ORIGINAL ARTICLE

The Prevalence and Incidence of Dementia: a Systematic Review and Meta-analysis

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ABSTRACT: ***Introduction:*** Dementia is a common neurological condition affecting many older individuals that leads to a loss of independence, diminished quality of life, premature mortality, caregiver burden and high levels of healthcare utilization and cost. This is an updated systematic review and meta-analysis of the worldwide prevalence and incidence of dementia. ***Methods:*** The MEDLINE and EMBASE databases were searched for relevant studies published between 2000 (1985 for Canadian papers) and July of 2012. Papers selected for full-text review were included in the systematic review if they provided an original population-based estimate for the incidence and/or prevalence of dementia. The reference lists of included articles were also searched for additional studies. Two individuals independently performed abstract and full-text review, data extraction, and quality assessment of the papers. Random-effects models and/or meta-regression were used to generate pooled estimates by age, sex, setting (i.e., community, institution, both), diagnostic criteria utilized, location (i.e., continent) and year of data collection. ***Results:*** Of 16,066 abstracts screened, 707 articles were selected for full-text review. A total of 160 studies met the inclusion criteria. Among individuals 60 and over residing in the community, the pooled point and annual period prevalence estimates of dementia were 48.62 ($CI_{95\%}$: 41.98-56.32) and 69.07 ($CI_{95\%}$: 52.36-91.11) per 1000 persons, respectively. The respective pooled incidence rate (same age and setting) was 17.18 ($CI_{95\%}$: 13.90-21.23) per 1000 person-years, while the annual incidence proportion was 52.85 ($CI_{95\%}$: 33.08-84.42) per 1,000 persons. Increasing participant age was associated with a higher dementia prevalence and incidence. Annual period prevalence was higher in North America than in South America, Europe and Asia (in order of decreasing period prevalence) and higher in institutional compared to community and combined settings. Sex, diagnostic criteria (except for incidence proportion) and year of data collection were not associated with statistically significant different estimates of prevalence or incidence, though estimates were consistently higher for females than males. ***Conclusions:*** Dementia is a common neurological condition in older individuals. Significant gaps in knowledge about its epidemiology were identified, particularly with regard to the incidence of dementia in low- and middle-income countries. Accurate estimates of prevalence and incidence of dementia are needed to plan for the health and social services that will be required to deal with an aging population.

RÉSUMÉ: Prévalence et incidence de la démence : revue systématique et méta-analyse. ***Contexte:*** La démence est une maladie neurologique fréquente touchant de nombreuses personnes âgées. Elle est la cause de la perte de l'indépendance, d'une qualité de vie altérée, d'une mortalité prématurée et constitue un fardeau important pour les soignants. Elle entraîne une utilisation et un coût élevé de soins de santé par ces patients. Nous avons effectué une revue systématique et une méta-analyse à jour de la prévalence et de l'incidence de la démence à travers le monde. ***Méthodologie:*** Nous avons identifié les études pertinentes publiées entre 2000 (1985 pour les publications canadiennes) et juillet 2012 dans les bases de données MEDLINE et EMBASE. Les articles choisis pour un examen du texte intégral ont été inclus dans l'examen systématique s'ils fournissaient une estimation originale à l'échelle populationnelle de l'incidence et/ou de la prévalence de la démence. Nous avons également recherché des études additionnelles dans la liste de références incluse dans ces articles. Deux évaluateurs ont revu indépendamment les résumés et le texte intégral des publications ainsi que l'extraction des données et ils en ont évalué la qualité. Nous avons utilisé des modèles à effets aléatoires et/ou de méta-régression pour générer des estimations regroupées par âge, sexe, milieu (communauté, institution ou les deux), critères diagnostiques utilisés, lieu (continent), et année de collecte des données. ***Résultats:*** Parmi les 16 066 résumés revus, 707 articles ont été choisis pour une revue du texte intégral. En tout, 160 articles rencontraient les critères d'inclusion. Chez les individus de 60 ans et plus demeurant dans la communauté, les estimés regroupés de prévalence ponctuelle et annuelle de démence étaient de 48,62

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(IC à 95%: 41,98 à 56,32) et 69,07 (IC à 95%: 52,36 à 91,11) par 1 000 personnes respectivement. Le taux d'incidence regroupée (même âge et contexte) était de 17,18 (IC à 95%: 13,90 à 21,23) par 1 000 personnes-années alors que la proportion d'incidence annuelle était de 52,85 (IC à 95%: 33,08 à 84,42) par 1 000. Un âge croissant des participants était associé à une prévalence et à une incidence plus élevées de démence. La prévalence annuelle pour une période donnée était plus élevée en Amérique du Nord qu'en Amérique du Sud, en Europe ou en Asie (en ordre décroissant de prévalence par période) et plus élevée dans un contexte institutionnel par rapport à la communauté et aux deux contextes combinés. Le sexe, les critères diagnostiques (sauf pour la proportion d'incidence) et l'année de la collecte des données n'étaient pas associés à des estimations de prévalence ou d'incidence significativement différentes au point de vue statistique, bien que les estimations étaient constamment plus élevées chez les femmes que chez les hommes. ***Conclusions:*** La démence est une maladie neurologique fréquente chez les individus plus âgés. Nous avons identifié d'importantes lacunes dans les connaissances sur l'épidémiologie, particulièrement en ce qui concerne l'incidence de la démence dans les pays à revenu faible et intermédiaire. Des estimations exactes de la prévalence et de l'incidence de la démence sont nécessaires pour la planification des services de santé et des services sociaux qui seront requis par une population vieillissante.

Keywords: dementia, meta-analysis, systematic review

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Introduction

Dementia as defined in the *Diagnostic and Statistical Manual of Mental Disorders–IV–Text Revision* (DSM–IV–TR) is an acquired condition marked by impairments in memory and at least one other cognitive domain that are severe enough to cause significant limitations in social and/or occupational functioning and are not accounted for by a delirium or another Axis I disorder.[1] The DSM–5 renames dementia as *major neurocognitive disorder*.[2] For diagnosis there must be evidence of significant decline in at least one cognitive domain that is severe enough to interfere with independence in everyday activities.[2] Compared to earlier versions of the DSM, memory loss and impairments in multiple cognitive domains are no longer required features.[2] The various causes of dementia are categorized by their neuropathology, clinical features and/or presumed aetiology. The commoner ones encountered in middle-aged and older individuals are Alzheimer's disease, vascular, Lewy body and frontotemporal dementia. They occur either as the sole cause of dementia (i.e., "pure" disease) or as combinations of two or more brain pathologies.

In addition to its significant personal toll, dementia is a major contributor to healthcare costs.[3] A 2013 report estimated that the annual cost of dementia in the United States was $157–215 billion US.[4] The total economic burden of dementia in Canada in 2008 was estimated to be $15 billion dollars.[5] The World Health Organization recognized dementia as a public health priority in 2012.[6] Age is the most important risk factor for dementia, with prevalence doubling every 5 years after 65 (from approximately 2-3% in those 65-69 to 30%+ among individuals over 80).[7-12] It might also be more common among women, though the literature is inconsistent on this point.[12,13] High prevalence estimates are found in long-term care institutions,[14] with the majority of those in these settings with moderate to severe dementia.[15] With societal aging, the burden of this condition will increase over the coming years. It is anticipated that the number suffering from dementia worldwide will double by 2030 and triple by 2050.[6]

Whether the incidence and/or prevalence of dementia are changing over time is a key question about the epidemiology of this condition. Recent studies suggest that the age-adjusted incidence and/or prevalence of dementia in older populations could be changing over time but not in a consistent pattern, with estimates decreasing in high-income countries but increasing in middle-income ones. As an example of the former, investigators using data from the Rotterdam Study reported a nonsignificant decline in age-adjusted incidence rates between 1990 and 2010 among those 65+ (incidence rate ratio 0.75, $CI_{95\%}$: 0.56-1.02), possibly on the basis of better control of vascular risk factors. In parallel with an increase in the use of antithrombotics and lipid-lowering drugs over time, brain MRIs showed fewer lacunar infarcts.[16] It is plausible that improved cardiovascular risk management would be associated with a decreased incidence but stable prevalence (or a prevalence that is decreasing less markedly than incidence) of dementia as populations affected by dementia would live longer. Matthews et al.[17] of the UK Medical Research Council Cognitive Function and Ageing Study (CFAS) found that the age- and sex-standardized prevalence of dementia among those 65+ years of age in three geographically defined areas of England was 65 per 1000 in 2011. This was significantly lower than the predicted rate based on 1991 data of 83 per 1000. There was a lower response rate in the 2011 study, but sensitivity analyses suggest that the estimates were robust to this. On the other hand, a systematic review of reports on the epidemiology of dementia in China found that the prevalence rose from 18 per 1,000 (65-69 years of age) and 421 per 1000 (95-99 years) to 26 per 1000 and 605 per 1000 respectively, between 1990 and 2010.[18] With societal aging worldwide, the number of individuals with dementia will increase, but there is uncertainty about what the actual number will be.[19] Aside from the importance of having accurate up-to-date figures for planning services to deal with the needs of those suffering from dementia, a better understanding of whether incidence and/or prevalence is changing would have important scientific and clinical consequences. For one thing, a decline would suggest that future rates are partially modifiable and that effectively dealing with modifiable risk factors might delay the onset if not entirely prevent the development of dementia as we age.

The specific objectives of this report are to: (1) provide estimates of the overall worldwide prevalence and incidence of dementia; (2) examine factors that underlie the heterogeneity of estimates (age, sex, setting [i.e., community, institution, both], diagnostic criteria, location of study [i.e., continent]); and (3) search for evidence of change over time in the prevalence and/or incidence of dementia. This study updates and extends the scope of previous reports on the epidemiology of this condition.[9-14]

Methods

This is one in a series of systematic reviews on the prevalence and incidence of priority neurological conditions funded by the Public Health Agency of Canada as part of the National Population Health Study of Neurological Conditions.[20]

Search Strategy

The systematic review and meta-analysis were conducted according to a predetermined protocol based on the PRISMA statement for systematic reviews and meta-analyses.[21] Study authors with expertise in dementia and disease epidemiology and a research librarian with systematic review expertise developed the search strategy and terms (see Appendix A). The MEDLINE and EMBASE databases were searched from January 1985 to February 2011, with references exported and managed using EndNote X5.[22] The search was updated in July of 2012. Due to the availability of prior systematic reviews covering earlier time periods, only international studies published after 1999 were included in our systematic review. Because of the national focus of this project, Canadian studies published between 1985 and 1999 were also included in order to ensure that the Canadian Study of Health and Aging (a large and impactful national study on the epidemiology of dementia) was captured.[9] Articles had to be published in either English or French. The reference lists of included articles were manually searched for additional relevant references.

Study Selection

Two reviewers independently screened the titles and abstracts of all identified references to determine if they appeared to report original data on the prevalence or incidence of dementia. Studies clearly not population-based were excluded at this stage. Two reviewers independently examined the full-text articles identified in the first phase. For inclusion in the systematic review, articles had to meet the following criteria: (1) original research; (2) population-based; and (3) reported an incidence and/or prevalence estimate of dementia. Reviewers fluent in the language of the article examined the paper. Disagreements pertaining to the inclusion of articles were resolved by consensus and, if not reached, by involvement of a third study author.

Data Extraction and Study Quality

Two reviewers independently extracted and reached agreement on data from included articles using a standard data collection form. When multiple articles reported data from the same study population, the reviewers made a judgment as to the most comprehensive and accurate data available, which was then used in analyses. In cases where the studies reported on different timeframes or subgroups (e.g., by sex or age), all data were included. Demographic data recorded included age, sex, study setting (i.e., community, institution, both), and geographic location of study (i.e., continent, country). As not all studies reported on the mean or median age of participants, the youngest age of participants included in a study was employed in our analyses of age. The definitions/diagnostic criteria used for determining the presence of dementia were noted. Incidence and prevalence estimates of dementia from each study were recorded, along with any stratification by age, sex or year of data collection. The quality of the included studies was evaluated using an assessment tool[23,24] (Appendix B) that assessed such factors as sample representativeness, methods used to determine the presence of dementia, and statistical methods. Each study was given a quality score that ranged from 0 (lowest) to 8 (highest). ANOVA testing was done to determine if study quality varied by location of study (i.e., continent).

Data Synthesis and Analysis

The significance of the impact of age, sex, setting, diagnostic criteria, continent and year of data collection (i.e., when the study was done) on incidence and prevalence estimates was assessed using meta-regression. Age was examined using the youngest age of participants in the study as a continuous variable. Sex, setting, diagnostic criteria and location (i.e., continent) were examined as categorical variables. Changes over time were examined in three separate sensitivity analyses using study start, midpoint and end-years of data collection. All pooled estimates provided are restricted to studies reporting on people aged 60+, 65+ or 70+ to mitigate the potential confounding effects of age. Estimates were also stratified by study setting to limit potential confounding by disease severity. Finally, all estimates reporting on a period (e.g., period prevalence) were converted to annual estimates (e.g., annual prevalence) without restricting time-years.

To be eligible for inclusion in the meta-analysis, studies had to provide either the estimate with 95% confidence intervals ($CI_{95\%}$), or the number of dementia cases along with the sample size, so the prevalence or incidence estimates could be calculated. Additionally, a subgroup was only included in the subgroup analysis if more than one study was available for that subgroup.

To assess for significant between-study heterogeneity, the Cochrane Q statistic was calculated and I^2 was used to quantify the magnitude of between-study heterogeneity. All the pooled estimates and 95% confidence intervals were calculated using a random-effects model. Publication bias was investigated visually using funnel plots and statistically using Begg's[25] and Egger's[26] tests.

All statistical analyses were carried out with *R* version 2.14.[27] The *meta* package was employed to produce the pooled estimates, forest plots and publication bias assessment.[28] The *metafor* package was used to conduct the meta-regression using restricted maximum likelihood estimation.[29] A p value <0.05 was deemed to be statistically significant.

Results

Identification and Description of Studies

The search strategy yielded a total of 16,066 citations, including duplicates (8,743 from MEDLINE and 7,323 from EMBASE). A total of 707 articles were selected for full-text review (Figure 1), of which 547 were excluded (i.e., 230 were international studies published before 2000, 164 did not report an incidence or prevalence of dementia, 114 were not population-based, while 39 provided no original data). An additional four articles were identified by the updated search, while manual reference searching of included papers led to an additional 12 articles, though these papers did not report estimates of overall dementia, but rather only reported on dementia subtypes. Thus, a total of 160 studies were retained, the characteristics of which are shown in Tables 1–3. Twenty studies were not eligible for meta-analysis because they reported duplicate data or did not provide the information necessary to calculate an estimate. A total

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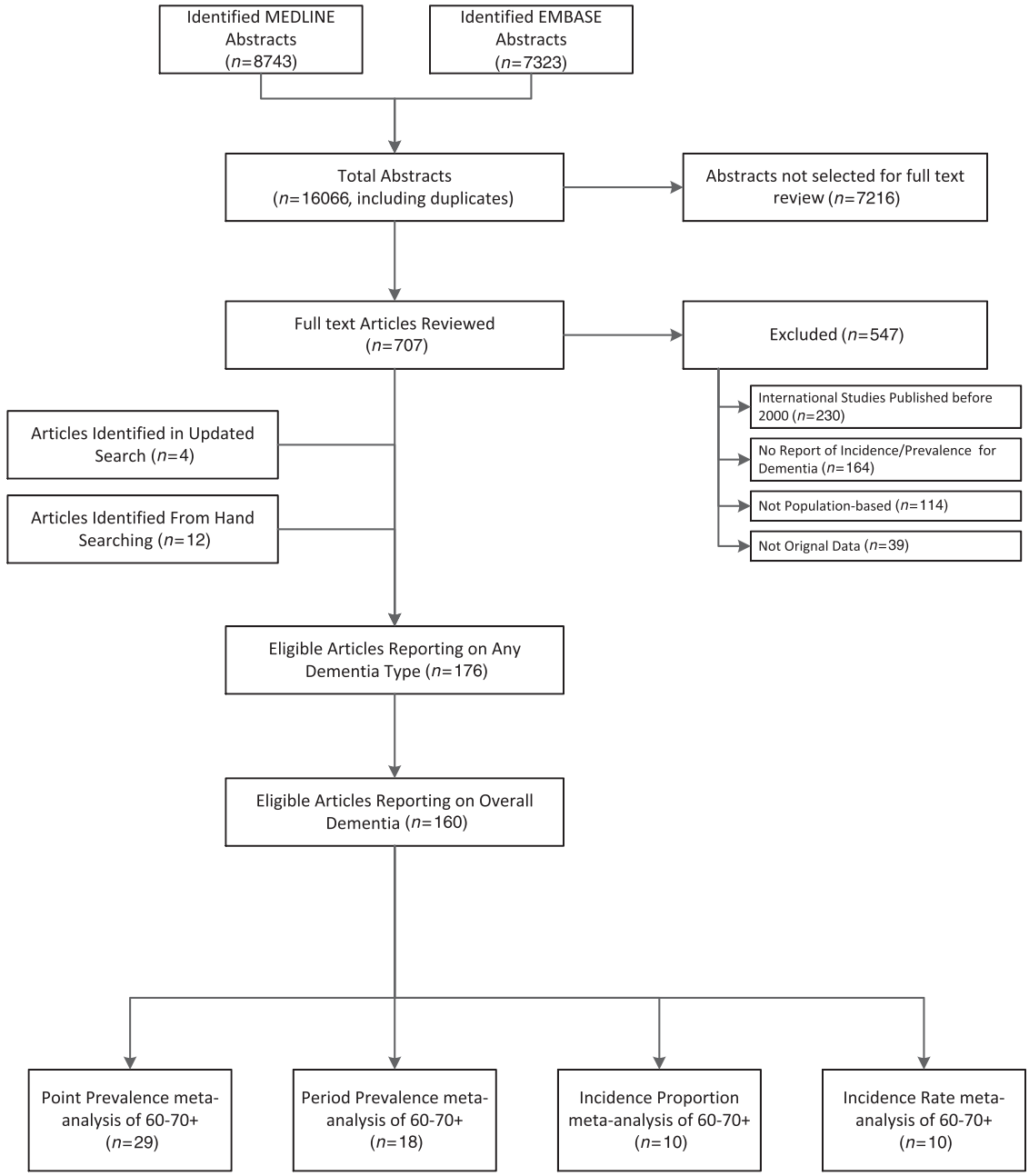

Figure 1: *Study flow diagram.*

of 67 studies met the eligibility criteria (described earlier) for inclusion in the meta-analysis of those aged 60+, 65+ or 70+ years.

Of the 160 total studies, 111 reported on prevalence,[9,11,14,30-137] 44 on incidence,[8,10,138-179] and 5 on both.[7,180-183] Sixty-three originated from Europe, 45 Asia, 43 North America, 7 South America, 5 Australia and 4 Africa (seven studies reported on data from more than one continent).

Prevalence of Dementia

Sixty-six articles reported on the point prevalence of dementia,[7,9,32,33,36,38,40-45,47,50-52,54-57,64,67-69,71,73-75,77-80,82,83,88-90,97,98,101-103,105-109,112-115,117,120,121,123-125,127-131,133,135,137,181] with 29 eligible for inclusion (i.e., provided an estimate with 95% confidence intervals, etc.) in the meta-analysis of those including populations aged 60+, 65+ or 70+ years.[9,32,33,38,41-43,50-52,54,67,71,73,75,78,82,89,90,98,113,120,123-125,129,131,135,181]

In all studies reporting on the point prevalence of dementia ($n = 66$), the majority of studies used a single data source to identify cases ($n = 51$). These included door-to-door surveys ($n = 16$), registry studies ($n = 10$), other sources ($n = 10$), administrative databases ($n = 3$), mail surveys ($n = 1$) and hospital/clinic reviews ($n = 1$). It was not possible to determine the data source in 10 of these studies. A total of 15 studies used multiple data sources. Half ($n = 33$) of the 66 included studies used a single diagnostic method, including a standardized assessment by a healthcare

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Table 1: Studies Reporting on the Prevalence of Dementia

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
Anttila (2002)	FINLAND	100+	Other	Health professional	NINCDS-ADRDA; NINDS-AIREN	1998	Overall Male Overall Female Overall
Anttila (2004)	FINLAND *Kupio and Joensuu*	70+	Cannot determine	Health professional	DSM-IV	1998	Overall
Banerjee (2008)	INDIA *Kolkata*	50+	Door-to-Door survey	Health professional	DSM-IV	2002-2003	Overall Male 51-60 Male 61-64 Male 65-70 Male 71-80 Male 81+ Male Overall Female 51-60 Female 61-64 Female 65-70 Female 71-80 Female 81+ Female Overall 51-60 61-64 65-70 71-80 81+ 60+
Bennett (2003)	AUSTRALIA	75+	Door-to-Door survey	Health professional	McKeith	1997-1999	Overall
Bermejo-Pareja (2008)	SPAIN *Las Margaritas, Lista, Arevalo*	65+	Door-to-Door survey Mailed survey	Health professional Administrative data codes Medical chart review	DSM-IV	1997-1998	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-90 Male 90+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-90 Female 90+ Female Overall 65-69 70-74 75-79 80-84 85-90 90+ Overall

Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
Borjesson-Hanson (2004)	SWEDEN *Goteborg*	95+	Census	Health professional Medical chart review	DSM-III-R	1996-1998	Male Overall Female Overall Overall
Bottino (2008)	BRAZIL *Sao Paulo*	60+	Door-to-Door survey	Health professional Imaging test	DSM-IV	2000	Overall 60-64 65-69 70-74 75-79 80-84 85-89 90+ Female Overall Male Overall
Canadian Study of Health and Aging Working Group (1994)	CANADA	65+	Administrative Databases	Health professional	DSM-III-R	1991-1992	Male 85+ Female 85+ Overall Male 65-74 Male 75-84 Male 85+ Male Overall Female 65-74 Female 75-84 Female 85+ Female Overall 65-74 75-84 85+
Cristina (2001)	ITALY *Belgioioso, Casorate Primo, Cava Manara, S. Martino Siccomario*	65+	Door-to-Door survey	Health professional	DSM-III-R	1992-1993	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85+ Female Overall 65-69 70-74 75-79 80-84 85+ Overall
Dahl (2007)	SWEDEN	65+	Registry	Health Professional; Administrative Data Codes	DSM-IV	2005	Overall

Das (2006)	INDIA *Kolkata*	50+	Door-to-Door survey	Health professional	DSM-IV	2003-2004	Overall Male Overall Female Overall Male 50-59 Male 60-69 Male 70-79 Male 80+ Female 50-59 Female 60-69 Female 70-79 Female 80+
Das (2008)	INDIA *Kolkata*	60+	Door-to-Door survey	Health professional	DSM-IV	2003-2004	Overall Female Overall Male Overall 60-69 Female 60-69 Male 60-69 70-79 Female 70-79 Male 70-79 80+ Female 80+ Male 80+
de Jesus Llibre (2009)	CUBA	75+	Door-to-Door survey Registry	Health professional Imaging test Other	DSM-IV	2003	Overall
de Ronchi (2005)	ITALY *Ravenna* Faenza and Granarolo	60+	Door-to-Door survey	Health professional	DSM-III-R	1991	Overall Male Overall Female Overall
de Silva (2003)	SRI LANKA *Ragama*	65+	Registry	Health professional	DSM-IV	2000	Overall Male 65-75 Male 76-85 Male 85+ Male Overall Female 65-75 Female 76-85 Female 85+ Female Overall 65-75 76-85 85+
Demirovic (2003)	USA	65+	Door-to-Door survey Census	Health professional Imaging test	NINCDS-ADRDA	1993-1996	Male Overall Female Overall
Fish (2008)	WALES *Caerphilly*	65+	Registry	Health professional Medical chart review Imaging test Other	NINCDS-ADRDA; NINDS-AIREN	2003	Overall 65-69 70-74 75-79 80-84
Fujishima (2002)	JAPAN *Hisayama*	65+	Registry	Health professional	DSM-III; DSM-III-R	1985 1992	Overall
Galasko (2007)	GUAM	65+	Door-to-door survey Telephone survey Registry	Health professional	DSM-IV	2003-2005	Overall Male Overall Female Overall 65-69 70-74

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Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
							75-79 80-84 85-89 90+ Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+
Ganguli (2000)	India *Haryana* Ballabgarh USA	55+ 70+	Door-to-Door survey Registry	Health professional Medical chart review	DSM-III-R	1995-1997 1987-1989	Overall
Gourie-Devi (2004)	INDIA	0+	Door-to-Door survey	Health professional	None	1993-1995	Overall
Guerchet (2010)	CONGO	70+	Door-to-Door survey	Health professional Medical chart review	DSM-IV	2008-2009	65-74 75-84 85+ Male 65-74 Male 75-84 Male 85+ Female 65-74 Female 75-84 Female 85+
Gureje (2006)	NIGERIA	65+	Door-to-Door survey	Health professional	DSM-IV	2003-2004	Overall Male Overall Female Overall 65-69 70-74 75-79 80+
Gurvit (2008)	TURKEY *Instabul* Kad-koy	70+	Door-to-Door survey	Health professional	DSM-III	N/A	Overall Male Overall Female Overall 70-74 75-79 80+ Male 70-74 Male 75-79 Male 80+ Female 70-74 Female 75-79 Female 80+

Hall (2009)	USA	65+ 70+	Door-to-Door survey	Health professional Medical chart review	DSM-III-R	1992 2001	Overall 70-74 75-79 80-85 85+
Herrera (2002)	BRAZIL *Sao Paulo* Catanduva	70+	Door-to-Door survey Census	Health professional Imaging test Other	NINDS-AIREN	N/A	Male Overall Female Overall Overall 70-74 75-79 80-84 85+
Ikeda (2001)	JAPAN *Nakayama*	65+	Door-to-Door survey	Health professional Medical chart review Other	DSM-IV	1997	Overall
Ikeda (2004)	JAPAN	65+	Door-to-Door survey	Health professional Imaging test	DSM-III-R	1997-1998	Overall
Jacob (2007)	INDIA	65+	Door-to-Door survey Registry	Other	DSM-IV	N/A	Overall
Jhoo (2008)	KOREA *Seongnam*	65+	Mailed survey Telephone survey	Health professional Imaging test Other	DSM-IV	2005-2006	65-69 70-74 75-79 80+ Male Overall Female Overall Overall
Jitapunkul (2001)	THAILAND *Bangkok* Romklao	60+	Door-to-Door survey Census	Other	None	1997	Overall
Jitapunkul (2009)	THAILAND *Bangkok* Romklao	50+	Door-to-Door survey Census	Health professional Medical chart review Imaging test	DSM-IV	1999	Overall Male Overall Female Overall 60-69 70-79 80+
Kim (2003)	KOREA *Busan*	65+	Door-to-Door survey	Health professional	DSM-III-R	2001-2002	65-69 70-74 75-79 80-84 85-89 90+ Overall Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall

Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
Kivipelto (2001)	FINLAND *Kupio and Joensuu*	70+	Cannot determine	Health professional	DSM-IV	1998	Overall
Kivipelto (2002)	FINLAND *Kupio and Joensuu*	70+	Cannot determine	Health professional	DSM-IV	1998	Overall
Landi (2005)	ITALY	80+	Registry	Health professional	None	2003-2004	Overall Male Overall Female Overall
Langa (2005)	USA	70+	Cannot determine	Health professional	DSM-III-R	2000-2002	Overall
Lee (2002)	KOREA *Seoul* Kwanak District	65+	Door-to-Door survey	Health professional Medical chart review Imaging test	DSM-IV	1999-2000	65-69 70-74 75-79 80-84 85+ Overall
Li (2007)	CHINA *Beijing*	60+	Door-to-Door survey	Health professional	DSM-IV	1997 1999	Male Overall Female Overall Overall 60-69 70-79 80+
Llibre Rodriguez (2008)	CUBA	65+	Administrative database Door-to-Door survey	Other	DSM-IV	N/A	Overall 65-69 70-74 75-79 80+
Llibre-Rodriguez (2008)	CHINA CUBA DOMINICAN REPUBLIC INDIA MEXICO PERU VENEZUELA	65+	Door-to-Door survey	Health professional	DSM-IV	N/A	Male 65-69 Male 70-74 Male 75-79 Male 80+ Female 65-69 Female 70-74 Female 75-79 Female 80+ Overall
Maneno (2006)	USA	60+	Administrative databases	Health professional Administrative database	ICD-9	2000-2002	Overall
Mathuranath (2010)	INDIA *Kerala*	55+	Door-to-Door survey	Health professional	DSM-IV	2004	55-59 60-64 65-69 70-74 75-79 80-84 85+ 55+ 65+ Male 55-59

							Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85+ Male 65+ Male Overall Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85+ Female 65+ Female Overall Overall
Meguro (2002)	JAPAN *Tajiri*	65+	Other	Health professional Imaging	DSM-IV	1998	Overall Male 65+ Female 65+
Mehlig (2008)	SWEDEN	38+	Registry	Health professional Medical chart review	DSM-III-R	1968-2002	Female
Molero (2007)	CARRIBEAN Venezuela *Maracaibo*	55+	Door-to-Door survey	Health professional Imaging	NINDS-AIREN	1998-2001	Male 55-64 Male 65-74 Male 75-84 Male 85+ Male Overall Female 55-64 Female 65-74 Female 75-84 Female 85+ Female Overall 55-64 65-74 75-84 85+ Overall
Nabalamba (2010)	CANADA	55+	Cannot determine	Self-report of a condition (diagnosed by a health professional)	None	2005	Overall Male Female
Ng (2010)	SINGAPORE	60+	Registry	Health professional	DSM-IV	2003	60-64 65-74 75-84 85+ Male Overall Female Overall
Nunes (2010)	PORTUGAL	65+	Other	Health professional Medical chart review Imaging test Other	DSM-IV-TR	2003	55-59 60-64 65-69 70-74 75-79 Male Female Overall

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Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
Perkins (2002)	USA	65+	Door-to-Door survey	Health professional Imaging	DSM-III-R; ICD-10	1997-1998	Overall
Plassman (2007)	USA	71+	Door-to-Door survey	Health professional Medical chart review Other	DSM-III-R; DSM-IV	2002	71-79 80-89 90+ Overall Male Overall Female Overall
Polvikoski (2001)	FINLAND *Vantaa*	85+	Cannot determine	Health professional Medical chart review	NINDS-AIREN	1991	Overall 85-89 90+ Male 85-89 Male 90+ Male Overall Female 85-89 Female 90+ Female Overall
Prince (2008)	CUBA	65+	Cannot determine	Health professional Other	DSM-IV	2003	Overall
Rahkonen (2003)	FINLAND *Kuopio*	71+	Cannot determine	Health professional Medical chart review Other	DSM-IV	1998	Overall
Riedel-Heller (2000)	GERMANY	75+	Door-to-Door survey Registry	Health professional	DSM-III-R	1997-1998	Overall
Rovio (2005)	FINLAND	65+	Other	Health Professional	DSM-IV	2000	Overall
Sanderson (2003)	USA	65+	Registry Administrative databases	Administrative data codes	None	2003	Overall
Scazufca (2008)	BRAZIL *Sao Paulo*	65+	Door-to-Door survey	Health professional	DSM-IV	2003-2005	Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85+ Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85+ 65-69 70-74 75-79 80-84 85+

Sekita (2010)	JAPAN *Hisayama*	65+	Registry	Health professional Medical chart review	Hachinski	1985 1992 1998 2005	Overall Female Overall Male Overall
Senanarong (2001)	THAILAND *Amphoe Nakhon Chaisi Amphoe Hang Chat Amphoe Muang*	55+	Door-to-Door survey	Health professional	DSM-IV	1997-1999	Overall
Senanarong (2001)	THAILAND *Amphoe Nakhon Chaisi Amphoe Hang Chat Amphoe Muang*	60+	Door-to-Door survey	Health professional	None	1995-1997	Overall
Shaji (2005)	INDIA *Cochin*	65+	Door-to-Door survey	Health professional	ICD-10	N/A	Overall Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall 65-69 70-74 75-79 80-84 85-89 90+
Sousa (2009)	CUBA DOMINICAN REPUBLIC URBAN CHINA URBAN INDIA URBAN MEXICO URBAN PERU RURAL CHINA RURAL INDIA RURAL MEXICO RURAL PERU	65+	Cannot determine	Health professional Other	DSM-IV	2003-2005	Overall
Spada (2009)	ITALY *Sicily* San Teodoro	65+	Door-to-Door survey Other	Health professional Other	NINDS-AIREN	2005	Overall
Suh (2002)	KOREA *Yonchon County*	65+	Door-to-Door survey	Health professional Medical chart review	NINDS-AIREN; Hachinski	1996-1997	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90-94 Male Overall Female 65-69

Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
							Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90-94 Female Overall 65-69 70-74 75-79 80-84 85-89 90-94 Overall
Vas (2001)	INDIA *Bombay* Mumbai	40+	Door-to-Door survey Mailed survey Other	Health professional Imaging test	DSM-IV; Hachinski	1991	Male <49 Male 50-54 Overall Male 55-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85+ Male Overall Female <49 Female 50-54 Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85+ Female Overall <49 50-54 55-59 60-64 65-69 70-74 75-79 80-84 85+ 49+ 50+ 55+ 60+ 65+ 70+ 75+ 80+ 85+

Wada-Isoe (2009)	JAPAN *Amino-Cho*	40+	Door-to-Door survey	Health professional Other	NINDS-AIREN	2008	65-69 70-74 75-79 80-84 85-89 90+ Overall Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall
Wakutani (2007)	JAPAN *Daisen-Cho*	65+	Hospital/ clinic chart review Administrative databases	Health professional	Hachinski	1980 1990 2000	Overall
Wangtongkum (2008)	THAILAND *Chian Mai province*	45+	Door-to-Door survey	Health professional Imaging test Other	NINDS-AIREN	2004-2005	Overall
Wertman (2007)	ISRAEL	65+	Other	Health professional Other	DSM-IV	2002	Overall Male Overall Female Overall 65-69 70-74 75-79 80-84 85+
Xu (2009)	SWEDEN	65+	Registry Telephone survey	Health professional	NINDS-AIREN	1998-2001	Overall Female Overall Male Overall
Yamada (2001)	JAPAN *Amino-Cho*	65+	Door-to-Door survey	Health professional Imaging test Other	NINDS-AIREN	1998	Male Overall Female Overall Overall Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90-94 Male 95-99 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90-94 Female 95-99 65-69 70-74

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Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
							75-79 80-84 85-89 90-94 95-99
Zhao (2010)	CHINA *Shanghai*	55+	Door-to-Door survey Census	Health professional Medical chart review	NINDS-AIREN	1997-1998	Overall Male 55-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall 60+ 65+ 70+ 75+ 80+ 85+
Zhou (2006)	CHINA	55+	Other	Health professional	DSM-IV; Hachinski	1999	Overall Male 55-54 Male 55-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male Overall Female 55-54 Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 55-54 55-59 60-64 65-69 70-74 75-79 80-84

Zuliani (2010)	ITALY *Tuscany* Greve in Chianti and Bagno a Ripoli	55+	Door-to-Door survey	Health professional	DSM-IV	1998-2000	Overall
Community & Institution							
Aguero-Torres (2001)	SWEDEN	75+	Registry	Health professional	DSM-III-R	1987-1990	Overall
Andersen-Ranberg (2001)	DENMARK	100+	Registry	Health professional Registry Medical chart review	ICD-10	1995-1996	Overall
Arslantas (2009)	TURKEY *Eskisehir*	55+	Door-to-Door survey	Health professional Imaging test	DSM-IV	2002-2004	Overall Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75+ Female Overall Male 55-59 Male 60-64 Male 65-69 Male 70-74 Male 75+ Male Overall 55-59 60-64 65-69 70-74 75+
Benedetti (2002)	ITALY	75+	Door-to-Door survey	Health professional	DSM-III-R	1996	Overall Female 75-79 Female 80-84 Female 85-89 Female 90-97 Female Overall Male 75-79 Male 80-84 Male 85-89 Male Overall 75-79 80-84 85-89 90-97
Borroni (2011)	ITALY	75+	Registry	Health professional Imaging Other	NINCDS-ADRDA	2009	Overall Male Overall Female Overall
Camicioli (2000)	USA	65+	Administrative database	Medical chart review	NINCDS-ADRDA	1994	Overall
Chien (2008)	TAIWAN	65+	Administrative databases	Administrative data codes	None	1996-2003	Overall
Corrada (2008)	UNITED STATES *California* Laguna Woods	75+	Door-to-Door survey Telephone survey	Health professional	DSM-IV	2006	Overall Male Female Female 90-91 Female 92-93 Female 94-95 Female 96-97 Female 98-99 Female 100+

Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
							Male 90-91 Male 92-93 Male 94-95 Male 96-97 Male 98-99 Male 100+
Di Carlo (2002)	ITALY *Genoa, Segrate (Milan), Selvazzano-Rubano (Padua), Impruneta (Florence), Fermo (Ascoli Piceno), Naples, Casamassima (Bari), and Catania*	65+	Door-to-Door survey Registry	Health professional Medical chart review	ICD-10	1995	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Overall Male Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female Overall 65-69 70-74 75-79 80-84 Overall
Ebly (1994)	CANADA	85+	Other	Health professional	ICD-10	1990-1992	Male 85-89 Male 90-94 Male 95+ Male Overall Female 85-89 Female 90-94 Female 95+ Female Overall 85-89 90-94 95+ Overall
Gascon-Bayarri (2007)	SPAIN *Catalonia* El Prat del Llobregat	70+	Door-to-Door survey Mailed survey Telephone survey	Health professional	DSM-IV	2002-2003	Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Overall Female 70-74 75-79 80-84 85-89 90+ Overall

Gavrila (2009)	SPAIN	70+	Door-to-Door survey Registry	Health professional	DSM-IV	2003-2005	Male Overall Female Overall 65-69 70-74 75-79 80-84 85+ Overall
Gislason (2003)	SWEDEN *Gothenburg*	85+	Registry	Health professional	DSM-III-R	1986-1987	Overall Male Overall Female Overall
Graham (1997)	CANADA	65+	Administrative Databases	Health professional	DSM-III	1991	Overall
Harvey (2003)	ENGLAND	70+	Registry Administrative Databases	Health professional Medical chart review	DSM-IV	N/A	Overall 40-44 45-49 50-54 55-59 60-64 30-64 45-64 30-34 35-39 40-44 45-49 50-54 55-59 60-64 30-64 45-64 Male 30-34 Male 35-39 Male 40-44 Male 45-49 Male 50-54 Male 55-59 Male 60-64 Male 30-64 Male 45-64 Female 30-34 Female 35-39 Female 40-44 Female 45-49 Female 50-54 Female 55-59 Female 60-64 Female 30-64 Female 45-64
Helmer (2006)	FRANCE	75+	Door-to-Door survey Other	Health professional	DSM-III-R	1998-1999	Overall Male Female 75-79 80-84 85-89 90+
Ikejima (2009)	JAPAN	65+	Mailed survey	Medical chart review	DSM-III-R	2006	20-24 25-30 30-34

Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
							35-39 40-44 45-49 50-54 55-59 60-64 Overall 45-64
Juva (2000)	FINLAND *Vantaa*	85+	Registry	Health professional Medical chart review	DSM-III-R	1991	Overall Female Overall Male Overall
Kahana (2003)	ISRAEL *Ashkelon*	75+	Door-to-Door survey Registry	Health professional	DSM-III-R	1989	Male 76-77 Male 78-79 Male 80-81 Male 82-83 Male 84-85 Male 86-89 Male 90+ Male Overall Female 76-77 Female 78-79 Female 80-81 Female 82-83 Female 84-85 Female 86-89 Female 90+ Female Overall 76-77 78-79 80-81 82-83 84-85 86-89 90+ Overall
Livingston (2001)	UK *London* Islington	60+	Door-to-Door survey	Health professional	None	N/A	Overall
Lovheim (2008)	SWEDEN	85+	Other	Health professional Medical chart review Other	DSM-IV	2005-2006	Overall
Luck (2008)	GERMANY *Saxony* Leizpig	75+	Door-to-Door survey	Health professional	SIDAM	1997-1998	Overall
Manton (2005)	USA	65+	Registry	Cannot determine	None	1982-1999	Overall
Phung (2010)	DENMARK	40+	Registry	Administrative data codes	None	1970-2004	Overall 40-49 50-59 60-64 65-69

							70-74 75-79 80-84 85-89 90+ Male 40-49 Male 50-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Female 40-49 Female 50-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Male 40-49 Male 50-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+
Riedel-Heller (2001)	GERMANY *Leipzig*	75+	Registry	Health professional	DSM-III-R	1997-1998	Female 75-79 Female 80-84 Female 85-89 Female 90-94 Female 95+ Female Overall Female 85+ Male 75-79 Male 80-84 Male 85-89 Male 90-94 Male 95+ Male Overall 75-79 80-84 85-89 90-94 95+ 85+ Overall
Rockwood (2000)	CANADA	65+	Other	Health professional	DSM-III-R	1991-1992	Overall 65-74 75-84 85+ Male Overall Female Overall

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Table 1. *(Continued)*

Author, Date	Country and Region	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
Sahadevan (2008)	SINGAPORE	50+	Door-to-Door survey	Health professional Other	NINDS-AIREN	2001	Overall Male Overall Female Overall 50-59 60-69 70-79 80+ 50-54 55-59 60-64 65-69 70-74 75-79 80-84 85+ Female 50-54 Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85+ Male 50-54 Male 55-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85+
Silver (2001)	USA *8 towns near Boston, MA*	65+	Registry	Health professional	DSM-IV	1996	Overall
Stevens (2002)	UK *London* Islington	65+	Door-to-Door survey	Health professional Medical chart review Other	NINDS-AIREN	N/A	Overall
van Exel (2002)	THE NETHERLANDS *Leiden*	85+	Door-to-Door survey	Medical chart review Other	None	1997-1999	Overall
von Heidken (2006)	SWEDEN *Umea*	40+	Other	Health professional Medical chart review Other	None	2000	Overall 90 95+ Male Overall Female Overall
Wancata (2007)	SWEDEN *Gothenburg*	70	Other	Health professional	DSM-IV	2000	Overall

Institution Only

Chen (2007)	TAIWAN	65+	Other	Health professional	DSM-IV	N/A	Male Overall Female Overall Overall
Feldman (2006)	ISRAEL	N/A	Hospital/clinic chart review	Health professional Medical chart review	DSM-IV	1999	Overall
Magaziner (2000)	USA *Baltimore* Maryland	65+	Other	Health professional Medical chart review	DSM-III-R	1992-1995	Overall
Martens (2007)	CANADA	55+	Administrative Databases	Administrative data codes	ICD-9-CM	1997-2002	Male 55-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-89 Male 90+ Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-89 Female 90+
Matthews (2002)	UK *England and Wales*	65+	Registry	Health professional	None	1991-1993	Male 65-74 Male 75-84 Male 85+ Male Overall Female 65-74 Female 75-84 Female 85+ Female Overall 65-74 75-84 85+ Overall
Rosenblatt (2004)	USA *Central Maryland*	55+	Other	Health professional Medical chart review	NINDS-AIREN	N/A	Overall

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Table 2: Studies Reporting on the Incidence Rate of Dementia

Author, Date	Country	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
Bermejo-Pareja (2009)	SPAIN *Las Margaritas, Lista, Arevalo*	65+	Door-to-Door survey Mailed survey	Health professional Administrative data codes Medical chart review	DSM-IV	1994	Overall Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall 65-69 70-74 75-79 80-84 85-89 90+ Overall
Fitzpatrick (2004)	USA	65+	Door-to-Door survey	Health professional Imaging test	DSM-IV	1992-1994	Overall <75 75-79 80-84 85+ Female <75 Female 75-79 Female 80-84 Female 85+ Female Overall Male <75 Male 75-79 Male 80-84 Male 85+ Male Overall
Fuhrer (2003)	FRANCE *Gironde and Dordogne*	65+	Door-to-Door survey Registry	Health professional Imaging test	DSM-III-R	1988-1997	Overall
Kukull (2002)	USA *Washington* Seattle	65+	Door-to-Door survey Other	Health professional Imaging test Other	DSM-IV	1994	65-69 70-74 75-79 80-84 85-89 90+ Overall

Kuller (2005)	USA *Washington* Seattle	<70-80+	Administrative Databases	Health professional Medical chart review Imaging	NINCDS-ADRDA	1998-1999	Male Overall Female Overall <70 70-74 75-79 80+ Overall
Larrieu (2004)	FRANCE	65+	Registry	Health professional	NINCDS-ADRDA	1993-1998	Overall
Li (2007)	USA	65+	Door-to-Door survey	Health professional Imaging	DSM-IV	1994-1996	Overall
Lopez (2003)	USA *Pittsburg* *Sacramento Winston-Salem* *Hagerstown*	65+	Administrative Databases Other	Health professional	DSM-IV	1998-1999	Male Female Overall
Matsui (2009)	JAPAN	65+	Registry	Health professional	DSM-III-R	1985-2002	Overall
Meguro (2007)						2003	Overall Male 65-69 Male 70-79 Male 80+ Female 65-69 Female 70-79 Female 80+
Mercy (2008)	UK	65+	Other	Health professional Imaging test	DSM-IV	2000-2006	Overall
Nitrini (2004)	BRAZIL *Sao Paulo* Catanduva	65+	Door-to-Door survey	Health professional Imaging test Other	DSM-IV	1997-2000	Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ 65-69 70-74 75-79 80-84 85-89 90+ Overall
Polvikoski (2006)	FINLAND *Vantaa*	85+	Cannot determine	Health professional Medical chart review	DSM-III-R	2001	Male 85-89 Male 90+ Male Overall Female 85-89 Female 90+ Female Overall 85-89 90+ Overall

Table 2. *(Continued)*

Author, Date	Country	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Ravaglia (2005)	ITALY *Conselice* *Ravenna* *Emilia Romagna region*	85+	Door-to-Door survey Registry	Health professional Medical chart review Imaging test	NINDS-AIREN	1999-2004	Male 65-74 Male 75-84 Male 85-94 Male Overall Female 65-74 Female 75-84 Female 85-94 Female Overall Overall 65-74 75-84 85-94
Ravaglia (2005)	ITALY *Conselice* *Ravenna* *Emilia Romagna region*	65+	Door-to-Door survey	Health professional Medical chart review Imaging test	NINDS-AIREN	2003-2004	Male 65-74 Male 75-84 Male 85-94 Male Overall Female 65-74 Female 75-84 Female 85-94 Female Overall 65-74 75-84 85-94 Overall
Ravalglia (2008)	ITALY *Conselice* *Ravenna* *Emilia Romagna region*	85+	Door-to-Door survey Registry	Health professional Medical chart review Imaging test	DSM-IV	1999-2004	Overall
Samieri (2008)	FRANCE *Bordeaux*	65+	Cannot determine	Health professional	DSM-IV	2003	Overall
Tyas (2006)	CANADA *Manitoba*	65+	Registry Administrative databases	Health professional Other	DSM-III-R; DSM-IV	1991-1992; 1996-1997	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall 65-69 70-74 75-79 80-84 85-89 90+ Overall

Waite (2001)	AUSTRALIA *Sydney*	40+	Door-to-Door survey Census	Health professional	DSM-IV	1991-1994	Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall 75-79 80-84 85-89 90+ Overall
Community & Institution							
Corrada (2010)	USA	75+	Door-to-Door survey Telephone survey	Health professional	DSM-IV	2003-2007	Male 90-94 Male 95-99 Male 100+ Male 90+ Female 90-94 Female95-99 Female100+ Female 90+ 90-94 95-99 100+ 90+
Di Carlo (2000)	ITALY *Genoa, Segrate (Milan), Selvazzano-Rubano (Padua), Impruneta (Florence), Fermo (Ascoli Piceno), Naples, Casamassima (Bari), and Catania*	65+	Door-to-Door survey Registry	Health professional Medical chart review	DSM-III-R	1992	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female Overall 65-69 70-74 75-79 80-84 Overall
Edland (2002)	UNITED STATES *Minnesota* Rochester	65+	Hospital/Clinic chart review Administrative Databases	Medical chart review	DSM-IV	1985-1989	Female 50-54 Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90-94 Female 95-99 Female Overall Male 50-54 Male 55-59 Male 60-64 Male 65-69

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Table 2. *(Continued)*

Author, Date	Country	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
							Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90-94 Male 95-99 Male Overall 50-54 55-59 60-64 65-69 70-74 75-79 80-84 85-89 90-94 95-99 Overall
Knopman (2002)	USA *Minnesota* Rochester	75+	Administrative Databases	Medical chart review	DSM-IV	1985-1989	Female 40-49 Female 50-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90-99 Female Overall Male 40-49 Male 50-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90-99 Male Overall 40-49 50-59 60-64 65-69 70-74 75-79 80-84 85-89 90-99 Overall

Knopman (2002)	USA	75+	Administrative Databases	Medical chart review	DSM-IV	1985-1989	Female 50-64 Female 90-99 Male 50-64 Male 90-99 50-64 90-99 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female Overall Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male Overall 65-69 70-74 75-79 80-84 85-89 Overall
Knopman (2004)	USA	75+	Administrative Databases	Medical chart review	DSM-IV	1990-1994	Overall 40-49 50-59 60-69
Matthews (2005)	UK	65+	Registry	Health professional	DSM-III-R	1990-1996	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85+ Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85+ 65-69 70-74 75-79 80-84 85+
McDowell (2007)	CANADA	65+	Other	Health professional	DSM-IV	1991-2001	Overall
Riedel-Heller (2001)	GERMANY *Leipzig*	75+	Registry	Health professional	DSM-III-R	1997-1998	Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall 75-79 80-84 85-89 90+ Overall

Table 2. *(Continued)*

Author, Date	Country	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Ruitenberg (2001)	NETHERLANDS *Rotterdam* Ommoord	55+	Door-to-Door survey	Health professional Medical chart review Imaging test	NINDS-AIREN	1990-1999	Female 55-59 Female 60-64 Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90-94 Female 95+ Female Overall Male 55-59 Male 60-64 Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90-94 Male 95+ Male Overall 55-59 60-64 65-69 70-74 75-79 80-84 85-89 90-94 95+ Overall
Institution Only							
Garre-Olmo (2010)	SPAIN *Catolonia*	30+	Registry	Health professional Medical chart review Imaging test	DSM-IV-TR	2007-2009	30-64 65+ 30-34 35-39 40-44 45-49 50-54 55-59 60-64 Male 30-34 Male 35-39 Male 40-44 Male 45-49 Male 50-54 Male 55-59 Male 60-64 Male 30-64 Female 30-34 Female 35-39 Female 40-44 Female 45-49 Female 50-54 Female 55-59 Female 60-64

Table 3: Studies Reporting on the Incidence Proportion of Dementia

Author, Date	Country	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Community Only							
Arai (2004)	JAPAN *Hokkaio* Minami Furano Town Hokkaio	65+	Door-to-Door survey	Health professional	None	1998-2002	Overall Male Female 65-69 70-74 75-79 80-84 85+
Canadian Study of Health and Aging Working Group (2000)	CANADA	65+	Administrative databases	Health professional	DSM-III-R	1996	Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90-94 Male 95+ Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90-94 Female 95+
Cornelius (2004)	SWEDEN *Stockholm* Kungsholmen district	75+	Cannot determine	Health professional Medical chart review	DSM-III-R	1991-1993 1994-1996	Overall
Forti (2010)	ITALY	65+	Registry	Health professional Imaging test	DSM-IV	2003-2004	<75 75+
Ganguli (2000)	USA *Pennsylvania* Monongahela Valley	65+	Door-to-Door survey Registry	Health professional Medical chart review	DSM-III-R	1997-1999	65-69 70-74 75-79 80-84 85-89 90+ Overall Male 65-69 Male 70-74 Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 65-69 Female 70-74 Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall
Hendrie (2001)	NIGERIA *Ibadan* Idkan area	65+	Door-to-Door survey	Health professional Imaging test	DSM-III-R	1997-1998	65-74 75-84 85+ Overall

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Table 3. *(Continued)*

Author, Date	Country	Age Range Studied	Data Source	Diagnosis Established by	Diagnostic Criteria	Years of Data Collection	Groups Studied
Kawas (2000)	USA	75+	Cannot determine	Health professional Medical chart review Imaging Other	DSM-III-R	1985-1998	Overall Male 55-59 Male 60-64 Male 65-69 Male 79-74 Male 75-79 Male 80-84 Male 85+ Male Overall Female 55-59 Female 60-64 Female 65-69 Female 70-64 Female 75-79 Female 80-84 Female 85+ Female Overall 55-59 60-64 65-69 70-74 75-79 80-84 85+
Knopman (2003)	USA	50+	Door-to-Door survey Registry	Health professional	DSM-IV	1985-1989	Overall
Kuller (2005)	USA	<70-80+	Administrative Databases	Health professional Medical chart review Imaging test	None	1998-1999	Overall
Lopez (2005)	USA	65+	Administrative Databases	Health professional Medical chart review Imaging test	DSM-IV	1994-1999	Overall
Lopez-Pousa (2004)	SPAIN	75+	Door-to-Door survey	Health professional	DSM-II-R	1990-1991	Male 75-79 Male 80-84 Male 85-89 Male 90+ Male Overall Female 75-79 Female 80-84 Female 85-89 Female 90+ Female Overall 75-79 80-84 85-89 90+ Overall
Miech (2002)	USA	65+	Door-to-Door survey	Health professional Imaging test	DSM-III-R	1998-1999	Overall Male Overall Female Overall Overall

Piguet (2003)	AUSTRALIA *Sydney*	75+	Registry	Health professional	DSM-IV	1997-2000	Overall
Seshadri (2002)	US	65+	Other	Health professional Medical chart review Imaging test	DSM-IV	1986-1990	Overall Male Overall Female Overall
Simons (2006)	AUSTRALIA	60+	Hospital/Clinic chart review Other	Administrative data codes Medical chart review	ICD-9-CM; ICD-10-AM	1988-2004	Overall Male Overall Female Overall
Vermeer (2003)	NETHERLANDS *Rotterdam*	65+	Door-to-Door survey	Health professional Imaging test	NINDS-AIREN	1999-2000	Overall
Institution Only							
Andreasen (1999)	SWEDEN	75+	Hospital/Clinic chart review	Health professional Imaging test Other	DSM-III-R	1990-1995	Overall 40-64 65-69 70-74 75-79 80-84 85-89 90+
Benito-Leon (2009)	SPAIN *Las Margaritas Lista and Arevalo*	65+	Mailed survey Other	Health professional Medical chart review	DSM-IV	1994-1998	Overall

professional ($n = 26$), administrative data codes ($n = 2$), medical chart review ($n = 2$), other sources ($n = 2$) and self-report of a physician diagnosis ($n = 1$).

The pooled point prevalence of dementia per 1000 in 23 community-setting studies was 48.62 ($CI_{95\%}$: 41.98-56.32), while the pooled point prevalence in combined community and institution settings ($n = 5$) was 57.98 ($CI_{95\%}$: 42.02-80.00) (Figure 2). The point prevalence of dementia within institutions ($n = 2$) was 581.09 ($CI_{95\%}$: 558.48-604.61) per 1000. Among the 29 eligible studies reporting on the point prevalence of dementia, estimates ranged from 8.00 per 1000 in a community-only study from India[75] to 592.51 per 1000 in an institutional sample from Taiwan.[43]

Fifty articles reported on the period prevalence for dementia,[11,14,30,31,34,35,37,39,46,48,49,53,58-63,65,66,70,72,76,81,84-87,91-96,99,100,104,110,111,116,118,119,122,126,132,134,136,180,182,183] with 18 eligible for inclusion (see Methods section) in the meta-analysis.[14,46,48,58-61,66,76,81,85-87,93,116,122,134,180,183]

In the 50 studies that reported on the period prevalence of dementia, the majority ($n = 39$) used a single source of the study population, including door-to-door surveys ($n = 21$), registries ($n = 8$), other sources ($n = 4$), administrative databases ($n = 2$) and a census ($n = 1$). It was not possible to determine the data source in three studies. Twenty-six of the 50 included studies used a single methodology to identify cases—the majority used a standardized assessment by a health professional ($n = 22$), followed by administrative data codes ($n = 3$). It was not possible to determine how they identified cases in one study.

In community-only settings ($n = 14$), the pooled annual period prevalence per 1000 was 69.07 ($CI_{95\%}$: 52.36-91.11) compared to 72.66 ($CI_{95\%}$: 42.96-122.91) in combined community and institution samples ($n = 2$) and 533.24 per 1000 within institutions ($n = 2$) (Figure 3). Among individual studies, the annual period prevalence estimates ranged from 7.92 in a community-only sample in India[48] to 593.00 per 1000 in an institutional study from the United Kingdom.[14]

Incidence of Dementia

Seventeen studies reported on the incidence proportion of dementia,[10,138-140,142,146,148,150,151,155,157,159,165,167,175,176,183] with 10 eligible for inclusion in the meta-analysis of those aged 60+, 65+ or 70+ years.[139,140,148,150,157,159,165,175,176,183] All were from community settings. Of 17 studies reporting on the incidence proportion of dementia, 16 used a single methodology to recruit participants, most frequently door-to-door survey ($n = 5$). Other approaches included administrative databases ($n = 3$), registries ($n = 2$), hospital/clinic chart reviews ($n = 1$) and other methods ($n = 1$). It was not possible to determine the data source in two cases, and one study used another methodology. In order to ascertain cases, most studies ($n = 11$) used multiple sources of data (e.g., healthcare professional diagnosis and imaging test results). Six studies based the case ascertainment purely on a healthcare professional assessment.

A random-effects model found that the overall pooled incidence proportion of dementia per 1000 was 52.85 ($CI_{95\%}$: 33.08-84.42) (Figure 4). Among the included studies, incidence proportion estimates ranged from 8.70 in a Japanese study[139] to 142.22 per 1000 in a U.S. one.[157]

Thirty-two studies reported on the incidence rate of dementia,[7,8,141,143-145,147,149,152-154,156,158,160-164,166,168-174,177-182] with nine

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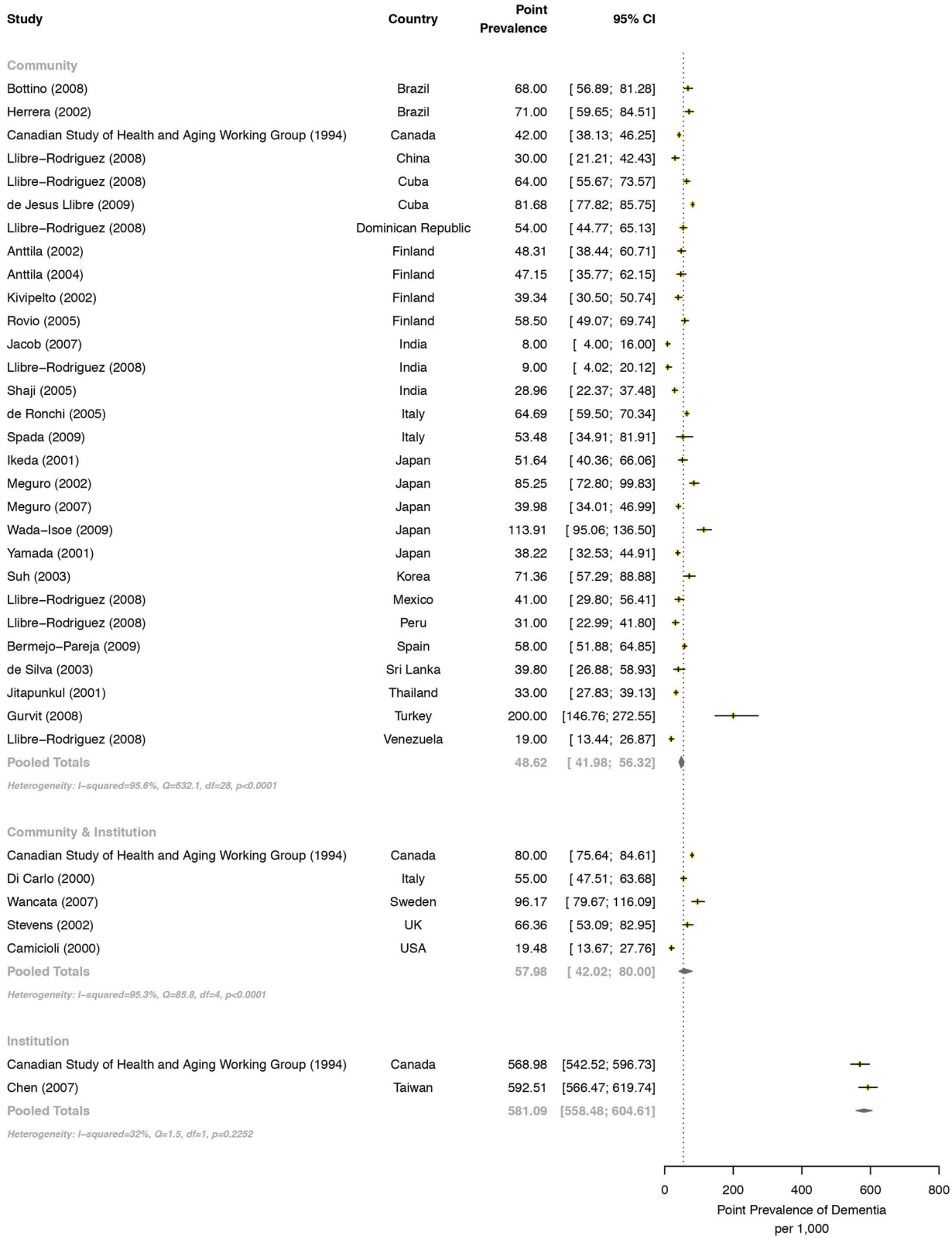

Figure 2: *Pooled point prevalence of dementia.*

eligible for inclusion in the meta-analysis.[141,143,145,156,158,166,170,174,177,178] The majority of the 32 studies reporting on the incidence rate of dementia used a single source to identify their population ($n = 21$)—these sources were door-to-door surveys ($n = 8$), registries ($n = 6$), administrative databases ($n = 3$) and other sources in two studies. It was not possible to determine the

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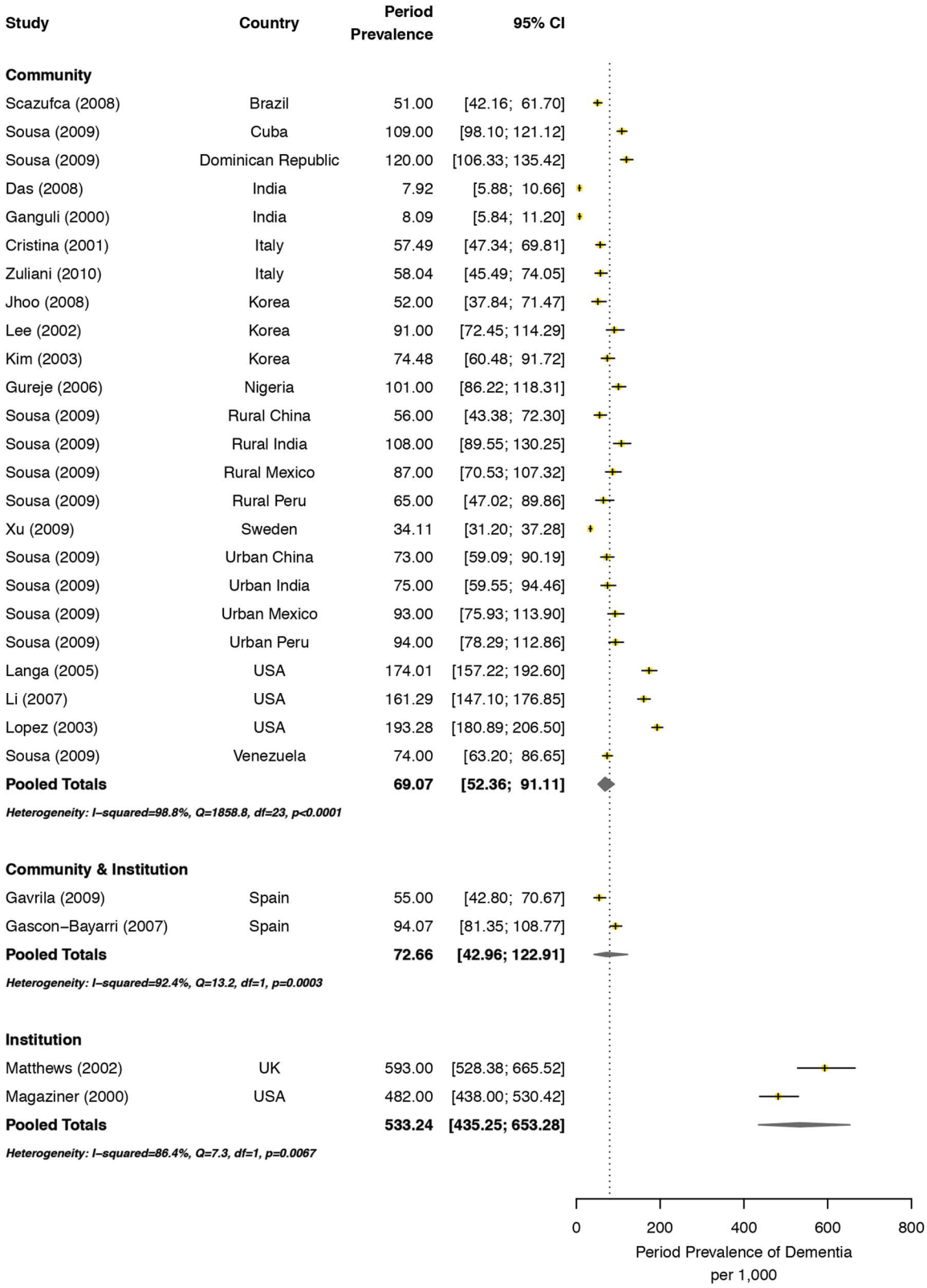

Figure 3: *Pooled period prevalence of dementia.*

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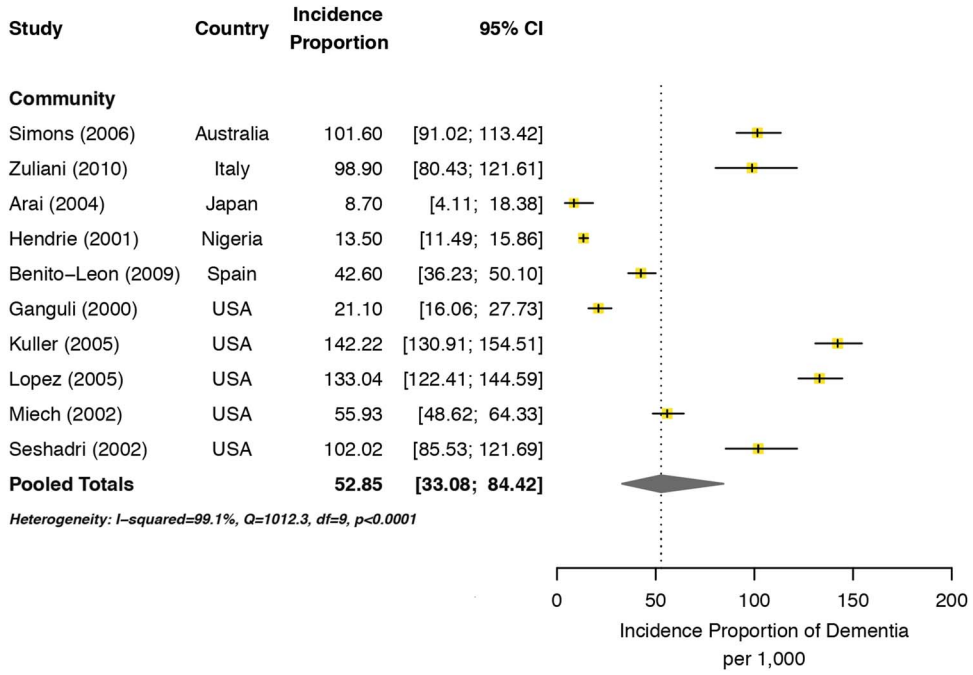

Figure 4: *Pooled incidence proportion of dementia.*

data source in another two studies. Fifteen of the 32 studies used a single methodology to identify cases, including a standardized assessment by a health professional ($n = 10$), chart review ($n = 4$) and administrative data codes ($n = 1$). The remaining 17 used multiple sources.

In community-only settings, the pooled incidence rate of dementia per 1000 person-years was 17.18 ($CI_{95\%}$: 13.90-21.23). In a single combined community and institution study, the estimated incidence rate was 13.33 per 1000 person-years ($CI_{95\%}$: 11.18-15.89) (there were no institution-only studies) (Figure 5). The incidence rate estimates ranged from 8.11 per 1000 person-years in a community-only study from the Netherlands[178] to 37.80 per 1000 person-years in a community-only study from Italy.[170]

Sources of Heterogeneity

In our exploration of sources of heterogeneity, we restricted our analyses to studies reporting on individuals 60+, 65+ or 70+ in order to minimize the potential confounding effects of age. Because of the small number of studies, we could not explore the interaction between the potential sources of heterogeneity.

Age

Using the youngest-aged person in a study to assess this characteristic, a series of meta-regression analyses revealed that increasing age was significantly associated ($p < 0.001$) with a higher prevalence or incidence of dementia.

Sex

Meta-regression showed no statistically significant differences between the sexes on any of our estimates, though estimates were consistently higher in females ($p > 0.05$).

Setting

Point Prevalence. Estimates from institution-only settings were significantly higher than those from community-only and combined community and institution settings ($p < 0.0001$). The difference in point prevalence in combined community and institutional settings (57.98 [$CI_{95\%}$: 42.02-80.00] per 1000) compared to community-only ones (48.62 [$CI_{95\%}$: 41.98-56.32] per 1000) was not statistically significant ($p = 0.33$).

Annual Period Prevalence. No significant difference in pooled estimates of annual period prevalence was found between community-only (70.86 [$CI_{95\%}$: 55.78-90.03] per 1000) and combined community and institution settings (72.66 [$CI_{95\%}$: 42.96-122.91] per 1000). Annual period prevalence was significantly higher in institution-only settings (533.24 [$CI_{95\%}$: 435.25-653.28] per 1000, $p < 0.0001$).

Incidence Proportion and Rate. Estimates for incidence proportion were derived solely from community-only settings. There was an insufficient number of studies from non-community settings to assess incidence rate.

Diagnostic Criteria

Comparisons were restricted to studies done in the same setting (community-only, community and institution, institution-only) and where the specific criteria were utilized by more than one study.

Point Prevalence. In community-only settings, there were only sufficient studies for analysis using either DSM–IV ($n = 16$) or DSM–III–R ($n = 4$) diagnostic criteria. There was no significant difference ($p = 0.33$) in the pooled point prevalence estimates between these two criteria.

DSM–IV ($n = 3$) and DSM–III–R ($n = 2$) were the most commonly used criteria in combined community and institutional settings (and the only criteria eligible for inclusion). There was

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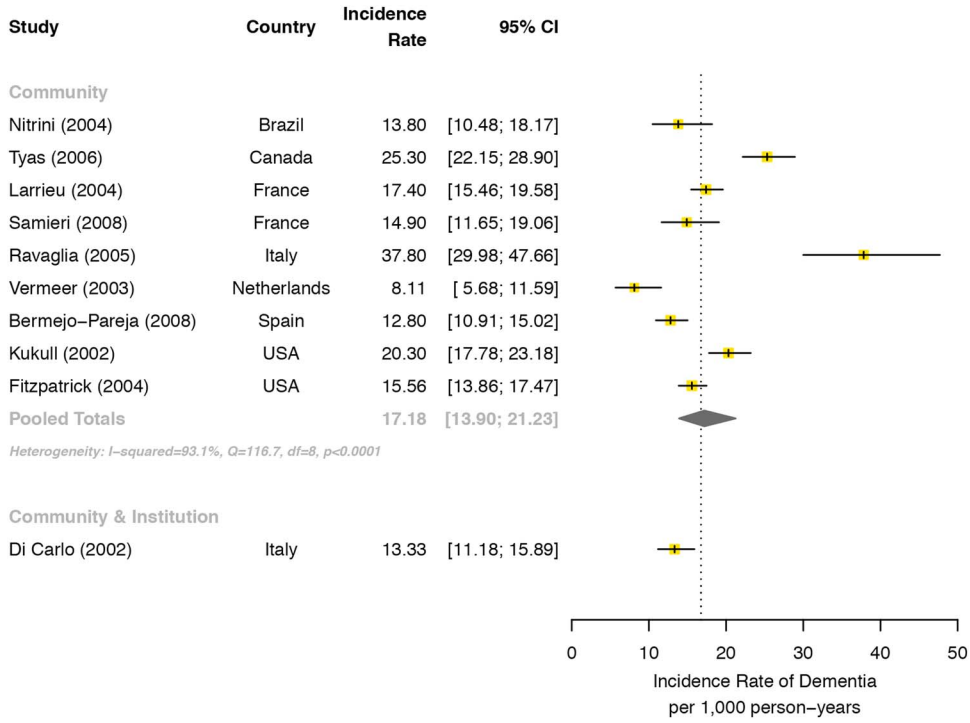

Figure 5: *Pooled incidence rate of dementia.*

no significant difference ($p = 0.30$) in pooled point prevalence estimates between them.

Annual Period Prevalence. Community-only studies eligible for this analysis employed either DSM–III–R ($n = 4$) or the DSM–IV ($n = 11$) criteria. There was no significant difference ($p = 0.49$) between their estimates for the annual period prevalence.

Incidence Proportion and Rate. In community-only settings, the most commonly used criteria to determine incidence proportion were the DSM–III–R ($n = 3$) and the DSM–IV ($n = 4$). These pooled estimates of the incidence proportion differed significantly from each other, with estimates higher in DSM–IV studies ($p = 0.03$). The only available study for incidence rate used DSM–III–R criteria.

Region

Point Prevalence. Among community-only studies, there were no significant differences in pooled estimates between Asia ($n = 12$), Europe ($n = 7$), North America ($n = 4$) and South America ($n = 3$). There were no differences between Europe ($n = 3$) and North America ($n = 2$) in the pooled point prevalence of dementia among community and institutional studies. The institution-only estimates from North America ($n = 1$) and Asia ($n = 1$) were very similar.

Annual Period Prevalence. There were estimates from four continents for the annual pooled period prevalence of dementia in community-only studies (Asia [$n = 6$], Europe [$n = 3$], North America [$n = 4$], South America [$n = 2$]). The pooled North American annual estimate (129.81 [$CI_{95\%}$: 104.73-160.91] per 1000) was significantly higher than that of Asia (45.24 [$CI_{95\%}$: 25.91-78.99] per 1000), Europe (47.98 [$CI_{95\%}$: 31.95-72.07] per 1000) and South America (69.63 [$CI_{95\%}$: 53.28-91.00] per 1000).

Incidence Proportion. There were community-only studies from two continents (Europe [$n = 2$], North America [$n = 5$]). The estimates from North America (75.48 [$CI_{95\%}$: 47.37-120.28] per 1000) and Europe (64.75 [28.37-147.79] per 1000) were not significantly different ($p = 0.75$).

Incidence Rate. In community-only studies, there were estimates from two continents (Europe [$n = 5$], North America [$n = 3$]). There were no significant differences ($p = 0.18$) in the estimates among them.

Year of Data Collection

Meta-regression revealed that there were no significant changes over time in the incidence or prevalence of dementia.

Publication Bias

There was no evidence of publication bias with either Begg's or Egger's test for point prevalence ($p > 0.05$). Evidence of publication bias was found for the period prevalence on both Begg's and Egger's tests where smaller studies of the effect were potentially missing ($p < 0.0001$). For the incidence rate, there was no evidence of publication bias on either the Begg's ($p > 0.05$) or Egger's ($p > 0.05$) test. Evidence of publication bias was found for the incidence proportion using the Egger's ($p = 0.037$) but not the Begg's ($p > 0.05$) test.

Study Quality

The median study quality score was 6 (range 2-8). ANOVA testing did not reveal any statistical difference in study quality by continent (see Table 4 for details).

Discussion

This systematic review and meta-analysis of the global incidence and prevalence of dementia provides overall estimates

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Table 4: Quality assessment scores of dementia incidence and prevalence studies

Study (Year)	Q1: Target population described?	Q2: Cases from entire population or probability sampling?	Q3: Response rate >70%?	Q4: Non-responders clearly described?	Q5: Sample representative of population?	Q6: Data collection methods standardized?	Q7: Validated criteria to assess disease?	Q8: Were estimates given with confidence intervals or subgroups?	Total Quality Score (/8)
Aguero-Torres (2001)	Yes	Yes	No	No	No	Yes	Yes	No	4
Andersen-Ranberg (2001)	Yes	Yes	Yes	Yes	NC	Yes	Yes	No	6
Andreasen (1999)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Anttila (2002)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Anttila (2004)	Yes	Yes	Yes	NR	NR	Yes	Yes	No	5
Arai (2004)	Yes	Yes	Yes	NC	NR	Yes	No	Yes	5
Arslantas (2009)	Yes	Yes	NC	No	NC	Yes	Yes	Yes	5
Banerjee (2008)	Yes	Yes	NR	NR	NC	Yes	Yes	Yes	5
Benedetti (2002)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Benito-Leon (2009)	Yes	Yes	Yes	No	NR	Yes	Yes	No	5
Bennett (2003)	Yes	Yes	NR	NR	NR	Yes	Yes	No	4
Bermejo-Pareja (2008)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Bermejo-Pareja (2009)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Borjesson-Hanson (2004)	Yes	Yes	No	No	NC	Yes	Yes	Yes	5
Borroni (2011)	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	5
Bottino (2008)	Yes	No	No	No	NC	Yes	Yes	Yes	4
Camicioli (2000)	Yes	Yes	Yes	Yes	NC	Yes	Yes	No	6
Canadian Study of Health and Aging Working Group (1994)	Yes	Yes	Yes	NR	NC	Yes	Yes	Yes	6
Canadian Study of Health and Aging Working Group (2000)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Chen (2007)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Chien (2008)	Yes	Yes	NA	NA	NR	Yes	Yes	Yes	5
Cornelius (2004)	Yes	NC	NR	NR	NR	Yes	Yes	Yes	4
Corrada (2008)	Yes	Yes	NR	No	Yes	Yes	Yes	Yes	6
Corrada (2010)	Yes	Yes	NR	No	Yes	Yes	Yes	Yes	6
Cristina (2001)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7
Dahl (2007)	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	5
Das (2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Das (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8

de Jesus Llibre (2009)	Yes	Yes	Yes	No	NR	Yes	Yes	Yes	6
de Ronchi (2005)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6
de Silva (2003)	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	5
Demirovic (2003)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6
Di Carlo (2000)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Di Carlo (2002)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	6
Ebly (1994)	Yes	Yes	Yes	NR	NR	Yes	Yes	Yes	6
Edland (2002)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Feldman (2006)	Yes	Yes	NR	NR	Yes	Yes	Yes	No	5
Fish (2008)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Fitzpatrick (2004)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Forti (2010)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Fuhrer (2003)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	6
Fujishima (2002)	No	NC	Yes	NR	NC	Yes	Yes	Yes	4
Galasko (2007)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Ganguli (2000)	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	5
Ganguli (2000)	Yes	Yes	NC	NR	NR	Yes	Yes	No	4
Garre-Olmo (2010)	Yes	Yes	NA	NA	Yes	Yes	Yes	Yes	6
Gascon-Bayarri (2007)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Gavrila (2009)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Gislason (2003)	Yes	Yes	No	No	NC	Yes	Yes	Yes	5
Gourie-Devi (2004)	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	5
Graham (1997)	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	5
Guerchet (2010)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Gureje (2006)	Yes	Yes	Yes	No	NC	Yes	Yes	Yes	6
Gurvit (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Hall (2009)	Yes	Yes	No	Yes	NC	Yes	Yes	Yes	6
Harvey (2003)	Yes	Yes	NA	No	NC	Yes	Yes	Yes	5
Helmer (2006)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Hendrie (2001)	Yes	Yes	NR	NR	Yes	Yes	Yes	Yes	6
Herrera (2002)	Yes	Yes	Yes	No	NC	Yes	Yes	Yes	6
Ikeda (2001)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7
Ikeda (2004)	Yes	Yes	Yes	Yes	NR	Yes	Yes	No	6
Ikejima (2009)	Yes	Yes	NR	NR	NC	Yes	Yes	Yes	5
Jacob (2007)	Yes	Yes	Yes	No	NC	NC	NC	Yes	4
Jhoo (2008)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6

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Table 4. *(Continued)*

Study (Year)	Q1: Target population described?	Q2: Cases from entire population or probability sampling?	Q3: Response rate >70%?	Q4: Non-responders clearly described?	Q5: Sample representative of population?	Q6: Data collection methods standardized?	Q7: Validated criteria to assess disease?	Q8: Were estimates given with confidence intervals or subgroups?	Total Quality Score (/8)
Jitapunkul (2001)	Yes	Yes	Yes	No	NR	Yes	No	Yes	5
Jitapunkul (2009)	Yes	NC	NR	Yes	No	Yes	Yes	Yes	5
Juva (2000)	No	Yes	Yes	No	NR	Yes	Yes	Yes	5
Kahana (2003)	Yes	Yes	Yes	NC	NC	Yes	Yes	Yes	6
Kawas (2000)	Yes	NC	NR	NR	No	Yes	Yes	Yes	4
Kim (2003)	Yes	Yes	No	No	NC	Yes	Yes	Yes	5
Kivipelto (2001)	Yes	Yes	Yes	No	NR	Yes	Yes	No	5
Kivipelto (2002)	Yes	Yes	Yes	No	NR	Yes	Yes	No	5
Knopman (2002)	No	Yes	Yes	Yes	Yes	Yes	Yes	No	6
Knopman (2002)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
Knopman (2003)	Yes	Yes	Yes	Yes	NC	Yes	Yes	Yes	7
Knopman (2004)	No	NC	Yes	Yes	Yes	Yes	Yes	Yes	6
Kukull (2002)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6
Kuller (2005)	No	Yes	NR	NR	NC	Yes	Yes	Yes	4
Landi (2005)	Yes	Yes	Yes	No	NR	Yes	No	Yes	5
Langa (2005)	Yes	Yes	No	No	NR	Yes	Yes	No	5
Larrieu (2004)	Yes	Yes	No	No	NR	Yes	Yes	Yes	6
Lee (2002)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7
Li (2007)	Yes	No	No	No	Yes	Yes	Yes	Yes	5
Li (2007)	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	7
Livingston (2001)	Yes	Yes	Yes	Yes	No	No	No	No	4
Llibre Rodriguez (2008)	Yes	Yes	Yes	No	NR	Yes	Yes	Yes	6
Llibre-Rodriguez (2008)	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	7
Lopez (2003)	Yes	NR	NR	NR	NR	Yes	Yes	Yes	4
Lopez (2005)	Yes	Yes	NR	NR	NR	Yes	Yes	No	4
Lopez-Pousa (2004)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Lovheim (2008)	Yes	Yes	Yes	Yes	No	Yes	No	Yes	6
Luck (2008)	Yes	NR	Yes	Yes	Yes	Yes	Yes	No	6
Magaziner (2000)	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	7
Maneno (2006)	Yes	No	Yes	Yes	Yes	NC	No	No	4
Manton (2005)	Yes	Yes	NA	NR	NA	NR	No	Yes	3
Martens (2007)	Yes	Yes	NA	NA	NC	Yes	NC	Yes	4

Mathuranath (2010)	Yes	Yes	NA	NA	NC	Yes	Yes	Yes	5
Matsui (2009)	Yes	Yes	Yes	No	NC	Yes	Yes	No	5
Matthews (2002)	Yes	Yes	Yes	NR	NC	Yes	Yes	Yes	6
Matthews (2005)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
McDowell (2007)	Yes	Yes	NR	NR	NR	Yes	Yes	No	4
Meguro (2002)	Yes	Yes	No	No	NR	NR	Yes	Yes	4
Meguro (2007)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6
Mehlig (2008)	No	Yes	Yes	No	NR	Yes	Yes	No	4
Mercy (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Miech (2002)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Molero (2007)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6
Nabalamba (2010)	Yes	Yes	Yes	No	Yes	Yes	No	Yes	6
Ng (2010)	Yes	Yes	Yes	No	NR	Yes	Yes	Yes	6
Nitrini (2004)	Yes	Yes	NR	Yes	Yes	Yes	Yes	Yes	7
Nunes (2010)	Yes	Yes	No	No	NR	Yes	Yes	Yes	5
Perkins (2002)	Yes	Yes	NR	NR	Yes	Yes	Yes	Yes	6
Phung (2010)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Piguet (2003)	Yes	Yes	Yes	No	NC	Yes	Yes	No	5
Plassman (2007)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7
Polvikoski (2001)	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	7
Polvikoski (2006)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	6
Prince (2008)	Yes	Yes	Yes	No	NR	Yes	Yes	Yes	6
Rahkonen (2003)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Ravaglia (2005)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Ravaglia (2005)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Ravalglia (2008)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Riedel-Heller (2000)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	6
Riedel-Heller (2001)	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	7
Riedel-Heller (2001)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Rockwood (2000)	No	Yes	No	No	NR	Yes	Yes	Yes	4
Rosenblatt (2004)	Yes	Yes	Yes	No	NR	Yes	Yes	No	5
Rovio (2005)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	5
Ruitenberg (2001)	Yes	Yes	Yes	No	NC	Yes	Yes	Yes	6
Sahadevan (2008)	Yes	Yes	No	Yes	No	Yes	Yes	Yes	6
Samieri (2008)	Yes	NC	Yes	No	NR	Yes	Yes	Yes	5
Sanderson (2003)	Yes	Yes	NA	NA	NA	NC	No	No	2

Table 4. *(Continued)*

Study (Year)	Q1: Target population described?	Q2: Cases from entire population or probability sampling?	Q3: Response rate >70%?	Q4: Non-responders clearly described?	Q5: Sample representative of population?	Q6: Data collection methods standardized?	Q7: Validated criteria to assess disease?	Q8: Were estimates given with confidence intervals or subgroups?	Total Quality Score (/8)
Scazufca (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Sekita (2010)	Yes	Yes	NC	No	NC	Yes	Yes	Yes	5
Senanarong (2001)	Yes	NC	NR	NR	NR	Yes	Yes	No	3
Senanarong (2001)	Yes	NC	NR	NR	NR	Yes	No	Yes	3
Seshadri (2002)	Yes	Yes	Yes	No	NC	Yes	Yes	Yes	6
Shaji (2005)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Silver (2001)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	7
Simons (2006)	Yes	Yes	Yes	NR	Yes	No	No	Yes	5
Sousa (2009)	Yes	Yes	Yes	No	NC	NC	Yes	Yes	5
Spada (2009)	Yes	Yes	Yes	No	NR	Yes	Yes	No	5
Stevens (2002)	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	7
Suh (2002)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Tyas (2006)	No	Yes	No	Yes	NC	Yes	Yes	Yes	5
van Excel (2002)	Yes	Yes	Yes	Yes	No	Yes	No	No	5
Vas (2001)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	7
Vermeer (2003)	Yes	Yes	No	Yes	No	Yes	Yes	No	5
von Heidken (2006)	Yes	Yes	Yes	Yes	No	Yes	No	Yes	6
Wada-Isoe (2009)	Yes	Yes	NR	No	Yes	Yes	Yes	Yes	6
Waite (2001)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8
Wakutani (2007)	Yes	Yes	Yes	No	NR	Yes	Yes	Yes	6
Wancata (2007)	No	NC	No	Yes	No	Yes	Yes	No	3
Wangtongkum (2008)	Yes	Yes	NR	No	No	Yes	Yes	No	4
Wertman (2007)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7
Xu (2009)	Yes	Yes	Yes	No	NR	Yes	Yes	No	5
Yamada (2001)	No	Yes	NR	No	NR	Yes	Yes	Yes	5
Zhao (2010)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	6
Zhou (2006)	Yes	Yes	Yes	No	NR	Yes	Yes	Yes	7
Zuliani (2010)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	6

*Note: NR= Not reported; NC= Not clear

as well as subgroup analyses by age, sex, setting, diagnostic criteria, study location (e.g., continent) and year of data collection. While, as expected, the incidence and prevalence of dementia rose with increasing age, no significant differences in the pooled estimates between men and women were found. There was a non-significant trend for community-only settings to have a lower prevalence than combined community plus institution studies, while the prevalence estimate was significantly higher in institution-only settings. Other than for incidence proportion, there were no significant differences between studies using the DSM–III–R and DSM–IV diagnostic criteria. North American pooled period prevalence and incidence proportion estimates were the highest, while those from Asia were lowest. Estimates of prevalence and incidence did not change over time. Unfortunately, we were not able to show the decline found in some recent studies.[16,17] This could have a significant impact on the future burden of this condition. As noted earlier, with societal aging it is anticipated that the number of people with dementia worldwide will double by 2030 and triple by 2050.[6] A decline in prevalence as seen in the CFAS[17] would lower estimates of future costs for dealing with dementia in the United States by approximately 40%.[184]

The present study updates the body of literature on the epidemiology of dementia. Compared to other systematic reviews, a broader perspective was generally taken. For example, a recent systematic review on the prevalence of dementia was restricted to persons diagnosed only with DSM–IV and ICD–10 criteria and did not assess heterogeneity by any factor other than geographic region,[185] or focused only on China or Asia and/or did not perform a systematic review or meta-analysis.[186-188]

Erkinjuntti and colleagues[189] examined the effect of different diagnostic criteria on the prevalence of dementia in a large population-based cohort and found widely varying estimates (e.g., 3.1% using the ICD–10 classification system versus 29.1% with DSM–III criteria). More modest differences were found when DSM–III–R and DSM–IV criteria were compared (17.3 and 13.7%, respectively). In this report, we had a limited ability to explore the influence of diagnostic criteria but found evidence that DSM–III–R and DSM–IV criteria produced similar results, other than for incidence proportion.

Prior research has suggested that there might be significant regional differences in the prevalence and incidence of dementia.[185] Unfortunately, there are major limitations in the available data, such as a lack of nationally representative studies in a number of large countries, few reports from some regions of the world (e.g., Sub-Saharan Africa), and the marked heterogeneity seen between countries within a geographic region (i.e., studies carried out in one or two countries cannot be safely generalized to all nations within a specific region). Study quality did not vary by continent in the present analyses. The lowest estimates of period prevalence obtained from Asia are consistent with other recent systematic reviews where the incidence and/or prevalence of other neurodegenerative conditions (i.e., Parkinson's and Huntington's disease) have been reported to be lower in Asia.[190,191] A number of factors could account for these differences, including population genetics, exposure to environmental risk factors, differing life expectancy, and variations in case ascertainment due to the amount of stigma associated with certain conditions resulted in underreporting.

The strength of the conclusions that can be drawn from this study is limited by a number of factors. First, the quality of the included studies was variable and at times less than desired (e.g., no reporting of response rates or nonresponder characteristics). Second, significant heterogeneity was present among all estimates of prevalence and incidence. This was likely driven by the differing populations studied and methods used. There was evidence of publication bias for the incidence proportion and period prevalence of dementia, suggesting that there may be unpublished studies reporting differing results. Finally, some studies did not provide the specific data (e.g., proportion with $CI_{95\%}$, numerator and denominator, etc.) necessary to include them in the meta-analyses. To improve the comparability of studies and comprehensiveness of future meta-analyses in this area, an effort should be made to standardize study procedures and reporting.

In conclusion, dementia is a common neurological condition in older individuals. Significant gaps in knowledge about its epidemiology were identified. For example, there are few studies examining the incidence of dementia in low- and middle-income countries, where the disruptive impact of an aging population may be greatest in view of limited resources. Future research should also focus on assessing the impact of utilizing DSM–5 diagnostic criteria for major neurocognitive disorders on estimates, examining differences in rates among subgroups within a larger study population, where appropriate, and further assessing dementia in a variety of settings and geographic regions.

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Disclosures

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Statement of Authorship

KMF, NJ, JIR, CJM, TP and DBH contributed to study conception and design. KMF, NJ, JIR, CJM, EES, SEB, LB, AC, LD, JH, AK, DP, AV and DBH contributed to the acquisition of data. KMF conducted the data analysis. KMF, NJ, JIR, CJM, EES and DBH participated in the interpretation of study data. All authors participated in critically revising the manuscript for important intellectual content

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and gave final approval for the submission of this manuscript and any further submissions of this work.

Supplementary Material

To view the supplementary material that exist for this study (Appendix A and B), please visit http://dx.doi.org/10.1017/cjn.2016.18.

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