD		NR	PBE	INF	Irr
31	Hope <sup>5</sup>	2001	CLIN	See 5	Cog	max: 9 yrs.	mean:10.5	4	86	NR (n=77 until death of which 75 >1yr)	NR	AD, VD		NR	PBE	INF	Wan
44	McShane <sup>5</sup>	1995	CLIN	See 5	Per, Cog	max: 5 yrs. (until death)	NR	4	98	41 (who had died)	13	AD		NR	PBE	INF	Hal
30	Hope <sup>5</sup>	1999	CLIN	See 5	Per	max: 9 yrs.	NR	4	100	48 (at least 1 yr.)	14	AD, VD, mixed, other	60	78	PBE and Past behavioural history	INF	Dep, Anx, Irr, Hal, Del, Sle, Wan, Eat

															interview			
45	McShane <sup>5</sup>	1998	CLIN	See 5	Inc, Cog	max: 4 yrs. (until death)	NR	4	86	80 (>4yrs or until death)	15	AD, VD, DLB, Other		77	PBE	INF	Dep, Anx, Irr, Hal, Del	
4	Asada	1999	DC + VOL	Outpatients at clinic, voluntary patients whose caregivers were members of a self-help network and patients identified by formal service providers, Japan	Cog	5 yrs.	6	12	103	31	NR	AD	NR (SD 8.7)	79.4	Troublesome behaviour scale (TBS)	INF	Agi/Irr factor, Wan factor	
47	Neundorfer	2001	DC	University hospitals, Alzheimer disease research centre, USA	Per	max:5 yrs.	max:10	12	353	NR	NR	AD, other	50	73	CERAD	INF	Dep	
43	McCarty	2000	DC	Memory Disorders Clinic at University, USA	Cog	24	3	12	150	61	13.52	AD	56	74.2	Memory and Behaviour Problem Checklist-Revised	INF	Apa factor; Dep/Anx/Agi/Wan/Irr factor	
26	Haupt <sup>4</sup>	1996	DC	Outpatient Clinic of University, Germany (4)	Cog	24	3	12	90	61	NR	AD	57	74.3	BEHAVE-AD	INF + PAR	Hal, Del	
27	Haupt <sup>4</sup>	2000	DC	See 4	Per, Inc	24	3	12	90	60	13.5	AD	57	73.4	BEHAVE-AD	INF + PAR	Dep, Anx, Irr, Agi/Wan, Hal, Del	
14	Chang	2004	DC	Memory clinic for veterans, Taiwan	Inc	mean: 51.9	NR	NR	56	NR (>1 visit)	NR	AD	NR (SD 8.8)	74.2	SCID DSM IIIR	INF + PAR	Dep, Hal, Del	
<b>Severe dementia (MMSE 0-9)</b>																		
55	Wetzels	2010	CH	Dementia special care units from nursing homes, The Netherlands	Per, Inc	24	5	6	290	117	7.6	AD, VD	NR (SD 7.4)	81.7	NPI nursing home version	INF	Apa, Dep, Anx, Irr, Agi/Wan, Hal, Del, Sle, Ela, Eat, Dis	
12	Burgio	2007	CH	Nursing homes, USA	Per, Cog	18	4	6	78	55	8	AD, VD, mixed, uncertain	59.8	82.2	Modified NHBPS and observation	INF + OBS	Irr	

18	de Rooij	2012	CH	5 long-term care settings in The Netherlands and Belgium	Per	12	3	6	179	126	S-MMSE 6.1	Not reported	NR	85.9	QUALIDEM	INF	Dep, Agi
<b>Normal cognitive function (MMSE 27+, no dementia)</b>																	

37	Kohler	2010	POP	Collaborative network of family practices, the Netherlands	Per, Inc, Cog	6	3	3	598	412	27.7 (MMSE<24 excluded)	Not reported	60	69.4	Symptom Checklist	NR	Dep
7	Becker	2009	POP	Non-institutionalised individuals from the Part A Medicare list, USA	Cog	max: 9 yrs.	9	12	441	288 (at least 3 measures)	NR (cognitively normal at baseline)	AD	70	77.5	CES-D	NR	Dep
53	Vinkers	2004	POP	Population-based study of all 85 year old inhabitants of city, The Netherlands	Cog	4 yrs.	5	12	500	298	27 (MMSE<19 excluded)	Not reported	All aged 85	85	GDS15	NR	Dep
3	Amieva	2008	POP	Population-based sample of community dwelling individuals, France	Cog	max: 14 yrs.	7	12-36	350 who developed AD and 350 control	25 AD and 24 control	NR Dementia free at baseline, those who developed dementia during follow-up compared to control.	AD	65	86.2	CES-D	NR	Dep
58	Wilson	2010	POP	Census of a geographically defined region of city, USA	Cog	max: 8-9 yrs.	mean:3.6/4.0	36	357+340	NR (100% / 90% "longitudinal data")	Initially dementia free; 20.4 at dementia diagnosis	AD	65	82.5	CES-D (10-item) and Hamilton Depression Rating Scale (0-35)	INF + PAR	Dep
9	Bielak	2011	POP	Electoral role Australian citizens, Australia	Cog	max: 15 yrs. (mean: 6.0 yrs.)	5	2-6yrs	1,206	NR	NR (without dementia)	Not reported	70	78.16	CES-D	PAR	Dep
32	Houde	2008	DC	Memory Clinic of university General Hospital, Canada	Cog	max: 10 (mean: 4.3 yrs.)	max:11	1	60	NR	27.2 (MCI)	MCI, AD	55	74.5	GDS	NR	Dep
21	Dotson	2008	VOL	Community dwelling generally healthy group of volunteers, USA	Cog	max 26 yrs. 9mean: 4.4 yrs.)	NR	24	1,586	NR	28.65 (without dementia)	Not reported	50	65.4	CES-D	PAR	Dep
41	Mackin	2011	VOL	Alzheimer's Disease Neuroimaging Initiative, USA and Canada	Per, Cog	3 yrs.	4	12	405	227	27.2 (MCI)	MCI	NR	74.9	GDS	NR	Dep
57	Wilson	2008	OTHER	Older Catholic nuns, priests and brothers, USA	Cog	max: 13 yrs.	mean:7.8	24	917	23 (13yrs; 5+yrs: 630)	27.4 No dementia at baseline, some developed	MCI, AD	65	74.8	CES-D	PAR	Dep

												AD during follow-up						
<b>Comparing cognitive groups</b>																		
33	Janzing	2000	CH	6 homes for the elderly in the specified region, The Netherlands	Cog	12	3	6	201	121 (49 dem)	18.2 (moderate dementia) and 26.7 (normal)	Not reported	NR (SD 5.3; 6.5)	86.6 (dem); 82.6 (normal)	GMS AGECAT	PAR?	Dep	
10	Blansi	2005	DC	Memory Clinic of University Hospital and control sample, Switzerland	Cog	max: 3-4 yrs.	3-4	12	662 (217 dem)	36 (dem 4+ visits)	26.1 (AD, 24+); 28.8 (control)	AD	50	73.4	NOSGER	INF	Dep, Disturbing behaviour	
40	Li	2001	DC + VOL	Cognitively impaired outpatients and cognitively normal volunteers, USA (76% treated with antidepressant medication)	Per, Inc	max 7.8 yrs. (mean 3.5 yrs.)	NR	3-12	294 (129 dem)	239 (3+ visits, 93 dem)	17 (moderate dementia); 29 (normal); 26.1 (MCI)	MCI, AD, VAD	50	76.5	HDRS	PAR	Dep	
11	Bunce	2012	PB (community)	Aged 70 and over living in the community in Canberra or nearby, Australia	Cog	max: 12 yrs.	max 4	4yrs	837-870	95	NR	Not reported	70	76.6	Goldberg Depression and Anxiety Scales	PAR	Dep, Anx	
<b>Dementia severity not reported</b>																		
36	King-Kallimanis	2010	CH	Veterans Administration nursing homes, USA	Per, Inc	4 yrs. (mean 390/297 days)	mean:4	3	6,673	NR	NR	Not reported	24	72.5	Minimum dataset	NR	Wan	
54	Volicer	2012	CH	8 nursing homes, The Netherlands (retrospective Minimum Dataset analysis)	Per	15	4	3	1101	1101	NR	AD, other, mixed	65	84.2	Minimum dataset	NR	Agi/Wan	
46; 38	Morgan; Kunik	2012	DC	Veterans administration outpatient data files, flyers, radio and print advertisements and the primary care and geriatrics clinic (94% male), USA	Inc	24	7	4	171	NR	NR	Not reported	60	75.8	CMAI	INF	Irr	

17	Cohen-Mansfield	1998	CH?	Community dwelling, senior day care centres in Maryland, USA	Per, Cog	24	5	6	200	104	NR	AD, VD, PD, unknown, no diagnosis	60	79.2	CMAI-C	INF	Irr, Agi
15	Chen	1991	DC	Patients presenting for evaluation of dementia in a clinical practice, USA	Inc	mean 5 yrs.	2 or more	6	72	NR (29 followed until death)	NR	AD	At onset AD: 64.1, mean duration at baseline: 3.0 years	NR	DSMIII-R	INF + PAR	Psy
34	Jost	1996	DC	Autopsy confirmed AD patients enrolled in a regional brain bank through a university geropsychiatry clinic and by clinicians and caregivers in surrounding communities, USA	Inc	Retrospective using medical records		Retrospective	Retrospective	100	NR	AD	NR	NR	Medical record review		Dep, Anx, Irr, Hal, Del, Sle
42	Marin	1997	DC	Alzheimer's disease Research Centre, USA	Cog	mean 37.1	mean:6.0	6	201	153 (12+ months)	NR	AD	50	86.6	ADAS	INF	Dep, Irr, Agi, Agi/Wan, Hal, Del, Total score
13	Caligiuri	2003	NR	NR, USA	Inc	24	3	12	54	NR	NR	AD	NR (SD 8.6)	77.1	BEHAVE-AD	INF	Hal, Del



Reference numbers refer to the Online Reference List

**Papers from the same study groups:**

1a Predictors study 1: Columbia Medical Centre, John Hopkins University School of Medicine, Massachusetts General Hospital, USA

1b Predictors study 2: 3 centres in USA (see 1a) and 2 centres in Europe (Paris and Greece)

2 Maasbed study

3 Ballard et al. (Psychiatry services in the West Midlands and a memory clinic in Bristol)

4 Haupt et al. (Outpatient clinic at the institute of psychiatry of the Technical University in Munich)

5 Hope et al. (Oxford)

**Reports on:**

Per=Persistence

Inc=Incidence

Cog=Association with cognitive function

**Settings**

DC=Dementia or memory clinic

POP=Population-based

CH=Care home

CLIN=Referred by clinicians

VOL=Volunteers

NR=Not reported

**Data collection**

INF=Informant-based

PAR=Participant-based

OBS=Observation

BPSD= behavioural and psychological symptoms of dementia

Apa=apathy

Dep=depression

Anx=anxiety

Irr=irritability/aggression

Agi=agitation

Hal=hallucination

Per=persecution

Mis=misidentification

Sle=sleep problems

Wan=wandering

Ela=elation

AD=Alzheimer's disease

VD=Vascular Dementia

DLB=Dementia with Lewy Bodies

MCI=Mild Cognitive Impairment

PD=Parkinson's Disease

NR=not reported

MMSE=Mini Mental State Examination

**Table DS2 Definition and baseline prevalence of BPSD**

**Affective symptoms**

	Author	Year	Instrument	Depression / Anxiety / Apathy	Prevalence (%)
				Definition	
<b>Mild dementia (MMSE 21-26)</b>					
22	Eustace	2002	BEHAVE-AD	<b>Dep:</b> Tearfulness and other depressed mood (e.g. death statements) with or without clear affective or physical components <b>Anx:</b> Anxiety about upcoming events, other anxieties, fear of being left alone, other phobias	Dep: 33 Anx: 52
16	Clare	2012	HADS; NPI total	<b>Dep:</b> 8 items including a loss of interest, laughing less, being less cheerful, being less optimism, and not being hopeful about the future <b>Anx:</b> 8 items including about feeling tense, worrying, panic attacks, feeling something awful is about to happen	NR
<b>Moderate dementia (MMSE 15-20)</b>					
39	Levy	1996	ADAS	<b>Dep:</b> Tearfulness and depression	Dep: 23
8	Berger	2005	BEHAVE-AD	<b>Dep:</b> Tearfulness and other depressed mood (e.g. death statements) with or without clear affective or physical components <b>Anx:</b> Anxiety about upcoming events, other anxieties, fear of being left alone, other phobias	Dep median 0.5 Anx median 0.0
29	Holtzer <sup>1b</sup>	2005	CUSPAD	<b>Dep:</b> Depressed mood (sad, depressed, blue, down in the dumps), difficulty sleeping and change in appetite	Dep: 40
50	Scarmeas <sup>1a</sup>	2002	CUSPAD	<b>Dep:</b> Depressed mood (sad, depressed, blue, down in the dumps), difficulty sleeping and change in appetite	Dep: 43.7
20	Devanand <sup>1a</sup>	1997	CUSPAD	<b>Dep:</b> Depressed mood (sad, depressed, blue, down in the dumps), difficulty sleeping and change in appetite	Dep: 25.1
24	Garre-Olmo	2010	NPI-10	<b>Dep:</b> Includes seeming sad or depressed, saying or acting as if sad or in low spirits <b>Anx:</b> Includes being very nervous, being worried, or frightened, being tense <b>Apa:</b> Loss of interest, more difficult to engage, apathetic or indifferent	Dep: 43.8 Anx: 31.2 Apa: 51.3
1	Aalten <sup>2</sup>	2005	NPI	<b>Dep:</b> Includes seeming sad or depressed, saying or acting as if sad or in low spirits <b>Anx:</b> Includes being very nervous, being worried, or frightened, being tense <b>Apa:</b> Loss of interest, more difficult to engage, apathetic or indifferent	Dep: 35.2 Anx: 21.1 Apa: 40.2
2	Aalten <sup>2</sup>	2005	NPI	<b>Mood/apathy cluster:</b> depression, apathy, night-time behaviour disturbances and eating abnormalities (See Aalten <sup>2</sup> )	See Aalten <sup>2</sup>
25	Gillette-Guyonnet	2011	NPI	<b>Dep:</b> Includes seeming sad or depressed, saying or acting as if sad or in low spirits <b>Anx:</b> Includes being very nervous, being worried, or frightened, being tense <b>Apa:</b> Loss of interest, more difficult to engage, apathetic or indifferent	Dep: 20.6 Anx: 23.9 Apa: 43.0
59	Zahodne	2013	CUSPAD	<b>Dep:</b> Depressed mood (sad, depressed, blue, down in the dumps), difficulty sleeping and change in appetite	Mean 0.74 (0-4)
<b>Moderately severe dementia (MMSE 10-14)</b>					
23	Fauth	2006	Daily record of behaviour (DRB)	<b>Dep:</b> Mood, include crying and being tearful	NR
6	Ballard <sup>3</sup>	1996	Cornell scale	<b>Dep:</b> Sadness, sad expression, sad voice, tearfulness, lack of reactivity to pleasant events	Dep: minor 23.6; major 23.6
30	Hope <sup>5</sup>	1999	PBE and Past behavioural history interview	<b>Dep:</b> Apparent sadness, appearing to be particularly sad, miserable or depressed <b>Anx:</b> Anxiety or fearfulness (with physical symptoms)	NR
45	McShane <sup>5</sup>	1998	PBE	<b>Dep:</b> Apparent sadness, appearing to be particularly sad, miserable or depressed <b>Anx:</b> Anxiety or fearfulness (with physical symptoms)	Dep: 27.9 Anx: 16.3

47	Neundorfer	2001	CERAD	<b>Dep:</b> Feelings of anxiety, sad appearance, hopelessness, crying, feelings of guilt, poor self-esteem and feelings that life is not worth living	NR
43	McCarty	2000	Memory and Behaviour Problem Checklist-Revised	<b>Apathy cluster:</b> forgetting the day, can't self-start activities, unable to keep busy, following people, spends time inactive, talking little or none, sad/depressed	mean 1.34 (0.66) of max 3.00
27	Haupt <sup>4</sup>	2000	BEHAVE-AD	<b>Dep:</b> Tearfulness and other depressed mood (e.g. death statements) with or without clear affective or physical components <b>Anx:</b> Anxiety about upcoming events, other anxieties, fear of being left alone, other phobias	Dep: 57 Anx: 35
14	Chang	2004	SCID DSM IIR	<b>Dep:</b> SCID diagnosis	
<b>Severe dementia (MMSE 0-9)</b>					
55	Wetzels	2010	NPI nursing home version	<b>Dep:</b> Includes seeming sad or depressed, saying or acting as if sad or in low spirits <b>Anx:</b> Includes being very nervous, being worried, or frightened, being tense <b>Apa:</b> Loss of interest, more difficult to engage, apathetic or indifferent	Dep: 8.5 Anx: 17.1 Apa: 18.8
18	de Rooij	2012	QUALIDEM	<b>Dep:</b> negative affect	NR
<b>Normal cognitive function (MMSE 27+, no dementia)</b>					
37	Kohler	2010	Symptom Checklist	<b>Dep:</b> As in Symptom Checklist	Dep: 22 scored high
7	Becker	2009	CES-D	<b>Dep:</b> Includes depressed affect, positive affect, somatic complaint, interpersonal problem	NR
53	Vinkers	2004	GDS15	<b>Dep:</b> Satisfaction with life, dropping activities and interests, feeling life is empty, being bored, not being hopeful about future, being bothered by thoughts, not being in good spirits, being afraid, feeling less happy, feeling helpless, being restless, not going out, worrying, memory problems, feeling downhearted and blue, feeling worthless, being less excited, having less energy, feeling upset, crying, difficulty concentrating, not enjoying getting up, avoiding social gathering, being less decisive, not having a clear mind	Dep: Median score: 2, score 2 or less: 67%
3	Amieva	2008	CES-D	<b>Dep:</b> Includes depressed affect, positive affect, somatic complaint, interpersonal problem	NR
58	Wilson	2010	CES-D (10-item) and Hamilton Depression Rating Scale (0-35)	<b>Dep:</b> Includes depressed affect, positive affect, somatic complaint, interpersonal problem (CES-D) and depression, anxiety, insomnia, somatic complaint (HDRS)	Dep: Median CES-D score: 1.0; median HDRS score 2.0
9	Bielak	2011	CES-D	<b>Dep:</b> Includes depressed affect, positive affect, somatic complaint, interpersonal problem	Mean 50.1
32	Houde	2008	GDS	<b>Dep:</b> Satisfaction with life, dropping activities and interests, feeling life is empty, being bored, not being hopeful about future, being bothered by thoughts, not being in good spirits, being afraid, feeling less happy, feeling helpless, being restless, not going out, worrying, memory problems, feeling downhearted and blue, feeling worthless, being less excited, having less energy, feeling upset, crying, difficulty concentrating, not enjoying getting up, avoiding social gathering, being less decisive, not having a clear mind	Dep: 52
21	Dotson	2008	CES-D	<b>Dep:</b> Includes depressed affect, positive affect, somatic complaint, interpersonal problems	NR

41	Mackin	2011	GDS	<b>Dep:</b> Satisfaction with life, dropping activities and interests, feeling life is empty, being bored, not being hopeful about future, being bothered by thoughts, not being in good spirits, being afraid, feeling less happy, feeling helpless, being restless, not going out, worrying, memory problems, feeling downhearted and blue, feeling worthless, being less excited, having less energy, feeling upset, crying, difficulty concentrating, not enjoying getting up, avoiding social gathering, being less decisive, not having a clear mind	Dep: 55
57	Wilson	2008	CES-D	<b>Dep:</b> Includes depressed affect, positive affect, somatic complaint, interpersonal problems	Dep: 23.9 reporting 1, 9.7 reporting 2, 6.1 reporting 3 and 6.8 reporting 4 or more
<b>Comparing cognitive groups</b>					
33	Janzing	2000	GMS AGE CAT	<b>Dep:</b> Subcase or depressive case	Dep: Dementia - Depressive case: 12.2, subcase 20.4
10	Blansi	2005	NOSGER	<b>Dep:</b> Mood	NR
40	Li	2001	HDRS	<b>Dep:</b> HDRS>7 and "motivationally related depressive symptoms", including loss of interest, fatigue, retardation, loss of energy and general somatic symptoms	Dep: AD: 32.4; VAD: 29.7
11	Bunce	2012	Goldberg depression and anxiety scale	<b>Dep:</b> 9 items including about energy, interest, confidence, hope, concentration, slowing, weight and waking <b>Anx:</b> 9 items including being on edge, worrying, being irritable, having difficulty relaxing, difficulty sleep, having headaches and physical symptoms	NR
<b>Dementia severity not reported</b>					
34	Jost	1996	Medical record review	<b>Dep:</b> Depression, mood change, social withdrawal, suicidal ideation (reported as separate symptoms) <b>Anx:</b> Anxiety	NR
42	Marin	1997	ADAS	<b>Dep:</b> tearfulness, depressed mood	Tearfulness - moderate/severe: 3, very mild or greater: 20 Depressed mood - moderate/severe: 5, very mild or greater: 42

### Psychotic symptoms

	Author	Year	Instrument	Delusion / Hallucination / Misidentification	
				Definition	Prevalence (%)
<b>Mild dementia (MMSE 21-26)</b>					
22	Eustace	2002	BEHAVE-AD	<b>Hal:</b> Visual, auditory, olfactory and other hallucinations <b>Del:</b> Paranoid and delusional ideation (people are stealing things, one's house is not one's home, spouse or caregiver is imposter, abandonment, other)	Del: 38 Hal: 0
<b>Moderate dementia (MMSE 15-20)</b>					
39	Levy	1996	ADAS	<b>Psy:</b> Hallucination (visual, auditory, tactile) and delusion (belief in ideas that are almost certainly not true) combined in psychosis subscale	Psy: 11
8	Berger	2005	BEHAVE-AD	<b>Psy symptoms cluster,</b> Del: Paranoid and delusional ideation (people are stealing things, one's house is not one's home, spouse or caregiver is imposter, abandonment, other) Hal: Visual, auditory, olfactory and other hallucinations	Median 0.0

50	Scarmeas <sup>1a</sup>	2002	CUSPAD	<b>Hal:</b> Auditory, visual, tactile and olfactory illusions <b>Del:</b> General del (strange ideas or unusual beliefs), paranoid del (people are stealing things or unfaithful wife/husband or unfounded suspicions), abandonment del (accused caregiver of plotting to leave him/her), somatic del (false belief that the patient has cancer or other physical illness), misidentification (false belief that people are in the house when nobody is there, or that someone else is in the mirror, or that spouse/caregiver is an imposter, or that the patient's home is not home, or that the characters on TV are real) and a miscellaneous category. At least one of these.	Del: 33.3 Hal: 11.5
20	Devanand <sup>1a</sup>	1997	CUSPAD	<b>Hal:</b> Auditory, visual, tactile and olfactory <b>Del:</b> Paranoid del, misidentification (reported also separately), somatic and abandonment	Del: 23.9 Hal: 8.1
28	Holtzer <sup>1a</sup>	2003	CUSPAD	<b>Hal:</b> Auditory, visual, tactile and olfactory <b>Del:</b> Paranoid del, misidentification (reported also separately), somatic and abandonment	Del: 40 Hal: 8
24	Garre-Olmo	2010	NPI-10	<b>Hal:</b> Including visions, voices, experiencing things that are not present <b>Del:</b> Beliefs that are not true, believing people are not who they say they are, believing their house is their home	Del: 16.1 Hal: 5.5
1	Aalten <sup>2</sup>	2005	NPI	<b>Hal:</b> Including visions, voices, experiencing things that are not present <b>Del:</b> Beliefs that are not true, believing people are not who they say they are, believing their house is their home	Del: 21.6 Hal: 9.5
2	Aalten <sup>2</sup>	2005	NPI	<b>Psychosis cluster:</b> Hallucinations and delusion (See Aalten <sup>2</sup> )	See Aalten <sup>2</sup>
25	Gillette-Guyonnet	2011	NPI	<b>Hal:</b> Including visions, voices, experiencing things that are not present <b>Del:</b> Beliefs that are not true, believing people are not who they say they are, believing their house is their home	Del: 9.3 Hal: 3.1
49	Rosen	1991	DSMIII	<b>Hal:</b> e.g. visual, auditory, olfactory <b>Del:</b> Various types e.g. paranoia, the belief that one's spouse is an impostor	Del: 34.4 Hal: 31.3
48	Paulsen	2000	DIS for the DSMIII	<b>Hal:</b> e.g. visual, auditory, olfactory <b>Del:</b> Various types e.g. paranoia, the belief that one's spouse is an impostor	Psy: 23
56	Wilkosz	2006	CERAD	<b>Hal:</b> Sensory perceptions for which there was no basis in reality <b>Del:</b> A persistent false belief based on incorrect inference about external reality, resistant to persuasion or contrary evidence, and not attributable to social or cultural mores	Del: 0 Hal: 0 (excluded those with symptoms at baseline)
<b>Moderately severe dementia (MMSE 10-14)</b>					
19	Deudon	2009	CMAI, NPI and Observation Scale	<b>NPI Psychotic subgroup:</b> Hal (Including visions, voices, experiencing things that are not present) and del (beliefs that are not true, believing people are not who they say they are, believing their house is their home)	mean 6.14 (severity x frequency of 2 symptoms)
5	Ballard <sup>3</sup>	1997	Burn's symptom checklist	<b>Hal:</b> If described by the patient or if clearly described to the informant by the patient <b>Del:</b> Beliefs that are false, firmly held and impervious to evidence to the contrary and that are not explained entirely by cognitive failure and that have been experienced at least twice, on occasions more than 1 week apart <b>Mis:</b> Included the categories of Capgras delusions, misidentification of house, misidentification of television, and misidentification of one's mirror image. Symptoms also had to fulfil the definition for a delusion	<b>Psy:</b> 65.0
44	McShane <sup>5</sup>	1995	PBE	<b>Hal:</b> Appears to have auditory or visual hallucinations	NR (31.7 at some point during the study)
30	Hope <sup>5</sup>	1999	PBE and Past behavioural history interview	<b>Hal:</b> Appears to have auditory or visual hallucinations <b>Del:</b> Persecutory ideas: expressed ideas that people were trying to harm him/her, plotting against him/her or stealing or damaging his/her property	NR
45	McShane <sup>5</sup>	1998	PBE	<b>Hal:</b> Appears to have auditory or visual hallucinations <b>Del:</b> Persecutory ideas: expressed ideas that people were trying to harm him/her, plotting against him/her or stealing or damaging his/her property	Del: 11.6, Hal: 8.1
26	Haupt <sup>4</sup>	1996	BEHAVE-AD	<b>Hal:</b> Visual, auditory, olfactory and other hallucinations <b>Del:</b> Paranoid and delusional ideation (people are stealing things,	<b>Del:</b> GDS 5: 48; GDS 6: 25; GDS 7: 14 <b>Hal:</b> GDS 5: 12;

				one's house is not one's home, spouse or caregiver is imposter, abandonment, other)	GDS 6: 25; GDS 7: 19
27	Haupt <sup>4</sup>	2000	BEHAVE-AD	<b>Hal:</b> Visual, auditory, olfactory and other hallucinations <b>Del:</b> Paranoid and delusional ideation (people are stealing things, one's house is not one's home, spouse or caregiver is imposter, abandonment, other)	Del: 35 Hal: 18
14	Chang	2004	SCID DSM IIIR	<b>Hal:</b> Formed visual hallucinations, non-formed visual hallucinations, auditory hallucinations or other hallucinations (olfactory or tactile) <b>Del:</b> Thoughts or experiences of systematic persecution, non-systematic persecution, theft, infidelity or jealousy	Del: 0 Hal: 0 Excluded
<b>Severe dementia (MMSE 0-9)</b>					
55	Wetzels	2010	NPI nursing home version	<b>Hal:</b> Including visions, voices, experiencing things that are not present <b>Del:</b> Beliefs that are not true, believing people are not who they say they are, believing their house is their home	Del: 9.4 Hal: 3.4
<b>Dementia severity not reported</b>					
15	Chen	1991	DSMIII-R	<b>Psy:</b> presence of persistent hallucinations, illusions or delusions	25
34	Jost	1996	Medical record review	Hallucinations, paranoia, accusatory behaviour, and delusions (reported as separate symptoms)	NR
42	Marin	1997	ADAS	<b>Hal:</b> visual, auditory, tactile hallucination <b>Del:</b> belief in ideas that are almost certainly not true	Del: moderate/severe: 4. very mild or greater: 13 Hal: moderate/severe: 1, very mild or greater: 7
13	Caligiuri	2003	BEHAVE-AD	<b>Hal:</b> Visual, auditory, olfactory and other hallucinations <b>Del:</b> Paranoid and delusional ideation (people are stealing things, one's house is not one's home, spouse or caregiver is imposter, abandonment, other)	Del: 0 Hal: 0 (excluded those with symptoms at baseline)

### Hyperactivity symptoms

	Author	Year	Instrument	Irritability / Agitation / Wandering	Prevalence (%)
				Definition	
<b>Mild dementia (MMSE 21-26)</b>					
22	Eustace	2002	BEHAVE-AD	<b>Irr:</b> Verbal outbursts, physical threats and/or violence, other agitation <b>Agi/Wan:</b> activity disturbance, includes wandering and purposeless and inappropriate activities	Irr: 42 Agi/Wan: 58
<b>Moderate dementia (MMSE 15-20)</b>					
39	Levy	1996	ADAS	<b>Agi/Wan:</b> Pacing and increased motor activity	Agi/Wan: 25
8	Berger	2005	BEHAVE-AD	<b>Behavioural disturbances cluster</b> - aggressiveness, activity disturbances	Median 1.0
51	Scarmeas <sup>1b</sup>	2007	CUSPAD	<b>Agi/Wan:</b> Agitation/restlessness <b>Wan:</b> Wandering away from home or from the caregiver <b>Irr:</b> Verbal outbursts, physical threats, violence	NR
50	Scarmeas <sup>1a</sup>	2002	CUSPAD	<b>Behavioural symptoms:</b> wandering away from home, verbal outbursts, physical threats or violence, agitation or restlessness and sundowning	Behavioural symptoms: 56.3
20	Devanan <sup>d1a</sup>	1997	CUSPAD	<b>Agi/Wan:</b> Agitation/restlessness <b>Irr:</b> Verbal outbursts, physical threats, violence	Agi/Wan: 38.7 Irr (physical aggression): 6.4%
28	Holtzer <sup>1a</sup>	2003	CUSPAD	<b>Agi/Wan:</b> Agitation/restlessness <b>Irr:</b> Verbal outbursts, physical threats, violence	Agi/Wan: 39 Irr: 6
24	Garre-Olmo	2010	NPI-10	<b>Agi/Wan:</b> Includes pacing, repetitive behaviour <b>Irr ("irritability"):</b> Includes getting irritated and easily disturbed; changeable moods, abnormally impatient; <b>Irr ("agitation")</b> refuses to cooperate or won't let people help	Agi/Wan: 18.9 Irr: 36.7; 23
1	Aalten <sup>2</sup>	2005	NPI	<b>Agi/Wan:</b> Includes pacing, repetitive behaviour <b>Irr ("irritability"):</b> Includes getting irritated and easily disturbed; changeable moods, abnormally impatient; <b>Irr ("agitation")</b> refuses to cooperate or won't let people help	Agi/Wan: 25.6 Irr: 23.6; 18.6

2	Aalten <sup>2</sup>	2005	NPI	<b>Hyperactivity cluster:</b> agitation, euphoria, irritability, disinhibition, aberrant motor behaviour.	See 2
25	Gillette-Guyonnet	2011	NPI	<b>Agi/Wan:</b> Includes pacing, repetitive behaviour <b>Irr ("irritability"):</b> Includes getting irritated and easily disturbed; changeable moods, abnormally impatient; <b>Irr ("agitation")</b> refuses to cooperate or won't let people help	Agi/Wan: 18.2 Irr: 20.6; 21.3
<b>Moderately severe dementia (MMSE 10-14)</b>					
19	Deudon	2009	CMAI, NPI and Observation Scale	<b>Agi:</b> non-aggressive agitation (verbal and non-verbal) <b>Irr:</b> aggressive agitation (verbal and non-verbal); observational scale including screaming, hitting, tearing things, biting <b>NPI Hyperactivity subgroup:</b> Includes agi/wan (pacing, repetitive behaviour) and irr (anger, uncooperative)	<b>Agi:</b> Physical non-aggressive: mean 1.80; Verbal non-aggressive: mean 1.89 <b>Irr:</b> Physical aggressive: mean 1.28; Verbal aggressive mean 2.32; Observation scale: mean 13.26 <b>Hyperactivity subgroup:</b> mean 35.68 (severity x frequency of 5 symptoms)
23	Fauth	2006	Daily record of behaviour (DRB)	<b>Agi/Wan:</b> Restless, pacing up and down <b>Irr:</b> Disruptive, physically aggressive behaviour, including hitting, kicking, biting, scratching, spitting, pushing, grabbing	NR
35	Keene <sup>5</sup>	1999	PBE	<b>Irr:</b> Physical aggression (e.g. hitting, kicking, scratching, pushing or spitting in an aggressive manner), aggressive resistance (resisting help or being uncooperative), physical threats (e.g. shaking a fist), verbal aggression (spoken in an aggressive or angry way, e.g. angry or cross tone or voice raised in anger), refusing to speak (wilful or uncooperative), destructive behaviour (damaged objects in anger or deliberately), general irritability (bad mood or likely to become irritable at the least provocation), avoiding aggressive behaviour (carer avoided something that might have resulted in aggressive behaviour)	Verbal aggression: 89; aggressive resistance: 71; physical aggression: 51; physical threats: 48; refusing to speak: 44; destructive behaviour: 25; general irritability: 39; avoiding aggressive behaviour: 89
31	Hope <sup>5</sup>	2001	PBE	<b>Wan:</b> Increased walking, walks distinctly more than normal; attempting to leave home, made attempts to leave the house that have been prevented; being brought back home, number of times being brought back home; trailing, tends to follow right behind carer for total of at least 30 minutes; aimless walking, walked about the house, garden or beyond without an obvious reason; pottering, tended to walk around the house trying to do household chores or potter around the garden trying to do odd jobs; inappropriate, walking around the house, garden or outside for a reason that seems odd to carer; excessive inappropriate, walked around the house, garden or outside for an appropriate reason but repeated this several times; night time walking, walked during the night, includes walking aimlessly, pottering and walking inappropriately or excessively	Increased walking: 16; Attempting to leave home: 10; Being brought back home: 13; Trailing: 21; Aimless walking: 21; Pottering: 19; Inappropriate or excessive appropriate: 10
30	Hope <sup>5</sup>	1999	PBE and Past behavioural history interview	<b>Wan:</b> Time spent walking; attempts to leave house; being brought back; trailing and checking; aimless walking <b>Irr:</b> Physical aggression towards others; aggressive resistance (i.e. resisting care during intimate care e.g. washing and dressing), verbal aggression (i.e. spoke in an aggressive or angry way)	NR
45	McShane <sup>5</sup>	1998	PBE	<b>Irr:</b> Verbal aggression (i.e. spoke in an aggressive or angry way)	Irr: 43
4	Asada	1999	Troublesome behaviour scale (TBS)	<b>Irritability factor:</b> false accusation, ill-natured denial and/or distortion, hiding and/or losing things, interfering with a happy home circle, being restless and/or noisy at night, physical and/or verbal aggression, repetition and/or clinging, pica. <b>Hyperactivity factor:</b> hiding and/or losing things, wandering, pica, rummaging, making the dwelling dirty, crying and/or screaming	NR

43	McCarty	2000	Memory and Behaviour Problem Checklist-Revised	<b>Emotional and impulsive behaviours cluster:</b> confusing past and present, wandering/lost, restless/agitated, constantly talkative, waking people, sad/depressed, anxious/worried, angry, striking out, destroying property, dangerous behaviour	mean 0.61 (0.57) of max 3.00
27	Haupt <sup>4</sup>	2000	BEHAVE-AD	<b>Irr:</b> Verbal outbursts, physical threats and/or violence, other agitation <b>Agi/Wan:</b> activity disturbance, includes wandering and purposeless and inappropriate activities	Agi: 87 Irr: 57/47
<b>Severe dementia (MMSE 0-9)</b>					
55	Wetzels	2010	NPI nursing home version	<b>Agi/Wan:</b> Includes pacing, repetitive behaviour <b>Irr ("irritability"):</b> Includes getting irritated and easily disturbed; changeable moods, abnormally impatient; <b>Irr ("agitation")</b> refuses to cooperate or won't let people help	Agi/Wan: 23.1 Irr: 28.2; 20.3
12	Burgio	2007	Modified NHBPS and observation	<b>Irr:</b> Including screaming, talking to self, moaning, cursing, complaining, repeated requests for attention, repetitive words, inappropriate disrobing, hitting, punching, spitting, pounding, banging objects, stomping feet, kicking, pushing, grabbing, scratching or throwing objects	Total score Staff report: 15.2 (of 56), observation: 18.0 ( of 100)
18	de Rooij	2012	QUALIDEM	<b>Agi:</b> Restless behaviour	NR
<b>Comparing cognitive groups</b>					
10	Blansi	2005	NOSGER	Disturbing behaviour	NR
<b>Dementia severity not reported</b>					
36	King-Kallimani s	2010	Minimum dataset	<b>Wan:</b> Locomotion with no discernible, rational purpose	14
54	Volicer	2012	Minimum dataset	<b>Agi/Wan:</b> Periods of restlessness, repetitive physical movements, wandering, socially inappropriate/disruptive behaviour	75.6
46; 38	Morgan; Kunik	2012	CMAI	<b>Irr:</b> intent to harm through spitting, verbal aggression, hitting, kicking, grabbing, pushing, throwing, biting, scratching, hurting self/others, tearing things/destroying property, making inappropriate verbal sexual advances or making inappropriate physical sexual advances	Excluded at baseline
17	Cohen-Mansfield	1998	CMAI-C	<b>Agi:</b> Verbally non-aggressive behaviour; physically non aggressive behaviour <b>Irr:</b> Verbally aggressive behaviour and physically aggressive behaviour	NR
34	Jost	1996	Medical record review	<b>Irr:</b> mild irr and severe irr ("aggression")	NR
42	Marin	1997	ADAS	<b>Agi:</b> tremors <b>Agi/Wan:</b> pacing, increased activity <b>Irr:</b> uncooperativeness cluster	<b>Agi:</b> moderate/severe: 6, very mild or greater: 56 <b>Agi/Wan:</b> pacing - moderate/severe: 8, very mild or greater: 18 Increased activity - moderate/severe: 5, very mild or greater: 22 <b>Irr:</b> moderate/severe: 8, very mild or greater: 17

## Elation

	Author	Year	Instrument	Elation	
				Definition	Prevalence (%)
<b>Moderate dementia (MMSE 15-20)</b>					
24	Garre-Olmo	2010	NPI-10	Too cheerful or too happy, abnormally good mood, finds humour where others do not	9
1	Aalten <sup>2</sup>	2005	NPI	Too cheerful or too happy, abnormally good mood, finds humour where others do not	3.5
2	Aalten <sup>2</sup>	2005	NPI		



25	Gillette-Guyonnet	2011	NPI	Too cheerful or too happy, abnormally good mood, finds humour where others do not	3.1
<b>Severe dementia (MMSE 0-9)</b>					
55	Wetzels	2010	NPI nursing home version	Too cheerful or too happy, abnormally good mood, finds humour where others do not	4.3

### Sleep problems

	Author	Year	Instrument	Sleep problems	
				Definition	Prevalence (%)
<b>Mild dementia (MMSE 21-26)</b>					
22	Eustace	2002	BEHAVE-AD	Diurnal rhythm disturbances	21
<b>Moderate dementia (MMSE 15-20)</b>					
8	Berger	2005	BEHAVE-AD	Diurnal rhythm disturbance	Median 0.0
1	Aalten <sup>2</sup>	2005	NPI	Difficulty sleeping, up at night, wander at night	13.1
2	Aalten <sup>2</sup>	2005	NPI	Difficulty sleeping, up at night, wander at night	
25	Gillette-Guyonnet	2011	NPI	Difficulty sleeping, up at night, wander at night	11.5
<b>Moderately severe dementia (MMSE 10-14)</b>					
23	Fauth	2006	Daily record of behaviour (DRB)	Woke caregiver up during the night	NR
30	Hope <sup>5</sup>	1999	PBE and Past behavioural history interview	Disturbed diurnal rhythm: evidence of sever disruption of diurnal rhythm	NR
<b>Severe dementia (MMSE 0-9)</b>					
55	Wetzels	2010	NPI nursing home version	Difficulty sleeping, up at night, wander at night	6
<b>Dementia severity not reported</b>					
34	Jost	1996	Medical record review	Diurnal change	NR

Reference numbers refer to the Online Reference List

Papers from the same study groups:

1a Predictors study 1: Columbia Medical Centre, John Hopkins University School of Medicine, Massachusetts General Hospital, USA

1b Predictors study 2: 3 centres in USA (see 1a) and 2 centres in Europe (Paris and Greece)

2 Maasbed study

3 Ballard et al. (Psychiatry services in the West Midlands and a memory clinic in Bristol)

4 Haupt et al. (Outpatient clinic at the institute of psychiatry of the Technical University in Munich)

5 Hope et al. (Oxford)

Apa=apathy

Dep=depression

Anx=anxiety

Irr=irritability/aggression

Agi=agitation

Hal=hallucination

Per=persecution

Mis=misidentification

Sle=sleep problems

Wan=wandering

Ela=elation

Fig. DS2 Persistence of BPSD reported in included studies

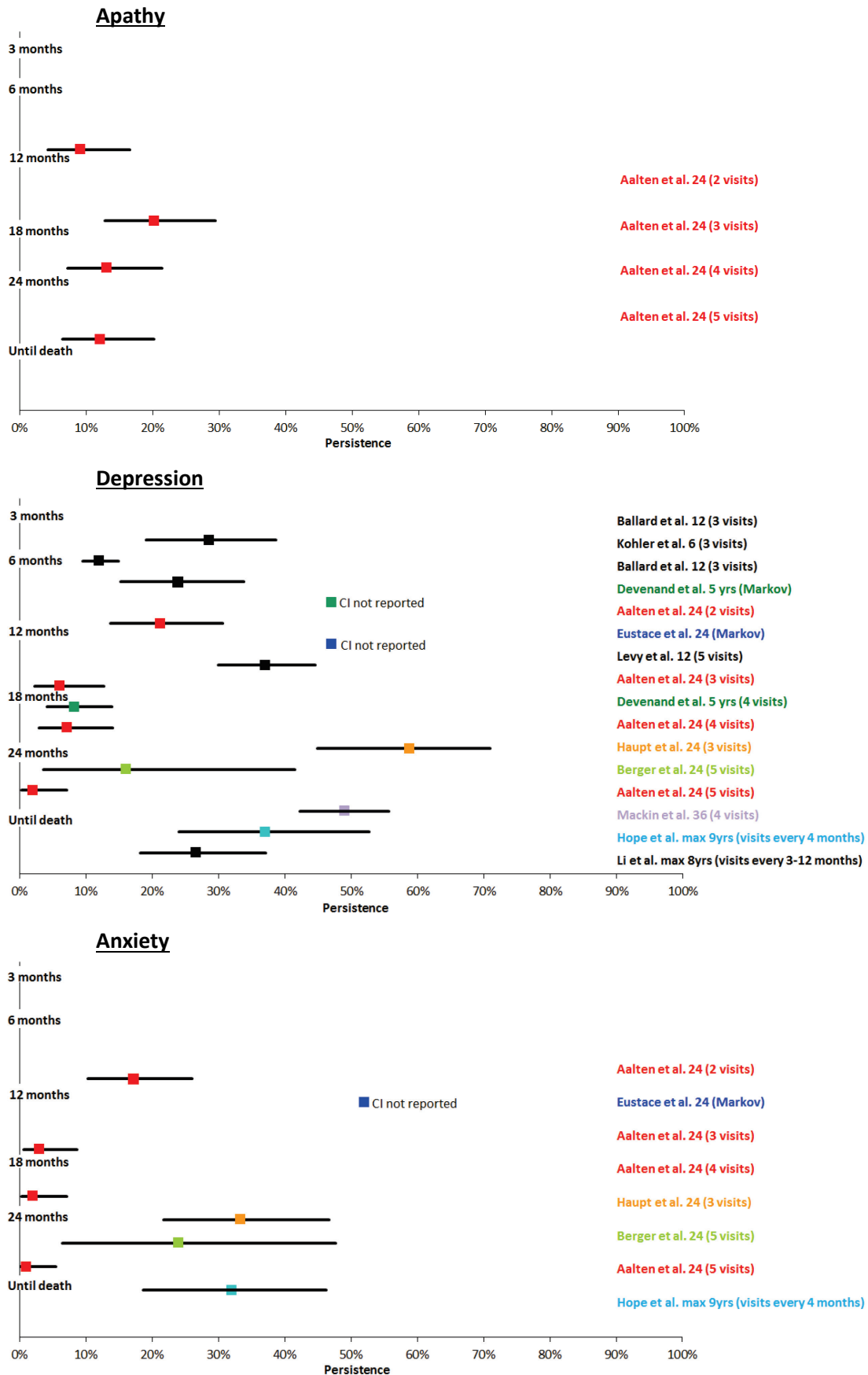
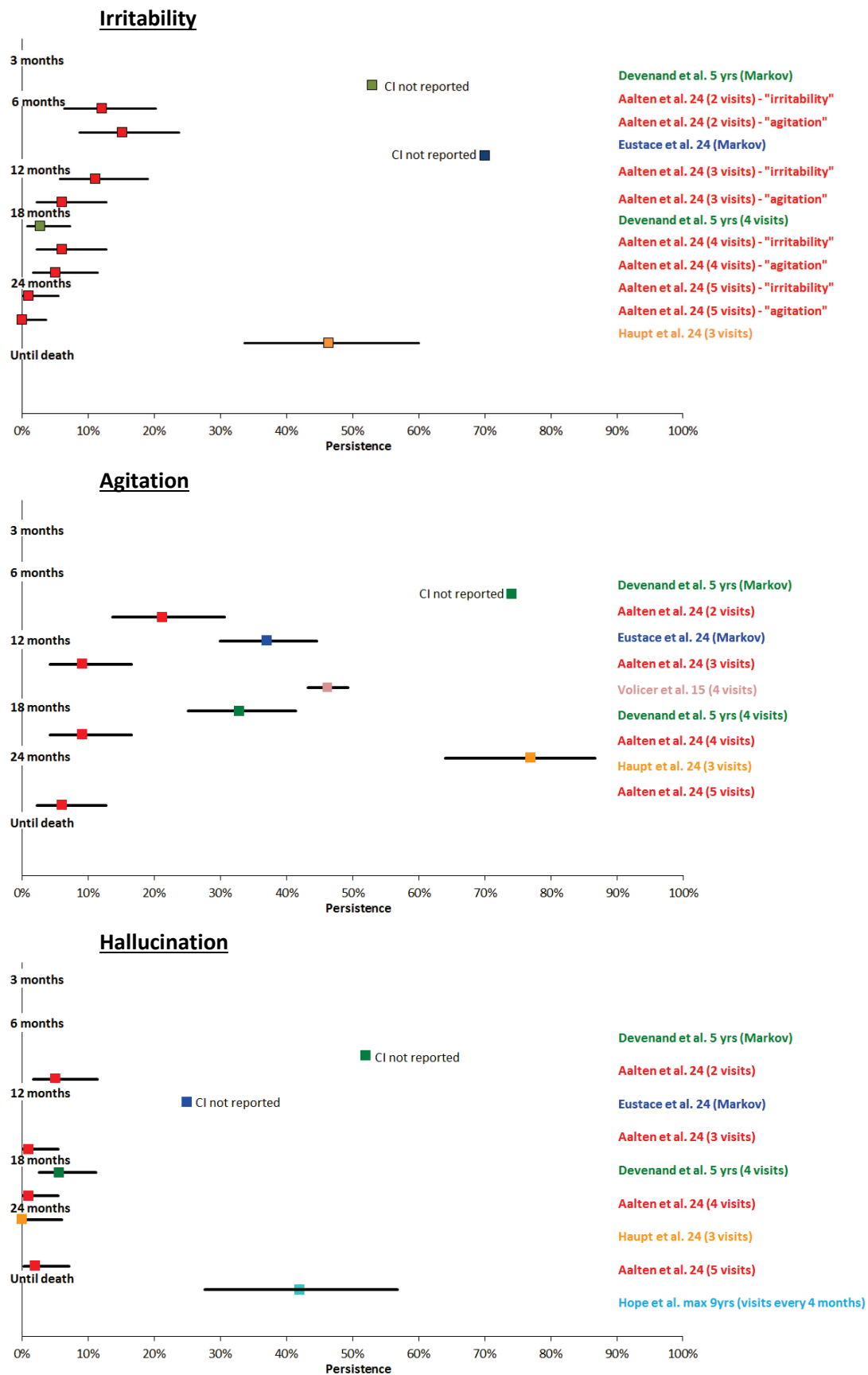


Fig. DS2 continued



The figures show the percentage of participants in which the symptom persisted over the period indicated on the y-axis, and the 95% confidence interval. For each figure, a legend shows the author name, the duration of the total follow-up in months and the number of visits.

**Table DS3 Persistence and remission of symptoms in those with symptoms at baseline**

**Affective symptoms**

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Depression / Anxiety / Apathy		
								Per measurement (%)	Over total follow-up (%)	Fluctuating (%)
<b>Mild dementia (MMSE 21-26)</b>										
22	Eustace	2002	DC	24	3	12	Transition probabilities (Markov model).	Dep: 47 Anx: 52		
16	Clare	2012	DC	20	3	8-12	Random effects regression analysis.			Dep, anx: No significant change over time
<b>Moderate dementia (MMSE 15-20)</b>										
39	Levy	1996	NR	12	5	3	No model; Present at all five visits when present at baseline.	Dep: 49-59	37	
8	Berger	2005	DC	24	5	3-6	Total: each measurement time over 2 year period. Fluctuation: Present at 50% or more / less than 50% of measurement time over 2 yr. period.		Dep: 16 Anx: 24	Dep: 38; 22 Anx: 31; 18
20	Devanand <sup>1a</sup>	1997	DC	5 yrs. (mean 3 yrs.)	7	6	Per obs: Markov model; Total: present at any 4 visits; Fluctuating: present at 1 2 or 3 visits of any 4 visits.	Dep: 47	Dep: 8.3	Dep: 23.9; 17.2; 9.4
24	Garre-Olmo	2010	DC	24	5	6	Linear and quadratic growth mixture models.			Factor score: Low and stable: 80.2%, High and decreasing: 9.0%, Low and increasing: 10.8%
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Present at any consecutive period of 6, 12, 18, 24 months.		Dep: 21.2; 6.1; 7.1; 2 Anx: 17.2; 3; 2; 1 Apa: 9.1; 20.2; 13.1; 12.1	

2	Aalten <sup>2</sup>	2005	DC	24	5	6	Repeated measure analysis between symptoms and baseline and follow-up, adjusted for MMSE and duration of illness.		Mood/apa: F=14.2, p<0.001 (also associated with baseline NPI total, hyperactivity and psy)	
59	Zahodne	2013	DC	5.5 yrs.	mean 10.1	6	Latent growth curve modelling.		No significant change - stable over time	
<b>Moderately severe dementia (MMSE 10-14)</b>										
23	Fauth	2006	NR	3	4	1	Latent growth curve modelling. A linear model of symptom change over time was compared to a model with a quadratic component and the fixed and random growth curve parameters of initial level, linear slope and quadratic slope were estimated. Log BPSD (frequency × duration +10) Covariates: MMSE score, use of neuroleptic medication, use of cholinesterase inhibitor, age, use of in-home respite care, relationship caregiver.		Mood: Quadratic model. Significant intra-individual variability in rate of change	
6	Ballard <sup>3</sup>	1996	CLIN/DC	12	12	1	Percentage with minor dep at baseline that had 3 or more months dep; 6 or more months.		Dep: 28.6; 23.8	
30	Hope <sup>5</sup>	1999	CLIN	9 yrs.	NR	4	Percentage with a single episode that persists until the last interview before death; Fluctuating: A single episode ending before death, more than one discrete episode, the behaviour may or may not persist until death.		Dep: 37 Anx: 32	Dep: 47; 16 Anx: 57; 11

47	Neundorfer	2001	DC	max: 5yrs	max:10	12	Hierarchical modelling or multilevel analysis.		Dep: Changes over time within patients and differences between patients.	
27	Haupt <sup>4</sup>	2000	DC	24	3	12	% of those with symptoms at baseline with symptoms after 1 and 2 years; Fluctuating: % with symptoms after 1 or 2 yrs.; % symptoms absent.		Dep: 58.8 Anx: 33.3	Dep: 26.5; 14.7 Anx: 28.6; 38.1
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4 months.	Dep: 70.0, 37.5, 12.4, 0.0 Anx: 39.8, 42.9, 24.8, 31.4 Apa: 54.8, 36.0, 51.9, 39.4		
<b>Normal cognitive function (MMSE 27+, no dementia)</b>										
37	Kohler	2010	POP	6	3	3	Stability defined as a score within the upper quartile group on 2 consecutive assessments: highly depressed at baseline only (fluctuating), highly depressed at follow-up only (fluctuating) and persistently highly depressed (total).		Dep: 12	Dep: 8; 25
41	Mackin	2011	VOL	3 yrs.	4	12	Proportion of individuals who remained stable, declined, improved, or fluctuated over 3 years was calculated and compared between groups using Fisher's exact test.		Dep: 49 stable	Dep: 16 worsening, 8 improved, 27 fluctuations
<b>Comparing cognitive groups</b>										
40	Li	2001	DC + VOL	93.6	NR	3-12	Persistent: All HDRS scores during follow-up >7 Improved (fluctuating): All HDRS scores during follow-up <7 Fluctuating: HDRS scores at follow-up >7 or <7.		Dep: AD 26.6; VAD 66.7; MCI 60.0	Dep: AD 66.7, 6.7; VAD 22.2, 11.1; MCI 20.0, 20.0

## Psychotic symptoms

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Delusion / Hallucination / Misidentification		
								Per measurement (%)	Over total follow-up (%)	Fluctuating (%)
<b>Mild dementia (MMSE 21-26)</b>										
22	Eustace	2002	DC	24	3	12	Transition probabilities (Markov model).	Del: 65 Hal: 25		
<b>Moderate dementia (MMSE 15-20)</b>										
39	Levy	1996	NR	12	5	3	No model; Present at all five visits when present at baseline.	Psy: 68-82	Psy: 57	
8	Berger	2005	DC	24	5	3-6	Total: each measurement time over 2 year period; Fluctuation: Present at 50% or more / less than 50% of measurement time over 2 year period.		Psy: 24	Psy: 20; 27
20	Devanand <sup>1a</sup>	1997	DC	5 yrs. (mean 3yrs)	7	6	Per obs: Markov model; Total: present at any 4 visits; Fluctuating: present at 1; 2; 3 of any 4 visits.	Del: 59 (includes mis) Hal: 52	Del: 12.8 Hal: 5.6	Del: 20; 17.8; 18.9 Hal: 18.9; 11.1; 4.4
28	Holtzer <sup>1a</sup>	2003	DC	5 yrs.	11	6	Markov model. By mMMSE 39-57, 33-38, 26-32, 14-25, 0-13.	Del: 76, 75, 78, 82, 64 Hal: 14, 42, 30, 50, 43		
24	Garre-Olmo	2010	DC	24	5	6	Linear and quadratic growth mixture models.			Factor score: Moderate and stable: 6.9%, Fluctuating: 6.9%, Low and stable 86.2%
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Present at any consecutive period of 6, 12, 18, 24 months.		Del: 11.1; 3; 4; 4 Hal: 5.1; 1; 1; 2	



2	Aalten <sup>2</sup>	2005	DC	24	5	6	Repeated measure analysis between symptoms and baseline and follow-up, adjusted for MMSE and duration of illness.		Psy: F=28.3, p<0.001. Also associated with baseline NPI total and hyperactivity, not mood/apathy)	
49	Rosen	1991	DC	6 yrs.	7	1yr	Percentage remission of those with at least one follow-up visit after onset symptom (n=6).			Psy: 33
<b>Moderately severe dementia (MMSE 10-14)</b>										
19	Deudon	2009	CH	3	3	1 or 2	Mixed linear model with random effect. Covariates: age.		NPI psychosis factor: beta= 0.03 (0.604)	
5	Ballard <sup>3</sup>	1997	CLIN/DC	12	12	1	Resolution of symptoms in those followed-up for a yr.			Psy: 53 Del: 73 Hal: 61 Mis: 65
44	McShane <sup>5</sup>	1995	CLIN	5 yrs.	NR	4	Proportion of interviews were hallucinations were present.	Hal: With cortical Lewy bodies: 0.44 (SEM<0.15); without cortical Lewy bodies: 0.06 (SEM 0.03)		
30	Hope <sup>5</sup>	1999	CLIN	9 yrs.	NR	4	Percentage with a single episode that persists until the last interview before death; Fluctuating: A single episode ending before death; More than one discrete episode, the behaviour may or may not persist until death.		Del: 23 Hal: 42	Del: 68; 9 Hal: 42; 17
27	Haupt <sup>4</sup>	2000	DC	24	3	12	% of those with symptoms at baseline with symptoms after 1 and 2 years; Fluctuating: % with symptoms after 1 or 2 years; % symptoms absent.		Del: 0 Hal: 0	Del: 42.9; 57.1 Hal: 72.7; 27.3
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	Del: 36.2, 28.3, 12.5, 28.3 Hal: 50.0, 25.0, 50.0, 50.0		

## Hyperactivity symptoms

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Irritability / Agitation / Wandering		
								Per measurement (%)	Over total follow-up (%)	Fluctuating (%)
<b>Mild dementia (MMSE 21-26)</b>										
22	Eustace	2002	DC	24	3	12	Transition probabilities (Markov model).	Irr: 70		
<b>Moderate dementia (MMSE 15-20)</b>										
39	Levy	1996	NR	12	5	3	No model; Present at all five visits when present at baseline.	Agi/Wan: 65-67	Agi/Wan: 37	
8	Berger	2005	DC	24	5	3-6	Total: each measurement time over 2 year period Fluctuation: Present at 50% or more / less than 50% of measurement time over 2 year period.		Behavioural disturbances, aggressiveness, activity disturbances: 44	Behavioural disturbances, aggressiveness, activity disturbances: 31; 16
51	Scarmeas <sup>1b</sup>	2007	DC	NR	14yrs	max:25	Generalised estimating equation model. Disruptive behavioural symptoms.			Symptoms increase by 0.07 for every year of follow-up (p<0.001)
20	Devanand <sup>1a</sup>	1997	DC	5 yrs. (mean 3 yrs.)	7	6	Per obs: Markov model; Total: present at any 4 visits; Fluctuating: present at 1; 2; 3 of any 4 visits.	Agi/Wan: 74 Irr: 53	Agi/Wan: 32.8 Irr: 2.8	Agi/Wan: 14.4; 16.7; 21.7 Irr: 14.4; 12.8; 8.9
28	Holtzer <sup>1a</sup>	2003	DC	5 yrs.	11	6	Markov model. By mMMSE 39-57, 33-38, 26-32, 14-25, 0-13.	Agi/Wan: 54, 59, 72, 81, 80 Irr: 27, 20, 22, 59, 69		
24	Garre-Olmo	2010	DC	24	5	6	Linear and quadratic growth mixture models.			Factor score: Low and smooth increasing: 66.6%, High and increasing: 4.3%, Moderate and stable: 17.5%, Low and sharp increasing: 11.6%

1	Aalten <sup>2</sup>	2005	DC	24	5	6	Present at any consecutive period of 6, 12, 18, 24 months.		Agi/Wan: 21.2; 9.1; 9.1; 6.1; Irr ("irritability"): 12.1; 11.1; 6.1; 1 Irr ("agitation"): 15.2; 6.1; 5.1; 0	
2	Aalten <sup>2</sup>	2005	DC	24	5	6	Repeated measure analysis between symptoms and baseline and follow-up, adjusted for MMSE and duration of illness.		Hyperactivity: F=4.8n p<0.05, Also associated with baseline NPI total, mood apathy and hyperactivity, but not psy	
<b>Moderately severe dementia (MMSE 10-14)</b>										
19	Deudon	2009	CH	3	3	1 or 2	Mixed linear model with random effect. Covariates: age.		Global CMAI: beta=0.02 (0.797) Physically non-aggressive behaviour: beta=-0.003 (0.368), verbally non-aggressive behaviour: beta=0.001 (0.832) NPI hyperactivity factor: beta=0.35 (0.091) Physically aggressive behaviour: beta=0.004 (0.11), verbally aggressive behaviour: beta=-0.001 (0.776). Observation scale: beta=-0.16 (0.17)	

23	Fauth	2006	NR	3	4	1	Latent growth curve modelling. A linear model of symptom change over time was compared to a model with a quadratic component and the fixed and random growth curve parameters of initial level, linear slope and quadratic slope were estimated. Log BPSD (frequency × duration +10) Covariates: MMSE score, use of neuroleptic medication, use of cholinesterase inhibitor, age, use of in-home respite care, relationship caregiver.		Disruptive problems: Quadratic model. Disruptive behaviour: Significant intra-individual variability in rate of change Restlessness: linear model. Significant variability of people's baseline scores.	
35	Keene <sup>5</sup>	1999	CLIN	10 yrs.	30	4	Persistence: Percentage with a single episode that persists until the last interview before death; Fluctuating: A single episode ending before death; More than one discrete episode, the behaviour may or may not persist until death.		Irr: verbal aggression: 54; aggressive resistance 60; physical aggression 51; physical threats 29; refusal to speak 17; destructive behaviour 28; general irritability 14; carer avoids aggression 44 (Same population as Hope et al. ref 43)	Irr: verbal aggression: 25; 21 aggressive resistance 18; 22 physical aggression 33; 16 physical threats 46; 25 refusal to speak 72; 11 destructive behaviour 68; 4 general irritability 73; 14 carer avoids aggression 40; 16

30	Hope <sup>5</sup>	1999	CLIN	9 yrs.	NR	4	Percentage with a single episode that persists until the last interview before death; Fluctuating: A single episode ending before death; More than one discrete episode, the behaviour may or may not persist until death.		Wan: Trailing and checking: 33; aimless walking: 35; being brought back 22; attempts to leave home 22; walking more 35; Irr: verbal aggression: 58; aggressive resistance 64; physical aggression 60	Wan: Trailing and checking: 60; 7 aimless walking: 57; 9 being brought back 70; 9 attempts to leave home 50; 28 walking more 50; 15 Irr: verbal aggression: 24; 18; aggressive resistance 18; 18 physical aggression 30; 10
27	Haupt <sup>4</sup>	2000	DC	24	3	12	% of those with symptoms at baseline with symptoms after 1 and 2 years; Fluctuating: % with symptoms after 1 or 2 years; % symptoms absent.		Agi: 76.9; Irr: 46.4	Agi: 21.2; 1.9
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	Irr ("agitation"): 51.4, 51.9, 37.6, 56.1 Irr ("irritability"): 54.1, 55.2, 62.4, 52.9 Agi/Wan: 63.0, 58.1, 41.9, 59.0		

12	Burgio	2007	CH	18	4	6	Multilevel analysis. Restricted maximum likelihood estimation method with a specification of the unstructured covariance. Analysed linear and curvilinear time effects.		Staff: Agitation changed little over the 18 month period; Obs: Both linear and quadratic effect were statistically significant ( $p < 0.05$ ) indicating that the trajectory of agitation had a decreasing trend linearly but the rate of decrease lessened over time.	
18	de Rooij	2012	CH	12	3	6	Changes across time within Dutch and Belgian traditional and small-scale settings.		Netherlands: coefficient -0.85; Belgium: -0.24	
<b>Dementia severity not reported</b>										
36	King-Kallimanis	2010	CH	4 yrs. (mean 390/297 days)	mean: 4	3	Total: Wan at admission and for the duration of the study Fluctuating: Wan at admission and one change to a non-wan; Wan at admission and changed to wan and back to wan; Wan at admission and fluctuated multiple times. (% of all wan at baseline).	Wan: 49	Wan: 43; 5; 3	
54	Volicer	2012	CH	15	4	3	Four groups: agi lower on first than last assessment (declined); higher agi score on first than last (improved), agi on both first and last (stable), not agi on first or last (no agi). In all second and third assessment intermediate between first and last.		Agi: increased 19.6, decreased 16.7, stable 46.2, no agi 17.3	

17	Cohen-Mansfield	1998	CH	24	5	6	Repeated measures multivariate analyses of variances (MANOVA) CMAI syndrome scores: mean of behaviours comprising each type of agitation.	Verbally non-aggressive behaviour increased F=270, p=0.03; Physical non-aggressive behaviour NS Verbally aggressive behaviour increased over time F=3.83, p<0.01, Physically aggressive behaviour increased over time F=4.43, p<0.01		
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### Elation

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Elation		
								Per measurement (%)	Over total follow-up (%)	Fluctuating (%)
<b>Moderate dementia (MMSE 15-20)</b>										
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Present at any consecutive period of 6, 12, 18, 24 months.		2, 0, 0, 0	
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	39.5, 17.6, 33.3, 20.9		

## Sleep problems

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Sleep problems		
								Per measurement (%)	Over total follow-up (%)	Fluctuating (%)
<b>Mild dementia (MMSE 21-26)</b>										
22	Eustace	2002	DC	24	3	12	Transition probabilities (Markov model).	68		
<b>Moderate dementia (MMSE 15-20)</b>										
8	Berger	2005	DC	24	5	3-6	Total: each measurement time over 2 year period; Fluctuation: Present at 50% or more / less than 50% of measurement time over 2 year period.		9	18; 29
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Present at any consecutive period of 6, 12, 18, 24 months.		10.1; 1; 1; 1	
<b>Moderately severe dementia (MMSE 10-14)</b>										
23	Fauth	2006	NR	3	4	1	Latent growth curve modelling. A linear model of symptom change over time was compared to a model with a quadratic component and the fixed and random growth curve parameters of initial level, linear slope and quadratic slope were estimated. Log BPSD (frequency × duration +10) Covariates: MMSE score, use of neuroleptic medication, use of cholinesterase inhibitor, age, use of in-home respite care, relationship caregiver.		Linear model. Significant variability of people's baseline scores. Intra-individual variability NS	



30	Hope <sup>5</sup>	1999	CLIN	9 yrs.	NR	4	Percentage with a single episode that persists until the last interview before death; Fluctuating: A single episode ending before death; More than one discrete episode, the behaviour may or may not persist until death.		23	68; 10
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	Sle: 56.7, 50.0, 0.0, 20.9		

### Total BPSD score

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Total score
<b>Mild dementia (MMSE 21-26)</b>								
16	Clare	2012	DC	20	3	8-12	Random effects regression analysis.	Significant increase over time (lope 0.17, p<0.001), no significant change in severity
52	Tschanz	2011	PB	Mean 3.8 yrs., max 12.9 yrs.	NR	NR	Linear effects models, annual rate of change in NPI total.	Increase of total NPI score over time: intercept: 2.5, time 3.1 (p=0.002)
<b>Moderate dementia (MMSE 15-20)</b>								
2	Aalten <sup>2</sup>	2005	DC	24	5	6	Repeated measure analysis between symptoms and baseline and follow-up, adjusted for MMSE and duration of illness.	NPI: F=16.5, p<0.001 Also associated with baseline mood/apathy, hyperactivity and psy

Moderately severe dementia (MMSE 10-14)								
23	Fauth	2006	NR	3	4	1	Latent growth curve modelling. A linear model of symptom change over time was compared to a model with a quadratic component and the fixed and random growth curve parameters of initial level, linear slope and quadratic slope were estimated. Log BPSD (frequency × duration +10) Covariates: MMSE score, use of neuroleptic medication, use of cholinesterase inhibitor, age, use of in-home respite care, relationship caregiver.	No fixed or linear quadratic parameters were significant - on <i>average</i> no significant change over time for any domain, BPSD stable over 3 months

Reference numbers refer to the Online Reference List

Papers from the same study groups:

1a Predictors study 1: Columbia Medical Centre, John Hopkins University School of Medicine, Massachusetts General Hospital, USA

1b Predictors study 2: 3 centres in USA (see 1a) and 2 centres in Europe (Paris and Greece)

2 Maasbed study

3 Ballard et al. (Psychiatry services in the West Midlands and a memory clinic in Bristol)

4 Haupt et al. (Outpatient clinic at the institute of psychiatry of the Technical University in Munich)

5 Hope et al. (Oxford)

Settings

DC=Dementia or memory clinic

POP=Population-based

CH=Care home

CLIN=Referred by clinicians

VOL=Volunteers

NR=Not reported

BPSD= behavioural and psychological symptoms of dementia

Apa=apathy

Dep=depression

Anx=anxiety

Irr=irritability/aggression

Agi=agitation

Hal=hallucination

Per=persecution

Mis=misidentification

Sle=sleep problems

Wan=wandering

Ela=elation

MMSE=mini mental state examination; mMMSE=modified mini mental state examination; SEM=standard error of the mean

**Table DS4 Incidence and absence of symptoms in those without symptoms at baseline**

**Affective symptoms**

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Depression / Anxiety / Apathy		
								Per measurement (%)	Over total follow-up (%)	Absent (%)
<b>Mild dementia (MMSE 21-26)</b>										
22	Eustace	2002	DC	24	3	12	Markov model. Transition probability for onset over 2 yr. period.	Dep: 25 Anx: 28		
<b>Moderate dementia (MMSE 15-20)</b>										
39	Levy	1996	NR	12	5	3	Rate of new appearance of a symptom during the observation period in patients who had not reported the symptom at study onset.		Dep:35	
8	Berger	2005	DC	24	5	3-6	Absent at each measurement time over the 2 yr. period.			Dep: 24 Anx: 31
50	Scarmeas <sup>1a</sup>	2002	NR	9.3 yrs.	NR	6	Manifesting incident symptoms at any follow-up visit. Calculated from manifesting symptom at follow-up and no symptom at first visit.		Dep: 73.5	
20	Devanand <sup>1a</sup>	1997	DC	5 yrs. (mean 3 yrs.)	7	6	Markov model. Absent: Of participants that completed 4 consecutive periods of 6 months: present at none of the 4 visits.	Dep: 14		Dep: 41.1
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Cumulative incidence: the proportion of patients who were symptom free at baseline but developed the specific symptom at next assessments.		Dep: 33.4 Anx: 27.5 Apa: 63.9	

25	Gillette-Guyonnet	2011	DC	max 48	mean 5.1	6	Incidence of NPI 4 or higher per 100 person years and % events during 4 year follow-up in those without the symptom at baseline (between brackets).		Dep: 16.5 (29.5) Anx: 19.6 (33.9) Apa: 41.7 (55.7)	
<b>Moderately severe dementia (MMSE 10-14)</b>										
6	Ballard <sup>3</sup>	1996	CLIN	12	12	1	Without major or minor depression at baseline interview		Dep: 29.8 minor; 10.6 major	
27	Haupt <sup>4</sup>	2000	DC	24	3	12	Absent at baseline and present after 1 or 2 years / 1 and 2 years (% without symptoms at baseline). Absent: absent at baseline and after 1 or 2 years (% without symptom at baseline).	Dep: 26.9; 26.9 Anx: 38.5; 7.7		Dep: 50.0 Anx: 53.8
14	Chang	2004	DC	mean: 51.9	NR	NR	Symptoms developed during follow-up period, those with symptoms at baseline excluded.		Dep: 12.5	
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	Dep: 8.4, 9.8, 3.0, 3.4 Anx: 6.2, 9.7, 11.9, 8.5 Apa: 13.7, 17.4, 27.2, 18.8		
<b>Normal cognitive function (MMSE 27+, no dementia)</b>										
37	Kohler	2010	POP	6	3	3	Those who had symptoms at follow-up visits only Absent: never highly depressed.		Dep: 25	Dep:55

Comparing cognitive groups										
40	Li	2001	DC + VOL	93.6	NR	3-12	Annual incidences of new-onset depressive symptoms among non-depressed subjects at baseline. No model. Calculated by dividing cumulative numbers of subjects showing new onset depressive symptoms (HDRS>7) by mean interval of follow-up years.	Dep: AD - 15 per 100 person years (8/26) MCI 11.7 (5/13) VAD 26.8 (13/23)		
Dementia severity not reported										
34	Jost	1996	DC	Retro-spective using medical records	Retro-spective	Retro-spective	Documentation of onset of symptoms in medical records.		Dep: 72	

### Psychotic symptoms

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Delusion / Hallucination / Misidentification		
								Per measurement (%)	Over total follow-up (%)	Absent (%)
Mild dementia (MMSE 21-26)										
22	Eustace	2002	DC	24	3	12	Markov model. Transition probability for onset over 2 yr. period.	Del: 35 Hal: 7		

Moderate dementia (MMSE 15-20)										
39	Levy	1996	NR	12	5	3	Rate of new appearance of a symptom during the observation period in patients who had not reported the symptom at study onset.		Del: 25	
8	Berger	2005	DC	24	5	3-6	Absent at each measurement time over the 2 year period.			Psy: 29
50	Scarmeas <sup>1a</sup>	2002	NR	9.3 yrs.	NR	6	Manifesting incident symptoms at any follow-up visit. Calculated from manifesting symptom at follow-up and no symptom at first visit.		Del: 84.5 Hal: 45.5	
20	Devanand <sup>1a</sup>	1997	DC	5 yrs. (mean 3 yrs.)	7	6	Markov model. Absent: Of participants that completed 4 consecutive periods of 6 months: present at none of the 4 visits.	Del: 17 Hal: 9		Del: 30.6 Hal: 60
28	Holtzer <sup>1a</sup>	2003	DC	5 yrs.	11	6	Markov model. By mMMSE 39-57, 33-38, 26-32, 14-25, 0-13.	Del: 76, 75, 78, 82, 64 Hal: 14, 42, 30, 50, 43		
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Cumulative incidence: the proportion of patients who were symptom free at baseline but developed the specific symptom at next assessments.		Del: 34 Hal: 20.5	
25	Gillette-Guyonnet	2011	DC	max 48	mean 5.1	6	Incidence of NPI 4 or higher per 100 person years and % events during 4 year follow-up in those without the symptom at baseline (between brackets).		Del: 8.2 (16.5) Hal: 4.4 (9.4)	
49	Rosen	1991	DC	6 yrs.	7	1 yr.	Emerging of psychosis by MMSE score.		82.4 (n=14 of total n=32 of which n=15 with symptoms during course)	

48	Paulsen	2000	DC	4 yrs.	5	1 yr.	The cumulative incidence for hallucinations or delusions in patients with a clinical diagnosis of probable AD		20.1% at 1 year, 36.1% at 2 years, 49.5% at 3 years, and 51.3% at 4 years	
56	Wilkosz	2006	DC	mean: 25.8	NR	1 yr.	Only numbers and incidence rate given, I calculated percentages from this using n=288.		Psy: 28.5 Del: 8.7 Mis: 16.0	
<b>Moderately severe dementia (MMSE 10-14)</b>										
5	Ballard <sup>3</sup>	1997	DC	12	12	1	Percentage without symptoms at baseline that developed symptoms during follow-up.		Psy: 47 Del: 30 Hal: 20 Mis: 17	
27	Haupt <sup>4</sup>	2000	DC	24	3	12	Absent at baseline and present after 1 or 2 yrs. / 1 and 2 yrs. (% without symptoms at baseline). Absent: absent at baseline and after 1 or 2 years (% without symptom at baseline).		Del: 29.7; 0 Hal: 18.8; 2.1	Del: 7 Hal: 79.2
14	Chang	2004	DC	mean: 51.9	NR	NR	Symptoms developed during follow-up period, those with symptoms at baseline excluded.		Del: 32.1 Hal: 25	
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	Del: 2.9, 5.4, 5.5, 4.3 Hal: 1.8, 2.7, 0.0, 5.1		
<b>Dementia severity not reported</b>										
15	Chen	1991	DC	5 yrs.	2 or more	6	Incidence during follow-up period.		Psy: 29.6	
34	Jost	1996	DC	Retro-spective using medical records	Retro-spective	Retro-spective	Documentation of onset of symptoms in medical records.		Psy: 45	
13	Caligiuri	2003	DC? NR	24	3	1 yrs.	Incidence rate over 2 yrs. for new onset psychosis (those with symptoms at baseline excluded).		Psy: 32.5	

## Hyperactivity symptoms

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Irritability / Agitation / Wandering		
								Per measurement (%)	Over total follow-up (%)	Absent (%)
<b>Mild dementia (MMSE 21-26)</b>										
22	Eustace	2002	DC	24	3	12	Markov model. Transition probability for onset over 2 yr. period.	Irr: 38		
<b>Moderate dementia (MMSE 15-20)</b>										
39	Levy	1996	NR	12	5	3	Rate of new appearance of a symptom during the observation period in patients who had not reported the symptom at study onset.		Agi/Wan: 39	
8	Berger	2005	DC	24	5	3-6	Absent at each measurement time over the 2 year period.			9 (behavioural disturbance, aggressiveness, activity disturbance)
50	Scarmeas <sup>1a</sup>	2002	NR	9.3 yrs.	NR	6	Manifesting incident symptoms at any follow-up visit. Calculated from manifesting symptom at follow-up and no symptom at first visit.		Behavioural symptoms (wandering and irritability): 94.7	
20	Devanand <sup>1a</sup>	1997	DC	5 yrs. (mean 3 yrs.)	7	6	Markov model. Absent: Of participants that completed 4 consecutive periods of 6 months: symptom present at none of the 4 visits.	Agi/Wan: 31 Irr: 10		Agi/Wan: 14.4; Irr: 61.1
28	Holtzer <sup>1a</sup>	2003	DC	5 yrs.	11	6	Markov model. By mMMSE 39-57, 33-38, 26-32, 14-25, 0-13.	Agi/Wan: 54, 59, 72, 81, 80 Irr: 27, 20, 22, 59, 69		



1	Aalten <sup>2</sup>	2005	DC	24	5	6	Cumulative incidence: the proportion of patients who were symptom free at baseline but developed the specific symptom at next assessments.		Agi/Wan: 48.7 Irr ("irritability"): 33.5 Irr ("agitation"): 32.1	
25	Gillette-Guyonnet	2011	DC	max 48	mean 5.1	6	Incidence of NPI 4 or higher per 100 person years and % events during 4 year follow-up in those without the symptom at baseline (between brackets).		Agi/Wan: 21.4 (36.5) Irr ("irritability"): 20.6 (34.7) Irr ("agitation"): 17.1 (30.1)	
<b>Moderately severe dementia (MMSE 10-14)</b>										
45	McShane <sup>5</sup>	1998	CLIN	4 yrs.	NR	4	Newly developed behaviours during 3 year period (association with symptoms in first year also reported).		Irr: 31; Agi: 16.7	
27	Haupt <sup>4</sup>	2000	DC	24	3	12	Absent at baseline and present after 1 or 2 years / 1 and 2 years (% without symptoms at baseline). Absent: absent at baseline and after 1 or 2 years (% without symptom at baseline).		Agi: 28.6; 71.4 Irr: 31.3; 18.8	Agi: 0 Irr: 50
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	Irr ("agitation"): 9.5, 20.6, 15.3, 23.1 Irr ("agitation"): 17.2, 18.2, 16.5, 23.1 Agi/Wan: 15.6, 15.1, 10.5, 18.8		

Dementia severity not reported										
36	King-Kallimanis	2010	CH	4 yrs. (mean 390/297 days)	mean:4	3	Of non-wan at admission, changed to wan and remained wan; Of non-wan at admission, changed to wan and back to non-wan; Of non-wan at admission, changed to wan and fluctuated Absent: Of non-wan at admission, % that remained non wan for the duration of the study or until discharge.		Wan: 3;2; 1	Wan: 94
46; 38	Morgan; Kunik	2012	DC	24	7	4	Incidence during follow-up period (incidence in first 5 months excluded in Morgan 2012, included in Kunik 2010).		Agg: 38 (Morgan); 41 (Kunik)	
34	Jost	1996	DC	Retro-spective using medical records	Retro-spective	Retro-spective	Documentation of onset of symptoms in medical records.		Irr: 77 Wan: 43	

## Elation

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Elation		
								Per measurement (%)	Over total follow-up (%)	Absent (%)
<b>Moderate dementia (MMSE 15-20)</b>										
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Cumulative incidence: the proportion of patients who were symptom free at baseline but developed the specific symptom at the next assessments.		4.6	

25	Gillette-Guyonnet	2011	DC	max 48	mean 5.1	6	Incidence of NPI 4 or higher per 100 person years and % events during 4 year follow-up in those without the symptom at baseline (between brackets).		3.9 (8.2)	
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4 .	3.6, 4.5, 2.7, 2.7		

### Sleep problems

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Sleep problems		
								Per measurement (%)	Over total follow-up (%)	Absent (%)
<b>Mild dementia (MMSE 21-26)</b>										
22	Eustace	2002	DC	24	3	12	Markov model. Transition probability for onset over 2 year period.	15		
<b>Moderate dementia (MMSE 15-20)</b>										
8	Berger	2005	DC	24	5	3-6	Absent at each measurement time over the 2 year period.			44
1	Aalten <sup>2</sup>	2005	DC	24	5	6	Cumulative incidence: the proportion of patients who were symptom free at baseline but developed the specific symptom at next assessments.		30.6	
25	Gillette-Guyonnet	2011	DC	max 48	mean 5.1	6	Incidence of NPI 4 or higher per 100 person years and % events during 4 year follow-up in those without the symptom at baseline (between brackets).		11.2 (21.5)	
<b>Severe dementia (MMSE 0-9)</b>										
55	Wetzels	2010	CH	24	5	6	No model. For each observation 0-1, 1-2, 2-3, 3-4.	1.8, 6.3, 4.7, 8.5		

Dementia severity not reported											
34	Jost	1996	DC	Retrospective using medical records	Retrospective	Retrospective	Documentation of onset of symptoms in medical records.			56%	

Reference numbers refer to the Online Reference List

Papers from the same study groups:

1a Predictors study 1: Columbia Medical Centre, John Hopkins University School of Medicine, Massachusetts General Hospital, USA

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2 Maasbed study

3 Ballard et al. (Psychiatry services in the West Midlands and a memory clinic in Bristol)

4 Haupt et al. (Outpatient clinic at the institute of psychiatry of the Technical University in Munich)

5 Hope et al. (Oxford)

Settings

DC=Dementia or memory clinic

POP=Population-based

CH=Care home

CLIN=Referred by clinicians

VOL=Volunteers

NR=Not reported

BPSD= behavioural and psychological symptoms of dementia

Apa=apathy

Dep=depression

Anx=anxiety

Irr=irritability/aggression

Agi=agitation

Hal=hallucination

Per=persecution

Mis=misidentification

Sle=sleep problems

Wan=wandering

Ela=elation

**Fig. DS3 Incidence of BPS reported in included studies**

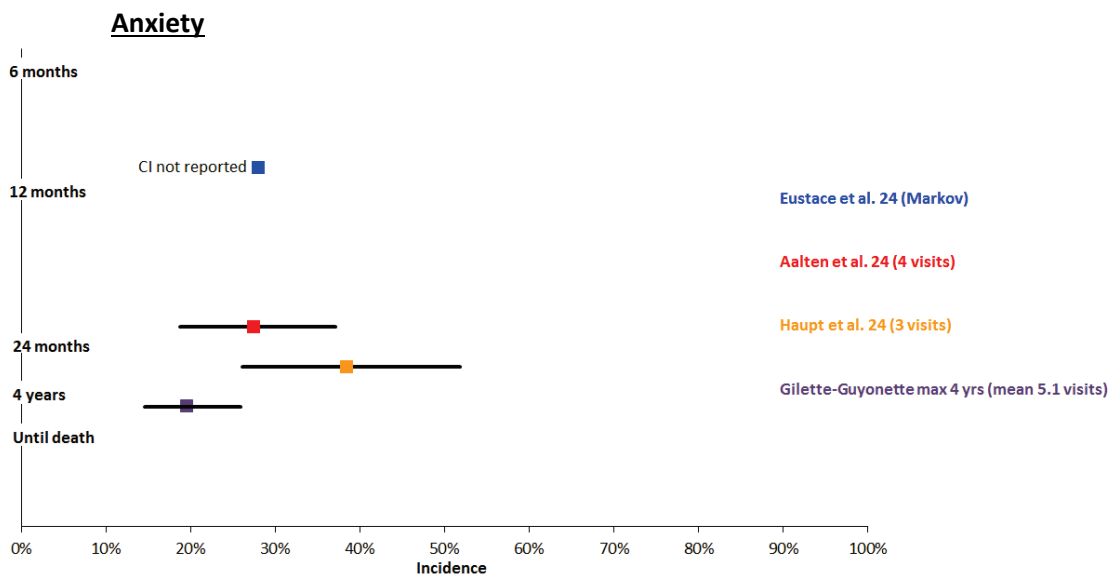
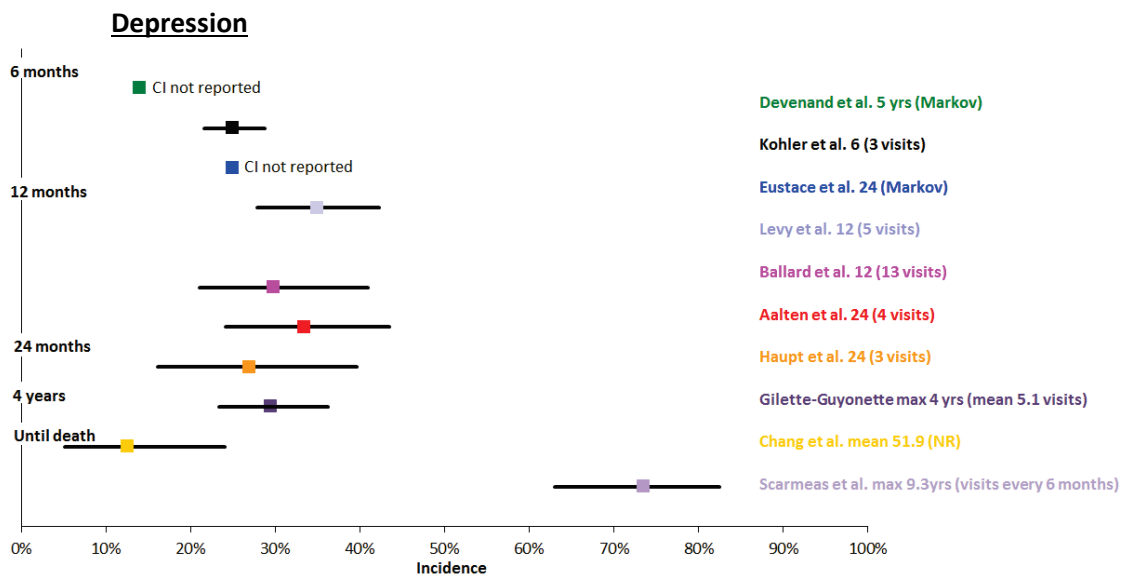
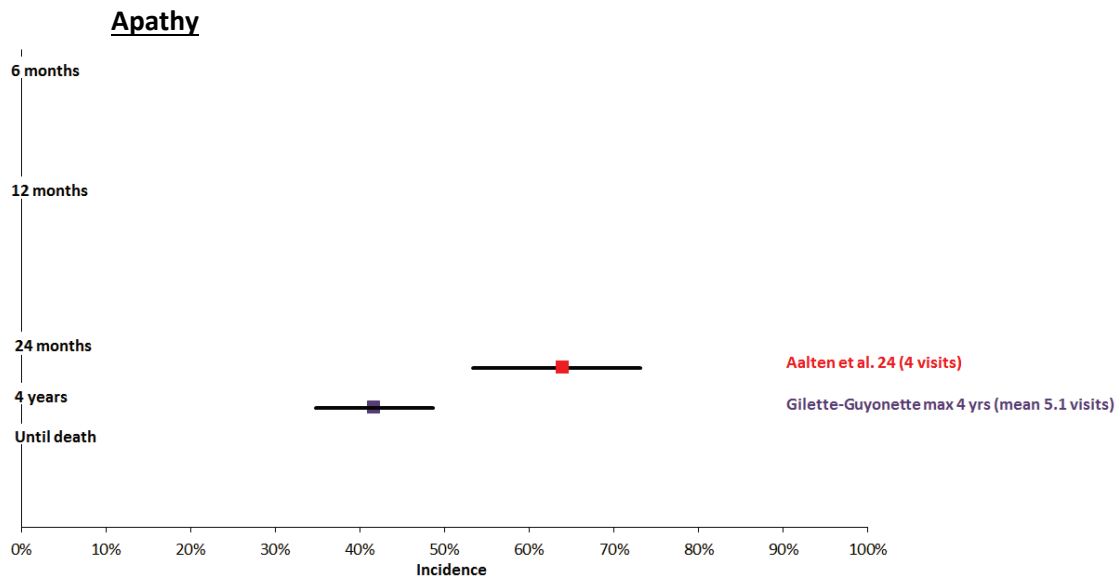


Fig. DS3 continued

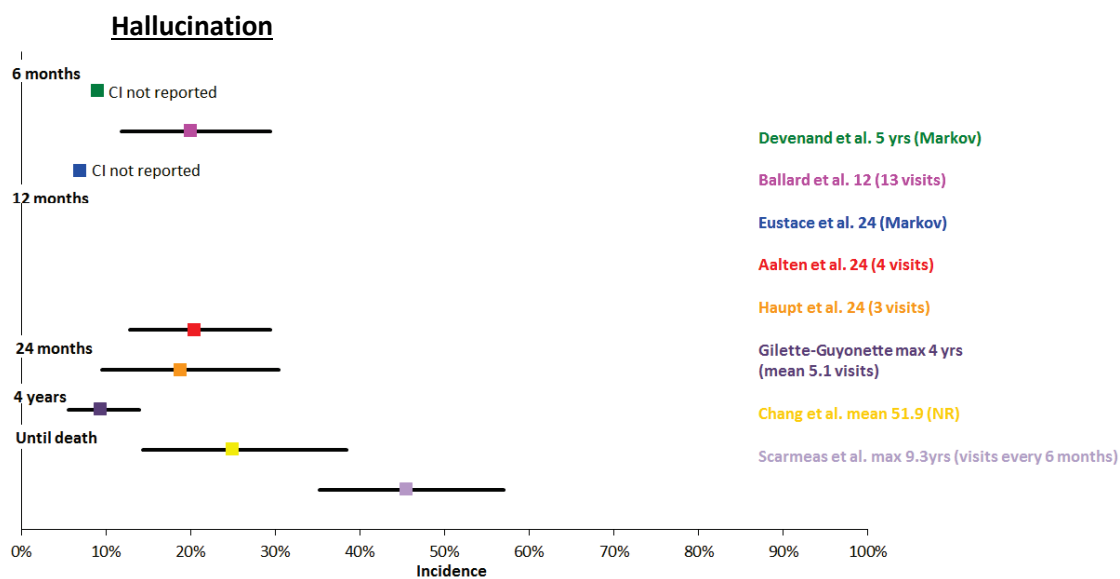
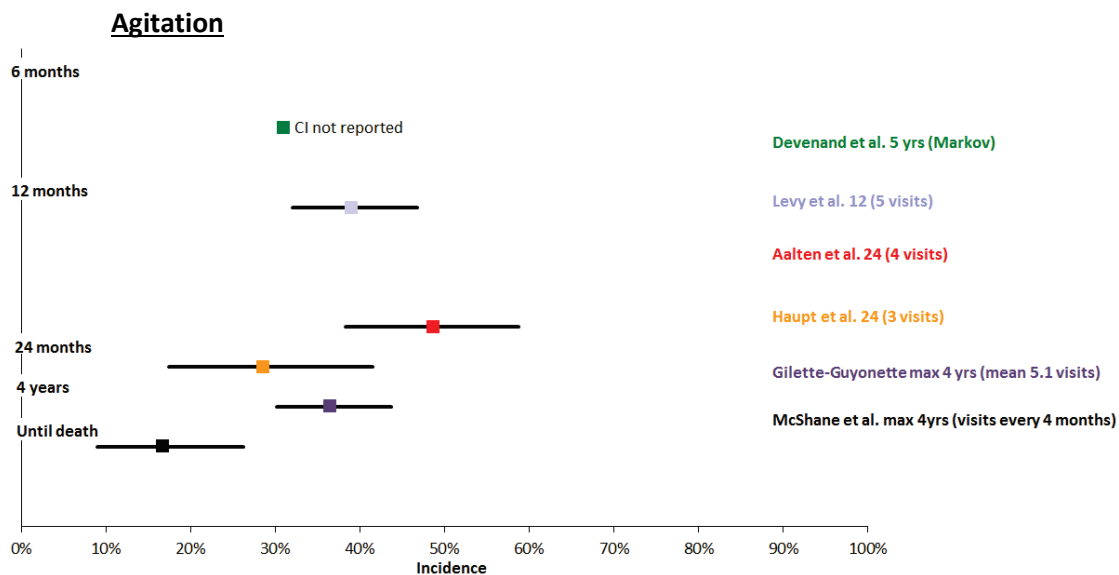
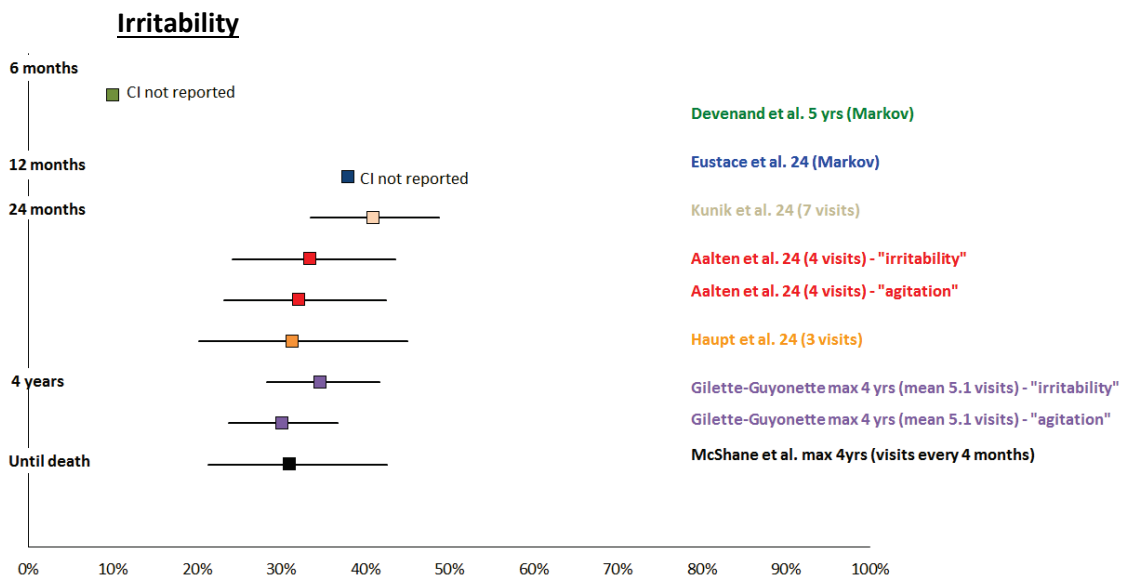


Fig. DS3 continued

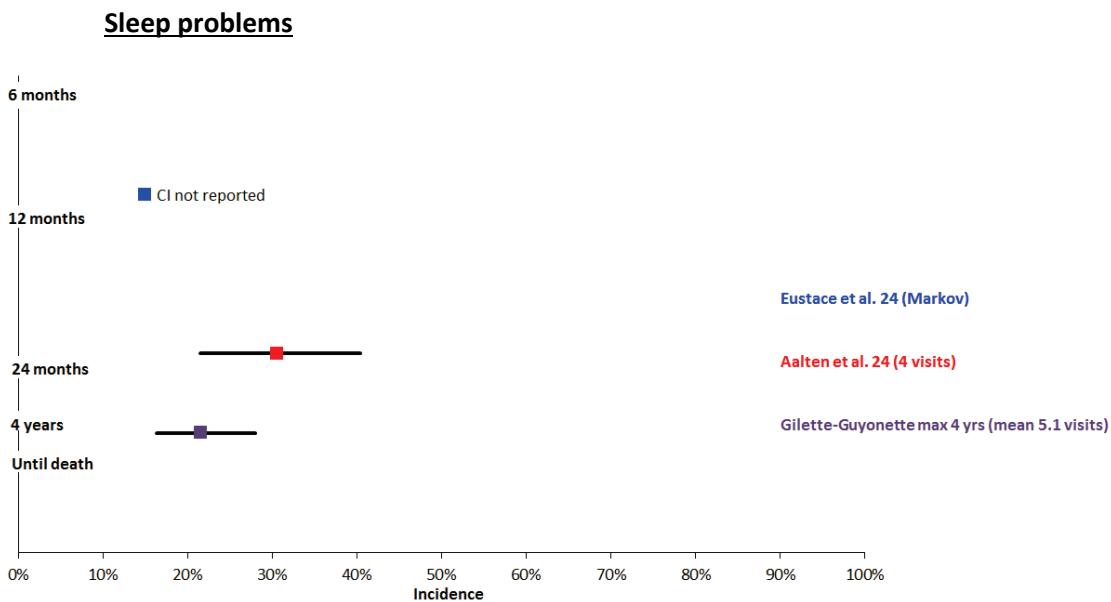
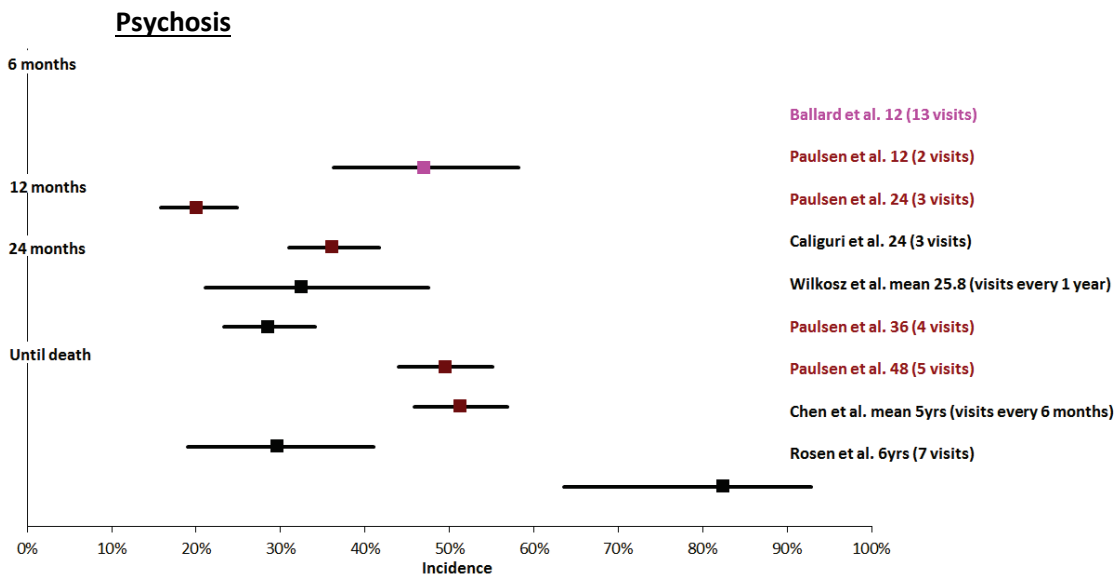
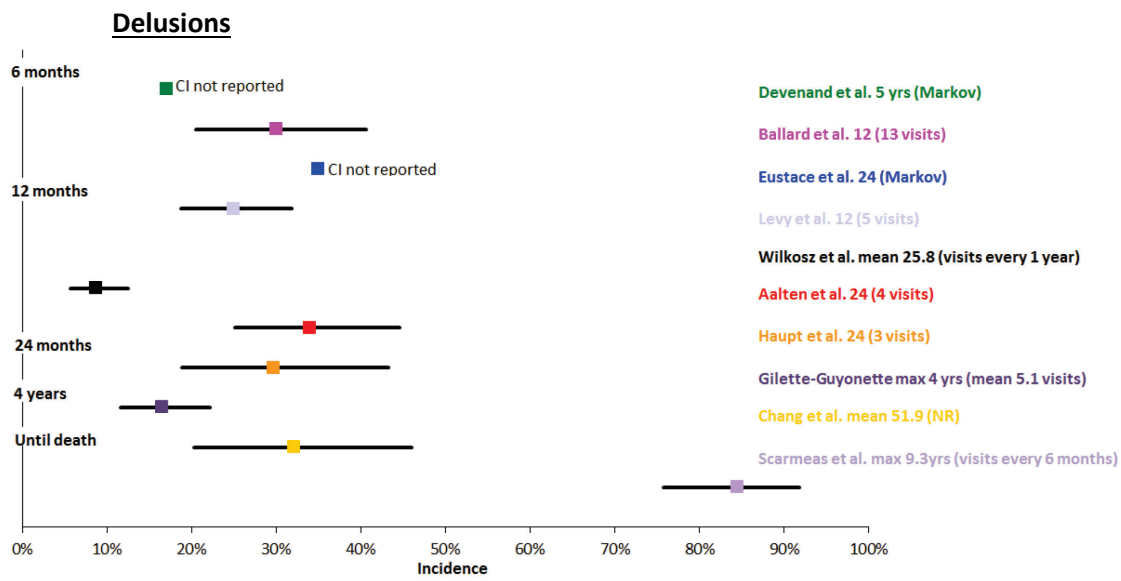
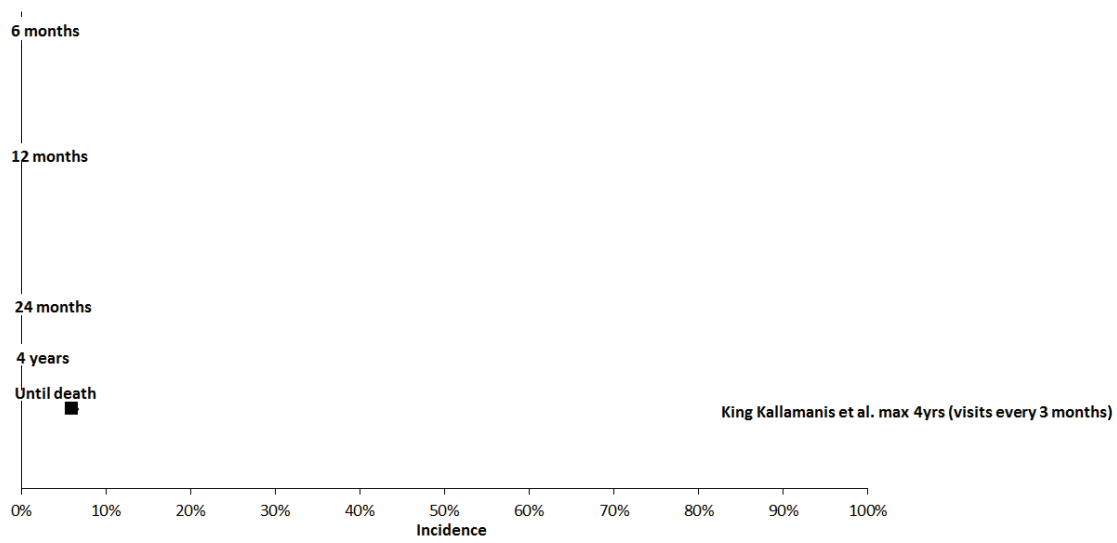
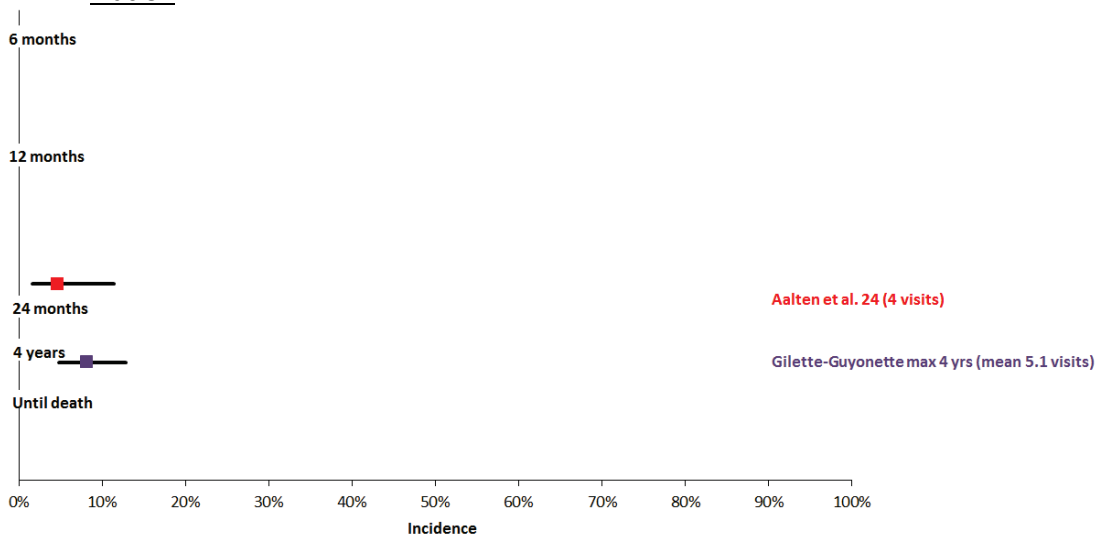


Fig. DS3 continued

Wandering



Elation



The figures show the percentage of participants in which new symptoms developed during the period indicated on the y-axis, and the 95% confidence interval. For each figure, a legend shows the author name, the duration of the total follow-up in months and the number of visits.



**Table DS5 Association BPSD and cognitive function**

**Affective symptoms**

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Covariates	Score	Depression / Anxiety / Apathy
<b>Moderate dementia (MMSE 15-20)</b>										
29	Holtzer <sup>1b</sup>	2005	DC	14yrs	28	6	Time-dependent Cox analysis to evaluate if cognitive status predicted the first episode of dep during follow-up. General estimating equation with cognitive status, functional activity and disease duration as predictors, taking into account the multiple visits per patient as well as the likelihood that an individual's characteristics correlate with each other over time. Dichotomous depression outcome, also results for categorical and continuous outcomes in paper.	Time, age, sex, education, cohort, antidepressant medication, Charlson comorbidity index.	1 Depression dichotomous exclusive of physical symptoms, 2 frequency of depression exclusive of physical symptoms (5 level scale), 3 total depression scores inclusive of physical symptoms.	Dep: Time dependent Cox analysis: mMMSE NS. GEE analysis with dichotomous outcome 1: mMMSE: 0.003 (0.000-0.006) (p=0.03), Time: -0.0022 (-0.037-0.007) (p=0.004), BDRS 0.002 (0.001-0.002) (p<0.001); mMMSE NS using other 2 depression outcomes.
2	Aalten <sup>2</sup>	2005	DC	24	5	6	Analyses of variance with repeated measures, overall between effects. MMSE at baseline and course of BPSD.	Age, sex, SES, MMSE and GDS at baseline. Also symptoms at baseline and duration of illness.	Three subsyndrome factors and NPI total score.	Dep: NR (both MMSE and GDS)
59	Zahodne	2013	DC	5.5yrs	mean 10.1	6	Latent growth curve modelling.	Cognitive decline and function.	CUSPAD dep, continuous.	Dep: higher level of dep was associated with worse initial functioning and faster subsequent cognitive and functional decline.
<b>Moderately severe dementia (MMSE 10-14)</b>										
43	McCarty	2000	DC	24	3	1	Mean response of the items that loaded on each factor. Test-retest correlations and mixed model analyses.	By 4 severity levels based on initial MMSE score.	BEHAVE-AD, total score 18 (6 questions with maximum score 3).	The patterns are similar for all factors (including Emotional/impulsive behaviours and apathy). Those with initial MMSE scores ranging from 11 to 30 (severity levels 1 and 2) tended to show increased memory and behavioural problems across time, whereas those with initial MMSE scores ranging from 1 to 10 (severity 3) tended to show stable scores across time.

Normal cognitive function (MMSE 27+, no dementia)										
37	Kohler	2010	POP	6	3	3	Linear mixed-model analysis was used to measure the association between depressive symptom severity and cognitive decline from baseline to 3- and 6-year follow-up.	Age, sex, education and baseline cognition scores.	Stability of depression was defined as a score within the upper quartile group on 2 consecutive assessments (baseline or follow-up (F1 or F2)). This produced four groups: highly depressed at baseline only, highly depressed at follow-up only and persistently highly depressed.	Participants who were persistently highly depressed over time showed a widespread pattern of decline, including memory ( $p<0.001$ ), processing speed ( $p=0.002$ ), and global cognition ( $p=0.0$ ) when compared to participants who were never highly depressed. They also performed lower on baseline measures of processing speed ( $p=0.04$ ) and attention and executive function ( $p<0.001$ ).
7	Becker	2009	POP	9yrs	9	12	Association between dep and cognitive function scores 1992-1999 which was then examined as a predictor of the development of dementia between 2002-2007. Cox proportional hazard models.	Age, ventricular grade.	CESD score or correlation variable of CESD and 3MSE scores.	No significant associations between non-dep/transiently dep/persistently dep in 1994-1998 and dementia after 1998-1999
53	Vinkers	2004	POP	4yrs	5	1	Separate linear mixed models. Additional annual increase of dep score per SD of cognitive function test score at baseline in those without dep at baseline ( $GDS15=<2$ ) (p).	Sex and educational level.	Total GDS-15 score.	Dep: Global cognitive function: -0.06 (0.17); Attention: 0.08 (0.05); Processing speed:-0.03 (0.42); Immediate recall: -0.17 (0.01); Delayed recall: -0.10 (0.02).
3	Amieva	2008	POP	4yrs	7	12-36	Longitudinal analyses were done using a semiparametric extension of the mixed-effects linear model. The mean changes of the scores are assumed to be smooth curves, approximated by cubic splines.		Total CES-D score.	Dep: CES-D score over time before diagnosis of dementia / control: Slight increase in score with some minor fluctuation. The score increased slightly but regularly in the pre-dementia group until the diagnosis and between 8 and 7 years before diagnosis the curve of the predementia group became distinguishable from that of the control subjects.
58	Wilson	2010	POP	8-9yrs	mean: 3.6	36	Change in depression scores using GEE models. The models included a term for time in years since baseline, indicators for MCI and AD, interactions of indicators with time. Also reported for depressive domains.	Age, sex, race, education.	CES-D score ranging from 0-10. Rate of 0.04 units per year equals 1 symptom per 25 years. Also Hamilton Depression Rating Scale, ranging from 0-235.	Dep: CES-D - Prediagnosis of AD: 0.04 (0.004); postdiagnosis of AD: -0.00 (0.913) Hamilton - scores did not change in any of the groups.

57	Wilson	2008	OTHER	13yrs	mean:7.8	24	Generalised estimating equation models to analyse change in depressive symptoms before the diagnosis of AD (compared to those who never developed dementia) during the study period, with a logit-link function and a binomial error. Because preliminary analyses with quadratic terms for time showed no evidence of nonlinear change, all analyses are of linear change.	Age, sex, education and interactions.	Treating the number of reported symptoms as a proportion of the 10 possible symptoms.	Dep: The rate of change in depressive symptoms in the incident AD subgroup did not differ from the rate in unaffected persons before the AD diagnosis ( $p=0.64$ ) or after it ( $p=0.62$ ). There was no systematic change in depressive symptoms in the unaffected subgroup or in the affected subgroup before ( $p=0.92$ ) or after ( $p=0.16$ ) the initial MCI diagnosis.
32	Houde	2008	DC	max:10	max:11 (unsure)	1	Cox proportional hazard of the association of symptoms and covariates with progression to dementia.	Age, education, MMSE score, Apoe E4 status.	GDS score.	Dep: Persistent dep associated with progression to AD. MCI individuals who remained MCI: depression tended to improve in the first two years of follow-up. MCI who progressed to dementia: persistence of depression until the year prior to diagnosis as AD. After diagnosis, depression improved.
21	Dotson	2008	VOL	max 26yrs	NR	24	Linear mixed models using the PROC MIXED procedure in SAS. Yields information on the unique effects of each predictor, including both fixed and random effects.	Baseline age, time interval and interval and interactions. Sex, self-reported race, educations and scores on the primary mental abilities vocabulary test.	Continuous CES-D score.	Dep: Higher average depressive symptoms were associated with poorer performance on TMT-A and TMT-B. Individuals with higher average CES-D scores showed greater longitudinal decline on CVLT-A, long delay free recall, BIMCS and MMSE. Some interaction effects. See table 5 and figure 3.
41	Mackin	2011	VOL	3yrs	4	12	Participants were classified 'MCI converters' if they were diagnosed with dementia within 3 years of their baseline evaluation or 'MCI cognitively stable' if they did not progress to dementia during this interval.			Dep: no difference in stability between cognitively stable and those who progressed to dementia.
9	Bielak	2011	POP	15yrs	5	2-6yrs	Bivariate dual change score models.	Age, education, baseline general cognitive ability and self-reported health.		Dep: the data best fit the hypothesis that depressive symptoms predict subsequent change in perceptual speed. More depressive symptoms predicted subsequently stronger declines in perceptual speed over time lags of 1 year.

Comparing cognitive groups										
33	Janzing	2000	CH	12	3	6	Logistic regression of dep and dementia.	Age, sex, physical illness and somatic complaints.		Subjects with and without dementia had comparable baseline prevalences of depressive caseness (12.2% compared to 11.1, ns) and depression subcaseness (20.4% compared to 28.9%, ns). This remained stable during 12 month follow-up.
10	Blansi	2005	DC	3-4yrs	3-4	12	Linear and quadratic curves were fitted to repeated symptom and MMSE measurements for each patient. Linear (increasing) or quadratic (inverse U-shaped) course as a function of MMSE scores.	Age, years of education and gender.		Dep: Sign test for the analysis of a linear course (increasing) was significant p<0.01; Quadratic (inverse U shaped) not significant.
11	Bunce	2012	PB	max 12yrs	max 4	4 yrs.	Latent growth models estimating the intercept and slope of dep and anx symptoms.	Cognitive measures.		Dep: Higher initial scores of dep significantly associated with poorer initial performance on SLMT, verbal fluency and episodic memory, dep slope NS Anx: Higher initial scores of anx associated with poorer verbal fluency, anx slope NS.
Dementia severity not reported										
17	Cohen-Mansfield	1998	CH?	24	5	6	Repeated measures multivariate analyses of variances (MANOVA).		CMAI syndrome scores: mean of behaviours comprising each type of agitation.	
42	Marin	1997	NR	mean 37.1	mean:6.0	6	Matched sample t-tests.			Dep: NS for any year.

### Psychotic symptoms

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Covariates	Score	Delusion / Hallucination / Misidentification
Moderate dementia (MMSE 15-20)										
28	Holtzer <sup>1a</sup>	2003	DC	5yrs	11	6	GEE analyses to calculate the odds of having each of the psychopathological behaviours as a function of cognitive status in the entire sample with all available patient visits.	Controlled for age, education and sex.		Del: mMMSE 39-57: ref; 33-38:1.4 (0.0314); 26-32: 2.3 (<0.0001); 14-25: 2.4 (<0.0001); 0-13: 1.1 (0.8356) Hal: mMMSE 39-57: ref; 33-38:2.0 (0.0287); 26-32: 2.6 (0.0009); 14-25: 3.3 (0.0001); 0-13: 2.6 (0.0059).
2	Aalten <sup>2</sup>	2005	DC	24	5	6	Analyses of variance with repeated measures, overall between effects. MMSE at baseline and course of BPSD.	Age, sex, social class, MMSE and GDS at baseline. Also symptoms at baseline and duration of illness.	Three subsyndrome factors and NPI total score.	MMSE at baseline related to higher level of psychosis at follow-up, F=3.5, p=0.034 - GDS NR.

49	Rosen	1991	DC	6yrs	7	1 yr.	Cognitive decline during entire follow-up for those who developed symptoms compared to those that did not.			Patients who developed psychosis exhibited a more rapid rate of cognitive decline on average during the entire follow-up period than those who did not develop psychosis (p<0.03).
<b>Moderately severe dementia (MMSE 10-14)</b>										
44	McShane <sup>5</sup>	1995	CLIN	4yrs	NR	4	Analysis of covariance.	Cortical Lewy bodies, visual problems, interaction term.	Proportion of all interviews at which hallucinations had been rated positively.	Hal: Cortical Lewy bodies associated with persistent hallucinations. Those who had ever had hallucinations (even if at only one interview) had significantly lower MMSE scores at their last interview (8.5 vs. 3.5, p=0.005); Cognitive decline did not have a significant independent effect on proportion of interviews with hallucinations, sum of squares 0.010, F=0.19, p=0.67.
26	Haupt <sup>4</sup>	1996	DC	24	3	1	Association of psychotic symptoms with rate of cognitive decline, multiple stepwise regression.	None	BEHAVE-AD, total score 18 (6 questions with maximum score 3).	Del: 12 months change - CAMCOG: 0.03 (NS), MMSE: 0.02 (NS), 24 months change - CAMCOG: 0.27 (significant), MMSE: 0.13 (NS) Hal: 12 months change - CAMCOG: 0.03 (NS), MMSE: 0.04 (NS), 24 months change - CAMCOG: 0.01 (NS), MMSE: 0.01 (NS)

### Hyperactivity symptoms

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Covariates	Score	Irritability / Agitation / Wandering
<b>Moderate dementia (MMSE 15-20)</b>										
51	Scarmeas <sup>1b</sup>	2007	NR	14yrs	max:25	6	Cox models predicting cognitive function by disruptive behavioural symptoms as time-dependent covariates. Also sundowning, also unadjusted results reported.	Controlled for cohort, recruitment centre, age, sex, education, baseline MMSE, baseline blessed dementia rating scale score, comorbidity index, use of cholinesterase inhibitors and use of neuroleptics.	Disruptive behavioural symptoms.	Agi: HR=1.64 (1.16-2.33) Wan: NS Irr: NS Total score: Sum (0-5): HR=1.21 (1.07-1.36); Any (0-1) HR=1.45 (1.03-2.03).
28	Holtzer <sup>1a</sup>	2003	DC	5yrs	11	6	GEE analyses to calculate the odds of having each of the psychopathological behaviours as a function of cognitive status in the entire sample with all available patient visits.	Controlled for age, education and sex.		Wan: mMMSE 39-57: ref; 33-38:1.5 (0.0568); 26-32: 2.0 (0.0064); 14-25: 3.3 (<0.0001); 0-13: 4.2 (<0.0001) Irr: mMMSE 39-57: ref; 33-38:3.5 (0.0016); 26-32: 3.1 (0.0001); 14-25: 3.6 (<0.0001); 0-13: 9.0 (<0.0001).
2	Aalten <sup>2</sup>	2005	DC	24	5	6	Analyses of variance with	Age, sex, SES, MMSE	Three subsyndrome factors	Hyperactivity - Significant interaction between time and

							repeated measures, overall between effects. MMSE at baseline and course of BPSD.	and GDS at baseline. Also symptoms at baseline and duration of illness.	and NPI total score.	GDS, F=4.9, p=0.008 - MMSE NR.
<b>Moderately severe dementia (MMSE 10-14)</b>										
31	Hope <sup>5</sup>	2001	CLIN	Cog	9yrs	mean:10.5	MMSE score at onset of behaviour and at death in participants included in the study for more than one year.	Period with dementia.		Lower MMSE score and death associated with wan (p<0.05). Median MMSE scores at onset suggests progression from excessive but appropriate walking, attempts to leave the home and pottering, through to clear hyperactivity that becomes increasingly aimless and inappropriate.
45	McShane <sup>5</sup>	1998	CLIN	4yrs	NR	4	Relationship between symptoms and cognitive function in first year using Pearson X <sup>2</sup> or student's t statistics as appropriate.			MMSE in year after entry lower in those with physical aggression than in those without (8.1 compared to 15.7, p<0.003) and in those with hyperactivity than in those without (9.2 compared to 16.0, p=0.001).
4	Asada	1999	DC + VOL	5yrs	6	1	Symptom change by baseline CDR stage: Repeated measurement analysis with the PROC MIXED program based only on the data for the subjects who completed all six assessments. Four candidate models were proposed: constant correlation, correlation declining exponentially with time, no mathematical pattern and no relation. Association symptom change and level of global impairment.		Behavioural factor score.	See figure 1 and 2 Hyperactivity: CDR 2 and 3: slopes of the lines for hyperactivity showed a significant downward trend. Factor score reached its peak during the CDR 2 stage and followed a linear downward trend thereafter. Agitation: CDR 2 Significant downward trend, CDR 3 NS.
<b>Severe dementia (MMSE 0-9)</b>										
12	Burgio	2007	CH	18	4	6	Examined cognitive status modelling time as a regression variable to compare cognitive status at specific times.			Irr: Staff: no difference; Obs: profoundly impaired (MMSE=<7) changed little, moderately impaired (MMSE>7) symptoms improved slightly up to 12 months and worsened at the 18 month point.
<b>Comparing cognitive groups</b>										
10	Blansi	2005	DC	3-4yrs	3-4	12	Linear and quadratic curves were fitted to repeated symptom and MMSE measurements for each patient. Linear (increasing) or quadratic (inverse U-shaped) course as a function of MMSE scores.	Age, years of education and gender.		Agi: Disturbing behaviour: Linear and quadratic not significant.

Dementia severity not reported											
17	Cohen-Mansfield	1998	CH?	24	5	6	Repeated measures multivariate analyses of variances (MANOVA)				Agi: Physical non-aggressive behaviour: those with moderate or severe impairment increased twice as much as those who were cognitively intact at baseline, average increases were 0.30, 0.35 and 0.14. Verbally non-aggressive behaviour: all groups showed relatively constant levels over time, with the group with moderate levels of impairment manifesting consistently higher levels of agitation. Irr: Both types of aggressive behaviours show increases over time, not significantly influenced by cognitive function
42	Marin	1997	NR	mean 37.1	mean:6.0	6	Matched sample t-tests				Agi: NS for any year Pacing: Significant yearly change from baseline to year 1 (0.39 points, p=0.003) Irr: NS for any year

### Elation

No results

### Sleep problems

No results

### Total BPSD score

	Author	Year	Setting	Months follow-up	n BPSD measures	Time between measures (months)	Details	Covariates	Score	Total score
Moderate dementia (MMSE 15-20)										
2	Aalten <sup>2</sup>	2005	DC	24	5	6	Analyses of variance with repeated measures. MMSE at baseline and course of BPSD	Age, sex, SES, MMSE and GDS at baseline. Also symptoms at baseline and duration of illness	Three subsyndrome factors and NPI total score	Significant interaction between time and GDS score and the NPI total score, F=4.9, p=0.008. Severe dementia: scores decreased, mild dementia: scores increased - MMSE NR
Dementia severity not reported										
42	Marin	1997	NR	mean 37.1	mean:6.0	6	Matched sample t-tests			Total scores did not worsen significantly during any study year (year 1: p>-.05, year 2: p>0/1, year 3: p>0.1, year 4: p>0.1, year 5: p>0.1)

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Papers from the same study groups:

1a Predictors study 1: Columbia Medical Centre, John Hopkins University School of Medicine, Massachusetts General Hospital, USA

1b Predictors study 2: 3 centres in USA (see 1a) and 2 centres in Europe (Paris and Greece)

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Agi=agitation

Hal=hallucination

Per=persecution

Mis=misidentification

Sle=sleep problems

Wan=wandering

Ela=elatio



**Table DS6 Adherence to the PRISMA reporting guidelines**

Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Title page
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	According to journal guidelines
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Introduction section
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Not relevant.
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Not available
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Methods – eligibility criteria
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Methods – search methods
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	eFigure1

Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Methods – data synthesis
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Methods – data synthesis
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Methods – data synthesis
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Not assessed
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Methods – data synthesis
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	Not applicable
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Not assessed
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	Not applicable
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Results – characteristics – search results (text box)
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	eTable 1
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Not assessed
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	No interventions. Results Figure 2 and Figure 3
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Not applicable

Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Not assessed
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	Not applicable
<b>DISCUSSION</b>			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Discussion
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Discussion
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Discussion
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Acknowledgements Abstract

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org)

## Online reference list of included studies

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