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Worldwide Prevalence and Incidence of Dementia

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Abstract

Dementia is a common and disabling disorder in the elderly. Because of the worldwide aging phenomenon, existing in both developed and developing countries, dementia has a growing public health relevance. This article reviews the prevalence and incidence data for dementia reported in the international literature in the last 10 years. Results from 36 prevalence and 15 incidence studies have been examined. Prevalence is equal to 0.3 to 1.0 per 100 people in individuals aged 60 to 64 years, and increases to 42.3 to 68.3 per 100 people in individuals 95 years and older. The incidence varies from 0.8 to 4.0 per 1000 person years in people aged 60 to 64 years, and increases to 49.8 to 135.7 per 1000 person years when the population was older than 95 years. The international comparison allows the following conclusions: (i) both prevalence and incidence show little geographical variation, as differences between countries seem to reflect methodological rather than real differences [the low prevalence of dementia in Africa needs to be confirmed by incidence data]; (ii) both incidence and prevalence figures increase with age even in the advanced ages; (iii) regarding dementia types, most of the inconsistency in results from different studies is due to vascular dementia rather than to Alzheimer's disease (AD); (iv) it is still unclear if the reported higher frequency of vascular dementia in Asian populations is due to differential distribution of genetic and/or environmental factors, or due to methodological differences; (v) different dementia types might have different age distributions.

Dementia is an emerging public health problem as it is one of the most common diseases in the elderly and a major cause of disability and mortality.[1,2] It is becoming more relevant from a public health perspective because of the increasing number of elderly in the world. In fact, during the past few decades, the aging of the population has become a worldwide phenomenon, no longer confined to Western societies.[3,4] The unprecedented declines in mortality and fertility have resulted in a rapid population aging process in most of the developing countries. In 1990, 26 nations had more than 2 million elderly citizens (≥65 years); by 2025, an additional 33 countries are likely to join the list. Between 1985 and 2025, the rate of increase of the elderly population in some developing countries will be up to 15 times higher than the increase in, for example, Sweden. On the other hand, the developed countries, which have already experienced a dramatic increase in the population aged 65 years and older, will face the progressive aging of the elderly population itself. In most of these countries, the oldest (those 80 years and older) are the fastest growing part of the elderly population.

Consequently, both developed and developing countries will face the challenge of coping with a high frequency of chronic diseases, such as dementia, which are characteristic of aging societies. In response to the worldwide increase in an older population and increased number of individuals affected by disabling disorders, many initiatives have been taken to promote attention to this topic. In April 1995, the World Health Organization (WHO) launched a new programme on aging and health in which research was one of the main objectives. In December 1996, the editor of the *Journal of the American Medical Association (JAMA)* announced that 80 major medical journals through more than 200 proposals had identified aging to be the most important topic to be addressed in the second global theme issue.[5] 11 months later this Global Theme Issue on Aging was published with the participation of 97 journals in 31 countries.[6] The European Commission has proposed, with the approval of the European Parliament in December 1997, that the aging population be one of the key initiatives for the programme for research and technological development in 1998 to 2002 (the 5th Framework Program, FP5).[3] This initiative is devoted to promoting healthy aging and independence in old age by preventing and treating age-related diseases and disability.[7]

All of these initiatives reflect the attention of the scientific world on the third age and related diseases. Epidemiology is one of the leading research areas, studying the aging process from an epidemiological point of view is a priority from a public health perspective. A large part of such studies have been devoted to dementia. The first epidemiological studies concerning dementia and different dementia types were carried out during the 1960s in the Scandinavian countries; however, it was during the 1980s that epidemiological methods first began to be widely used in the field of dementia research. These methods were used to describe different patterns of the dementias, and to identify risk factors for different dementing disorders. Finally, in the 1990s, follow-up studies regarding incidence, aetiology and natural history of the dementias have been initiated.

In spite of this large amount of research, several questions concerning the occurrence of dementia in the world are still open. This review aims to explore the following questions:

- Are there geographical differences in the occurrence of dementia?
- Does dementia incidence vary in different ethnic groups?
- Are the degenerative and vascular forms of dementia differently distributed in different countries?

1. Occurrence of Dementia

The occurrence of a disease can be measured as the proportion of individuals affected by the disease in a defined population at a specific instant (prevalence), or as the number of new cases that develop in a population of individuals at risk during a specific time interval (incidence). Whereas the prevalence provides an estimate of the risk of an individ-

ual to be ill at a certain point in time, the incidence estimates the risk of becoming ill.

The prevalence is determined both by incidence and disease duration. Thus, differences in prevalence between groups may be due to differences in treatment/care of the disease and/or general health conditions that can affect disease duration. Most of our knowledge about the occurrence of the dementias is based on prevalence rather than incidence data,[8,9] as the detection of incident cases is expensive and time consuming. International comparison based on prevalence figures needs to be examined with caution because of the uncertainties of interpretation.

Unfortunately, even the incidence data have limitations as they are often hampered by methodological problems such as small sample sizes, detection of disease onset, attrition rate and diagnostic accuracy. Worldwide comparison of incidence data needs to take into account methodological differences between studies.

Several attempts to review the prevalence of dementia in the world have already been reported,[10-18] either in the form of meta-analysis or review. In contrast, only 2 meta-analyses of published incidence data in the world[19,20] and a comparison of incidence studies in Europe[21] are present in the literature.

In this review, we will compare separately prevalence and incidence data in the last decade among different countries in the world, and among different ethnic groups in the same nation. Published prevalence and incidence studies were identified through: a Medline search from 1990 to 1998, existing reviews of the field and reference lists of identified studies. Population-based studies, in which dementia diagnosis was made according to comparable diagnostic criteria, were included. When the same study was replicated in the same population at different times, only the most recent figures were taken into account. We did not include articles in which age-stratified prevalence or incidence figures were not reported, or in which both the number of cases and the size of the study population were missing. Data from studies carried out in Europe, North America, Asia and multi-ethnic communities were pooled after stratification in 5-year age groups. When a study did not stratify the oldest ages, only data from the youngest groups were pooled. Prevalence and incidence studies included in this review are reported in tables I to III.

2. Prevalence of Dementia and Different Dementing Disorders

Table I shows the European prevalence studies on dementia. There is a good representation of western European countries, with wide north-south distribution: 2 studies were performed in Finland,[23,35] 1 in Norway,[34] 5 in Sweden,[22,32,36,40,46] 1 in Denmark,[42] 4 in the UK,[24,26,29,30] 2 in The Netherlands,[25,44] 1 in Belgium,[37] 3 in Germany,[27,38,39] 4 in Italy[31,41,43,45] and 1 in Spain.[28] We could include only 3 North American studies that investigated Caucasian populations;[45-49] 3 other studies examined Asian-Americans[55,56] and African-Americans[57] (table I). In Africa, only 1 study was performed in Nigeria.[57] From Asia, we included 2 studies from Japan[50,51] and 1 each from China,[54] Korea[52] and India[53] (table I).

2.1 Geographical Distribution of Dementia

Pooled age-specific prevalence figures from different continents and multi-ethnic groups are presented in figure 1. In all countries, dementia prevalence increases almost exponentially with age. This finding confirms previous reports that the disease prevalence doubles almost every 5 years.[11,12,19] Prevalence is very low in individuals under the age of 60 years in all countries (0.3 to 0.7 per 100 people) and increases even in the most advanced ages (33.3 to 68.3 per 100 people). In the age groups up to 85 years, if we exclude the data from Africa,[57] the prevalence figures are surprisingly similar, leading to a figure per 100 people equal to 0.5 cases in the age group 60 to 65 years, 1.5 in the age group 65 to 69 years, 3 in the age group 70 to 74 years, 6 in the age group 75 to 79 years, and 12 in the age group 80 to 84 years. The differences in the oldest ages are likely to be as a result of unstable prevalences caused by small sample sizes, especially in

Table I. Prevalence studies included in this review

Reference	Site of study	Age (y)	Dementia diagnostic criteria
Europe			
Hagnell et al.[22]	Lund, Sweden	30+	DSM-III
Sulkava et al.[23]	Finland	65+	DSM-III
Copeland et al.[24]	Liverpool, UK	65+	GMS-AGECAT, DSM-III
Heeren et al.[25]	Leiden, Netherlands	85+	DSM-III, GMS
Brayne & Calloway[26]	Cambridgeshire, UK	70+, women	CAMDEX
Cooper & Bickel[27]	Mannheim, Germany	65+	CAMDEX, ICD-9
Lobo et al.[28]	Zaragoza, Spain	65+	DSM-III, ICD-10, GMS
O'Connor et al.[29]	Cambridge, UK	75+	CAMDEX
Livingston et al.[30]	London, UK	65+	DSM-III, GMS
Rocca et al.[31]	Appignano, Italy	60+	DSM-III, NINCDS-ADRDA
Fratiglioni et al.[32]	Stockholm, Sweden	75+	DSM-III-R
Breteler et al.[33]	Amsterdam/Rotterdam, Netherlands	65+	CAMDEX, DSM-III-R
Engedal et al.[34]	Oslo, Norway	75+	DSM-III
Juva et al.[35]	Helsinki, Finland	75+	CDR
Skoog et al.[36]	Gothenburg, Sweden	85+	DSM-III-R, NINCDS-ADRDA, CT-scan
Roelands et al.[37]	Heist-op-den-Berg, Belgium	65+	DSM-III-R
Wernicke & Reischies[38]	Berlin, Germany	70+	DSM-III-R
Fichter et al.[39]	Munich, Germany	85+	DSM-III-R, GMS, ICD-10
Johansson & Zarit[40]	Jonkoping, Sweden	85+	DSM-III-R
Prencipe et al.[41]	L'Aquila, Italy	65+	DSM-III, NINCDS-ADRDA, NINCDS-AIREN
Andersen et al.[42]	Odense, Denmark	65+	CAMDEX, DSM-III-R, NINCDS-ADRDA
Ferini-Strambi et al.[43]	Vescovato, Italy	60+	NINCDS-ADRDA, NINCDS-AIREN
Boersma et al.[44]	Zwolle, Netherlands	65+	CAMDEX, DSM-III-R
De Ronchi et al.[45]	Granarolo, Italy	60+	DSM-III-R
von Strauss et al.[46]	Stockholm, Sweden	77+	DSM-III-R
North America			
Kokmen et al.[47]	Rochester, Minnesota, US	55+	DSM-III, NINCDS-ADRDA
Bachman et al.[48]	Framingham, Massachusetts, US	60+	DSM-III-R, NINCDS-ADRDA
Ebly et al.[49]	Canadian Study of Health and Aging (CSHA), Canada	85+	DSM-III-R, NINCDS-ADRDA
Asia			
Hasegawa et al.[50]	Kanagawa, Japan	65+	DSM-III
Ueda et al.[51]	Hisayama, Japan	65+	DSM-III, CT-scan
Park et al.[52]	Myun, Korea	65+	DSM-III-R, CAMDEX
Shaji et al.[53]	Kerala, India	60+	CAMDEX, DSM-III-R, ICD-10
Chiu et al.[54]	Hong Kong, China	65+	CAMDEX, DSM-IV, ICD-10, NINCDS-AIREN
Asian-Americans			
Graves et al.[55]	King County, Washington, US	65+	DSM-III-R, NINCDS-ADRDA
White et al.[56]	Honolulu, Hawaii, US	60+	DSM-III-R, NINCDS-ADRDA
African and African-Americans			
Hendrie et al.[57]	Ibada, Nigeria and	65+	DSM-III-R, ICD-10
	Copiah, Indianapolis, US	65+	DSM-III-R, ICD-10

CAMDEX = Cambridge Mental Disorders of the Elderly Examination; **CDR** = Clinical Dementia Rating; **CT-scan** = computed tomography scan; **DSM-III** = Diagnostic and Statistical Manual of Mental Disorders (third edition); **DSM-III-R** = DSM-III revised; **DSM-IV** = DSM (fourth edition); **GMS** = Geriatric Mental State Interview; **GMS-AGECAT** = GMS–Automated Geriatric Examination for Computer Assisted Taxonomy; **ICD-9** = International Classification of Diseases (ninth edition); **ICD-10** = ICD (tenth edition); **NINCDS-ADRDA** = National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association; **NINCDS-AIREN** = NINCDS and the Association Internationale pour la Recherche et L'Enseignement en Neurosciences.

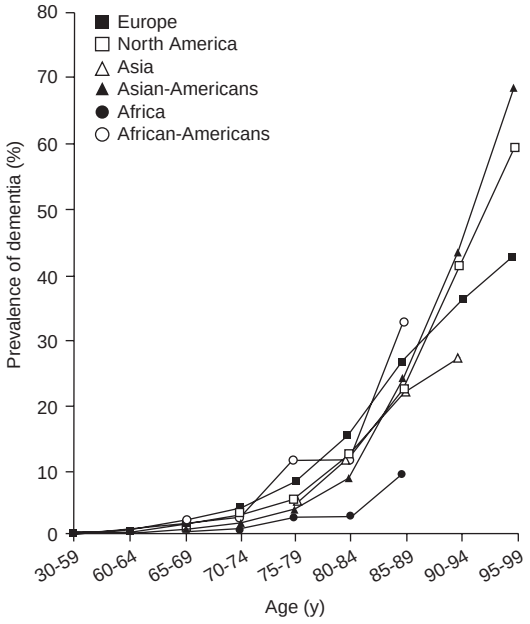

Fig. 1. Prevalence rates, per 100 people, for dementia on different continents. Pooled data from Europe, Asia and North America.[22-57]

the oldest European studies.[22,23,28,30,33] In fact, a recent report from Stockholm, Sweden,[46] found a prevalence of 37.3 and 47.9 per 100 people in the age groups 90 to 94 years and 95 years and older. These data are similar to those recently reported from North America.[47-49]

The prevalences in the only study from Africa are low in all ages.[57] Lower survival or methodological differences can explain this discrepancy,[16] but possible ethnic variation cannot be excluded. Environmental or genetic factors acting as prognostic and/or risk factors might determine this variation. For example, it has been reported that the apolipoprotein E e4 allele, which is a well known risk factor for dementia in Caucasian[73] and Asian populations, is not associated with a higher risk of dementia among Africans.[74]

2.2 Geographical Distribution of Dementia Types

Despite similar overall prevalence of dementia in North America, Europe and Asia, the relative proportions attributed to Alzheimer's disease (AD) and vascular dementia seems to differ among continents and multi-ethnic communities of Western countries (fig. 2). In most Western countries, 50 to 70% of the total dementia prevalence is attributed to AD, and 20 to 30% to vascular dementia. Only a few reports differ from this pattern.[31,36] In these 2 European studies[31,36] carried out in Italy and Sweden, respectively, there was a lower proportion of AD than vascular dementia, and age-specific prevalences were similar. In comparison with other European studies, Rocca et al.[31] and Skoog et al.[36] found higher vascular dementia prevalences, but similar AD figures, as shown in table II, in which age-specific prevalences from these studies are compared with our data from the Kungsholmen Project.[32]

In most Asian studies, higher percentages are found for vascular dementia, as vascular dementia represents 38% of the total dementia cases. Never-

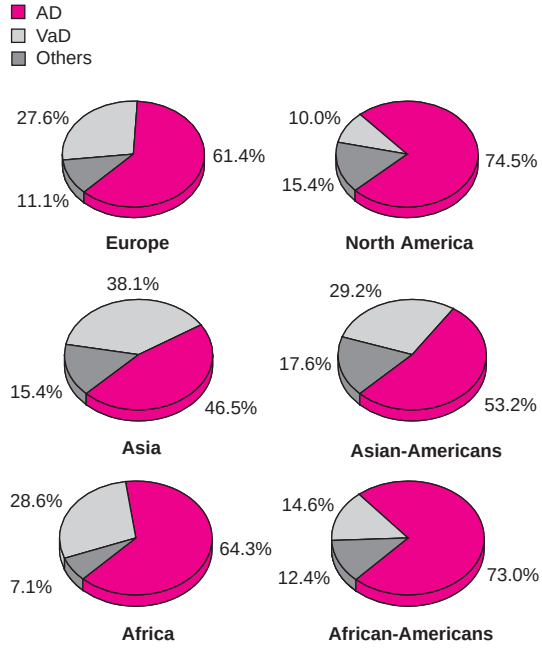

Fig. 2. Prevalent dementia cases: proportion of different dementing disorders in different continents. Pooled data from Europe, Asia and North America. **AD** = Alzheimer's disease; **VaD** = vascular dementia.[22-57]

Table II. Comparison of studies performed in Stockholm, Appignano and Gothenburg

Study [age (y)]	Prevalence per 100 population (95%confidence interval)		
	dementia	Alzheimer's disease	vascular disease
Stockholm, Sweden[32]			
75-79	5.7 (4.1-7.7)	3.4 (2.0-4.7)	1.4 (1.0-2.6)
80-89	13.3 (11.1-15.5)	7.0 (5.4-8.7)	3.1 (2.0-4.2)
85-89	20.4 (16.2-25.2)	11.8 (8.5-15.8)	4.9 (2.9-7.9)
Appignano, Italy[a][31]			
70-79	5.6 (3.0-8.2)	2.0 (0.4-3.5)	2.6 (0.8-4.4)
80-89	25.9 (17.7-34.2)	10.2 (4.5-15.9)	8.3 (3.1-13.5)
90+	14.3 (0.4-57.9)	14.3 (0.4-57.9)	0.0 (0.0-41.0)
Gothenburg, Sweden[35]			
85	29.8 (25.8-34.0)	13.0 (10.0-15.9)	14.0 (10.9-17.0)

a Mixed-dementia cases are not included in vascular disease.

theless, if we take into account only recent studies,[52-54] vascular dementia accounts for 31% and AD for 61%. These figures are similar to the findings reported in Europe, North America and Africa. However, the proportion of vascular dementia is 3 times higher among Asian-Americans than among the other ethnic groups.

In conclusion, it seems that most of the inconsistency present in the literature is due to the estimate of vascular dementia occurrence, rather than AD. The interpretation of the geographical differences in vascular dementia prevalence, if they exist, needs to take into account the following points:

- Variation in diagnostic criteria and procedure may occur. AD and vascular dementia diagnoses are hampered by the lack of diagnostic markers and by the controversial conceptual definition of vascular dementia.[75] Most epidemiological studies focused on multi-infarct dementia, whereas others used the broader definition of vascular dementia. Very few studies[33,36] used neuroimaging in the diagnosis of dementia type.
- Dementia duration may vary in different countries because of differential survival and care. This may explain different dementia prevalences between different countries.
- Different age structure of the study populations can affect the relative proportions of dementia types, when not stratified by age. It has been suggested[36] that vascular dementia may be the major cause of dementia in the highest ages, whereas other researchers have reached an opposite conclusion, suggesting that this type of dementing disorder may be more frequent in the youngest old ages.[76]
- Differential geographical distribution of vascular risk factors and stroke may cause differential distribution of vascular dementia. High rates of vascular diseases are present among Asian populations, which would inevitably predict a higher proportion of vascular dementias among this ethnic group.[77] However, the study on African and African-Americans did not show any significantly higher proportion of vascular dementia compared with Caucasian populations, although a higher frequency of hypertension and stroke has been reported in this group.[77]

3. Incidence of Dementia and Different Dementing Disorders

A limited number of incidence studies are present in the literature, especially regarding different dementing disorders (table III). Only 2 incidence studies were carried out in Asian countries, specifically in Beijing, China, and southern Taiwan[71,72] and only 1 assessed multi-ethnic American communities.[78]

3.1 Geographical Variation of Dementia

In figures 3 and 4, the findings from single studies are reported separately for Europe, North America and Asia. Incidence figures are surprisingly similar in the youngest old, whereas a wide variation is present in the 3 oldest groups, probably because of imprecise estimates. During 1 year, there is 1 person per 1000 people aged 60 to 65 years who becomes demented; when the population is older than 95 years, this number increases to an average of 90 new cases in 1 year per 1000 people. One study from Germany[65] (not reported in fig. 3), showed very high incidence rates in the age range 85 to 89 years (113.6 new cases per 1000 person years), 90 to 94 years (112.5 new cases per 1000 person years) and 95 years and older (235.7 new cases per 1000 person years), but the case ascertainment was performed during a very short time interval (1 year).

North American studies show a tendency towards lower incidence rates than European studies. Some methodological differences could account for these lower results: (i) in the Framingham study,[69] the inception of the dementia-free cohort was based on psychological tests, therefore early dementia cases, and maybe preclinical cases, were removed from the study population; (ii) in the Rochester study,[70] only those people who sought medical attention could be identified as demented cases, because the study was based on a record linkage system.

The incidence studies confirm that AD is the most common dementia disorder, perhaps more common in Caucasian populations than in Asian (fig. 5). Only 1 study reported similar rates for AD and

Table III. Incidence studies included in this review

Reference	Site of study	Age (y)	Dementia diagnostic criteria
Europe			
Copeland et al.[58]	Liverpool, UK	65+	GMS-AGECAT
Bickel & Cooper[59]	Mannheim, Germany	65+	ICD-9, CAMDEX
Boothby et al.[60]	London, UK	65+	CAMCOG, NINCDS-ADRDA
Letenneur et al.[61]	Bordeaux, France	65+	DSM-III-R, NINCDS-ADRDA
Paykel et al.[62]	Cambridge, UK	75+	CAMDEX
Gussekloo et al.[63]	Leiden, Netherlands	85+	DSM-III, GMS-AGECAT
Aevarsson & Skoog[64]	Gothenburg, Sweden	85+	ICD-10, NINCDS-ADRDA, CT-scan
Fichter et al.[65]	Munich, Germany	85+	DSM-III-R
Brayne et al.[66]	Cambridge, UK	70+, women	CAMDEX
Fratiglioni et al.[67]	Stockholm, Sweden	75+	DSM-III-R
Ott et al.[68]	Rotterdam, Netherlands	55+	CAMDEX, DSM-III-R, NINCDS-ADRDA, NINCDS-AIREN
North America			
Bachman et al.[69]	Framingham, Massachusetts, US	60+	NINCDS-ADRDA
Rocca et al.[70]	Rochester, Minnesota, US	50+	DSM-III-R, NINCDS-ADRDA
Asia			
Li et al.[71]	Beijing, China	60+	DSM-III
Liu et al.[72]	Kaohsiung, Taiwan	60+	ICD-10, NINCDS-ADRDA, NINCDS-AIREN

CAMCOG = Cambridge Cognitive Examination; **CAMDEX** = Cambridge Mental Disorders of the Elderly Examination; **CT-scan** = computed tomography scan; **DSM-III** = Diagnostic and Statistical Manual of Mental Disorders (third edition); **DSM-III-R** = DSM-III revised; **GMS-AGECAT** = GMS–Automated Geriatric Examination for Computer Assisted Taxonomy; **ICD-9** = International Classification of Diseases (ninth edition); **ICD-10** = ICD (tenth edition); **NINCDS-ADRDA** = National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association; **NINCDS-AIREN** = NINCDS and the Association Internationale pour la Recherche et L'Enseignement en Neurosciences.

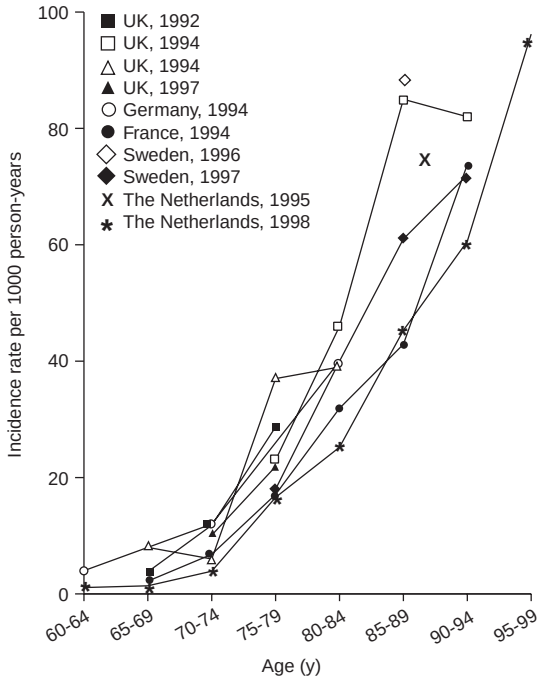

Fig. 3. Age-specific incidence rates for dementia per 1000 person-years in European studies.[58-64,66-68]

vascular dementia in the ages of 85 to 88 years.[64] Further investigations are needed in this area.

3.2 Dementia and Aging

In recent years, several studies have addressed the issue of whether dementia is an 'age- or aging-related disorder'.[14,19,38] In spite of the current availability of incidence data, it is still unclear if the exponential increase in dementia frequency with age continues even in the advanced ages as an inevitable feature of aging, or if the occurrence reaches a plateau in people aged 85 years and older. This uncertainty derives mainly from the difficulty in studying samples of individuals aged 90 years and older that are large enough to allow reliable estimations of dementia incidence. Moreover, the degree of diagnostic difficulty increases with age. In very old people, it may be problematic to distinguish between early manifestations of dementia and changes associated with 'normal aging'.[46]

Both dementia and AD incidence increase steeply with age, while the relationship between vascular dementia and age is not so clear. In very old ages, it is likely that both vascular and degenerative mechanisms contribute together to the development of dementia, which can be attributed to one or other subtype of dementia depending on the diagnostic tools used.[8,79]

4. Conclusions

Dementia is a growing worldwide medical, social and economic problem. In all countries, both the prevalence and incidence of dementia increase with increasing age, perhaps even in the most advanced ages. Both prevalence and incidence show little geographical variation, as differences between countries seem to reflect methodological rather than

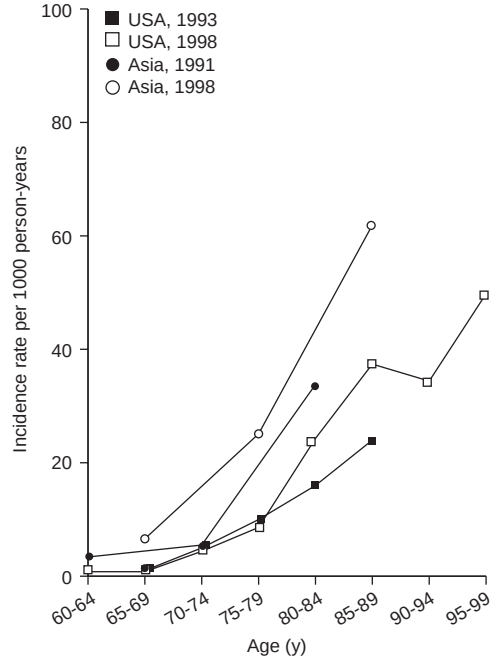

Fig. 4. Age-specific incidence rates for dementia per 1000 person-years in American and Asian studies.[69-72]

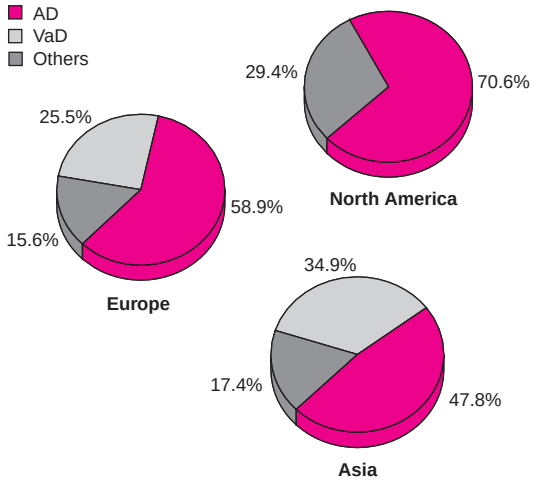

Fig. 5. Incident dementia cases: proportion of different dementing disorders in different countries, pooled data from Europe, Asia and the US. **AD** = Alzheimer's disease; **VaD** = vascular disease.[58-72]

real differences. The low prevalence of dementia in Africa needs to be replicated by other prevalence studies and confirmed by incidence data.[80,81] Regarding dementia types, it is still unclear if the reported higher frequency of vascular dementia in Asian populations is due to differential distribution of genetic and/or environmental factors, or if it is just a result of methodological differences. Finally, it is still controversial whether different dementia types have different age distributions.

Most of the inconsistency is with vascular dementia rather than AD. In fact, both AD and vascular dementia diagnoses are hampered by the lack of diagnostic markers. In addition, there is controversy regarding the definition of vascular dementia. Most likely, vascular and degenerative mechanisms contribute together to the development of dementia especially in very old ages. More incidence studies with comparable methodology are needed for a better understanding of the worldwide occurrence of dementia, and in order to generate new aetiological hypotheses.

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