

High prevalence of dementia among older adults from poor socioeconomic backgrounds in São Paulo, Brazil

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ABSTRACT

Background: The aim of this study was to determine the prevalence of dementia in a socioeconomically disadvantaged population of older adults living in the city of São Paulo, Brazil.

Methods: A cross-sectional one-phase population-based study was carried out among all residents aged ≥ 65 in defined census sectors of an economically disadvantaged area of São Paulo. Identification of cases of dementia followed the protocol developed by the 10/66 Dementia Research Group.

Results: Of 2072 individuals in the study, 105 met the criteria for a diagnosis of dementia, yielding a prevalence of 5.1%. Prevalence increased with age for both men and women after age 75 years, but was stable from 65 to 74 years. Low education and income were associated with increased risk of dementia.

Conclusions: The prevalence of dementia among older adults from low socioeconomic backgrounds is high. This may be partly due to adverse socioeconomic conditions and consequent failure to compress morbidity into the latter stages of life. The increasing survival of poorer older adults with dementia living in developing countries may lead to a rapid increase in the prevalence of dementia worldwide.

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Key words: epidemiology, dementia, cognitive impairment, prevalence, aging, developing countries

Introduction

The prevalence of dementia is increasing worldwide as the population ages (Cohen, 2003). Current estimates indicate that there are 24 million people with dementia worldwide, with approximately 60% of them living in developing countries (Ferri *et al.*, 2005). The proportion of people with dementia is expected to double every 20 years, and by 2040 70% of them will be living in developing countries such as Nigeria, India and Brazil.

Presently available epidemiological studies suggest that the prevalence of dementia is higher in developed than developing-countries (Jorm *et al.*, 1987; Hofman *et al.*, 1991; Hendrie *et al.*, 1995; Breitner *et al.*, 1999; Lobo *et al.*, 2000; 10/66 Dementia Research Group, 2000a; Vas, 2001; de Silva, 2003; Shaji, 2005; Zhang, 2005). However, the number of well-designed surveys aimed at ascertaining the prevalence of dementia in non-industrialized countries is small (10/66 Dementia Research Group, 2000b; Ferri *et al.*, 2005) and fails to express adequately the vast demographic, cultural and socioeconomic heterogeneity of these populations.

During the past few decades a large proportion of older adults living in Latin America moved from rural areas to large urban centres, where they often live in underprivileged areas of the city (Dufour and Piperata, 2004). These people have poor literacy and general health, including high prevalence of cardiovascular diseases (Marins *et al.*, 2007). Low educational attainment and cardiovascular diseases are associated with increased risk of dementia (Newman *et al.*, 2005; Valenzuela and Sachdev, 2006), which suggests that older people living in developing countries have a particularly high risk of developing dementia. These people also lack access to the factors that ultimately lead to successful compression of morbidity (Fries, 1980), and this may lead to earlier onset of illness and greater comorbidity among those living in disadvantaged communities.

Brazil has one of the fastest growing populations of older people in the world (United Nations Department of Economic and Social Affairs, 2002). Those aged 60 years or over currently represent 9% of the total Brazilian population (Instituto Brasileiro de Geografia e Estatística, 2006), but will make up 24% the total population by 2050 (United Nations Department of Economic and Social Affairs, 2002). Somewhat surprisingly, there is only sparse systematic information about the prevalence of dementia in Brazil. One study investigated the prevalence of dementia in a medium-size community in the southeast of Brazil (Herrera *et al.*, 2002). In that study, the total prevalence of dementia among subjects aged 65 years or over was 7.1%. There is currently no information about the prevalence of dementia in the socioeconomic disadvantaged large urban centres of Brazil. This study aimed to determine the prevalence of dementia among older adults of low socioeconomic status living in a well-defined region of the city of São Paulo, the largest metropolis in South America.

Methods

Study design

A cross-sectional one-phase population-based study was carried out with all residents aged 65 years or older living in an economically deprived area of São Paulo, Brazil. The present study is part of a collaborative program developed by the 10/66 Dementia Research Group, an international network of investigators, mostly from developing countries (10/66 Dementia Research Group, 2000a; Scazufca *et al.*, 2002).

Study setting and sample

The city of São Paulo has an estimated population of 10.4 million inhabitants (Instituto Brasileiro de Geografia e Estatística, 2006) and is divided into 31 administrative boroughs, with territorial and population demarcations. The present investigation was carried out in the borough of Butantã, located on the west side of the city. In 2000 the area had 377,576 residents, of whom 6.2% were aged 65 years or over and 13% lived in shanty towns. The study was carried out in 66 census sectors (the smallest administrative areas) covering a population of approximately 63,000 residents, representing 17% of the total population of the Butantã borough. The selection of areas was based on the presence of shanty towns and/or Family Health Program teams (such teams are normally placed in the most disadvantaged areas of the city of São Paulo), but was not limited by them (i.e. they included the entire census areas, not only shanty towns). These areas had the lowest Human Development Indexes of the borough (Secretaria do Governo da Prefeitura de São Paulo, 2004).

Eligible participants were people aged 65 years and over who were residents in the defined census sectors. They were identified and recruited through door knocking of all households within the census sectors boundaries. All eligible subjects were invited to participate, regardless of whether or not other older adults living in the same residence had already consented to take part in the study. Institutionalized individuals were not included.

The sample size was based on the precision of the prevalence estimate, and was calculated to be 2000 subjects, for a prevalence of dementia of 5.0% with a 95% confidence interval of 4% to 6%.

Measurements

The assessment of dementia was carried out with a harmonized one-phase dementia diagnostic procedure developed by the 10/66 Dementia Research Group for use in population-based studies in developing countries (Prince *et al.*, 2003), and a detailed assessment of the onset and course of the dementia syndrome. This procedure, which was devised to avoid educational and cultural bias in the assessment of dementia, included the Community Screening Instrument for Dementia (CSI-D) (Hall *et al.*, 2000), an adapted version of the CERAD ten-word list learning task with delayed recall, the animal naming verbal fluency task from the CERAD (Welsh *et al.*, 1994), the Geriatric Mental State (GMS; a semi-structured clinical interview for the assessment of mental

status) (Copeland *et al.*, 1986; Prince *et al.*, 2004), and a structured neurological assessment to ascertain the presence of lateralizing signs, parkinsonism, ataxia, apraxia and primitive “release” reflexes. The interview with the informants consisted of an enquiry about the participant’s cognitive and daily function according to the CSI-D (Hall *et al.*, 2000) and a brief history of the participant’s functional and cognitive decline based on the History and Aetiology Schedule Dementia Diagnosis and Subtype (HAS-DDS) schedule (Dewey and Copeland, 2001), which was completed when informants reported the presence of decline in the CSI-D. The diagnosis of dementia followed DSM-IV criteria (American Psychiatric Association, 1994) and used all the information collected from the subject and his/her informant. The HAS-DDS also provided information that allowed for the classification of dementia subtypes (American Psychiatric Association, 1994) as Alzheimer disease (AD), vascular dementia (VaD) or mixed dementia. The latter included cases with characteristics of both AD and VaD, and cases with a history of parkinsonism.

We ascertained age by asking older adults and their informants about the dates of birth of participants, and by collecting the information from participants’ identity cards (which are mandatory in Brazil). In the rare instances where there was inconsistency between these sources, the interviewer asked further questions to determine the likely age of the participant.

Procedures

Eight mental health workers were trained in the use of the research protocol. The assessments were conducted between May 2003 and April 2005. All eligible residents who consented were interviewed. For each participant, an informant was also identified. Informants were co-residents aged 16 years or over, or a relative or friend who was familiar with the participant’s life history. Interviews with participants and informants were scheduled to take place at the participants’ homes approximately one week after recruitment and, whenever possible, were carried out simultaneously by two different interviewers. These assessments took approximately 90 minutes. For participants with severe mental or physical disabilities, informants were also asked about the participant’s socioeconomic characteristics.

Ethical considerations

Participants provided written informed consent. Those deemed unable to consent because of mental or physical incapacities were recruited on the basis of informants’ signed agreement. When participants were illiterate, the information sheet and consent form were read aloud, and verbal witnessed consent was obtained. The study received ethics approval from the Brazilian National Committee for Ethics and Research (CONEP-Brazil).

Statistical analysis

Data entry was carried out twice, and consistency checks performed. Data analysis was carried out with the software STATA 9.0 (StataCorp, 2005). Age was grouped in five-year age bands from 65 to 84 years, and one group aged

85 years or older. Monthly income was grouped into five categories (in US dollars equivalent): zero to 85, 86 to 127, 128 to 246, 247 to 500, and 501 or more. Educational attainment was grouped into three categories: no formal education, incomplete basic education (1 to 3 years), and complete basic primary school education (four or more years of school education). The total prevalence of dementia was estimated with its respective 95% confidence interval (95% CI). The prevalence of dementia according to gender and age group was also estimated. We used the direct method to calculate the standardized estimate of the prevalence of dementia, with corresponding 95% confidence interval (United Nations Department of Economic and Social Affairs, 2005). Briefly, this approach takes into account the age structure of a standard population (in this case, the UN population for developed countries) and the prevalence of dementia for each age group in the study population. The standardized estimate can be seen as the prevalence that would be observed if the study population had the same age structure as the standard population. The prevalence of Alzheimer disease (AD), vascular dementia (VaD) and mixed AD and VaD was estimated with respective 95% CI. The associations between AD, VaD, and mixed AD and VaD with gender were estimated. These analyses were controlled for age group. We estimated the association between dementia and educational attainment as well as income with logistic regression. These analyses were controlled for gender and age group. Statistical significance was assessed with likelihood ratio tests.

Results

Sample characteristics

It was necessary to contact (by door-knocking) 21,727 households in 66 census sectors to identify 2,266 persons aged 65 years and over, of whom 2,072 (91.4%) agreed to participate in the study. Among the 194 non-participants, 180 (8.0%) refused to participate and 14 (0.6%) died or moved to an address outside the study area between the identification and interview phases. Participants and non-participants had similar gender and age distributions. Twenty-five (1.2%) participants were severely ill and did not answer any of the cognitive questions. Most informants were the children (47.0%) or spouses (33.6%) of participants; 76.6% were women, and the mean age of informants was 50.0 years (range: 16 to 95, median: 49). We were unable to identify an informant for four participants (0.2%). We completed the assessment of these subjects and all available information was then used to determine whether or not dementia was present at a consensus meeting of the investigators.

Table 1 shows the demographic and socioeconomic characteristics of the participants. Their ages ranged from 65 to 102 years, 42.9% were aged 65 to 69 years old, 65.8% had been born in rural areas, 45.9% were married, 38.3% were illiterate and 31.0% had a monthly income of less than US\$85.00 (only 29 (1.4%) subjects had a monthly income of more than US\$1,000). Those living in shanty towns numbered 545 (26.3%). Of the participants, 1,255 (60.6%) were

Table 1. Demographic and socioeconomic characteristics of participants

CHARACTERISTIC	WOMEN N (%)	MEN N (%)	TOTAL N (%)
AGE BAND (YEARS)			
65 to 69	519 (41.3)	370 (45.3)	889 (42.9)
70 to 74	339 (27.0)	217 (26.6)	556 (26.8)
75 to 79	220 (17.5)	126 (15.4)	346 (16.7)
80 to 84	98 (7.8)	71 (8.7)	169 (8.2)
85 or more	79 (6.3)	33 (4.0)	112 (5.4)
PLACE OF BIRTH*			
Rural area	836 (66.7)	525 (64.5)	1361 (65.8)
Town	267 (21.3)	207 (25.4)	474 (22.9)
City	151 (12.0)	82 (10.1)	233 (11.3)
MARITAL STATUS			
Married	339 (27.0)	613 (75.0)	952 (45.9)
Widowed	616 (49.1)	115 (14.1)	731 (35.3)
Never married/separated	300 (23.9)	89 (10.9)	389 (18.8)
EDUCATION (YEARS)			
none	527 (42.0)	266 (32.5)	793 (38.3)
1 to 3	629 (50.1)	454 (55.6)	1083 (52.3)
4 or more	99 (7.9)	97 (11.9)	196 (9.4)
MONTHLY PERSONAL INCOME (US\$)**			
None to 85	476 (37.9)	167 (20.4)	643 (31.0)
86 to 127	289 (23.0)	113 (13.8)	402 (19.4)
128 to 246	285 (22.7)	230 (28.2)	515 (24.9)
247 to 500	161 (12.8)	202 (24.8)	363 (17.5)
501 or more	44 (3.5)	105 (12.8)	149 (7.2)

* Four participants with missing values.

** The minimum Brazilian wage at the time of the study was approximately US\$85.

women, and women were older than men and had lower educational attainment and income.

Prevalence of dementia

The criteria for the diagnosis of dementia were met in 105 participants, yielding a prevalence of 5.1% (95% CI 4.1–6.0) (Table 2) and a standardized population prevalence of 6.6% (95% CI 5.4–7.8). Among women, the prevalence of dementia was 5.4% (95% CI 4.2–6.7) and among men 4.5% (95% CI 3.1–6.0). The prevalence of dementia increased with age, from 2.3% among those aged 65–69 to 16.7% among those aged 80 years and over.

Of the participants with dementia, 34 (32.4%) had AD, 34 (32.4%) VaD and 37 (35.2%) other types of dementia (29 cases of mixed AD and VaD, and eight cases with a history of parkinsonism). The prevalence of AD was 1.6%

Table 2. Prevalence of dementia by gender and age group, and odds ratios (OR) with 95% confidence intervals for the association of dementia with age group by gender

AGE GROUP (YEARS)	N (%)	NUMBER WITH DEMENTIA	PREVALENCE (95% CI)	ODDS RATIO (95% CI)	P-VALUE ¹
FEMALE					
65–69	519 (41.4)	11	2.1 (0.9–3.4)	1	<0.001
70–74	339 (27.0)	6	1.8 (0.4–3.2)	0.83 (0.30–2.27)	
75–79	220 (17.5)	17	7.7 (4.2–11.3)	3.87 (1.78–8.40)	
80–84	98 (7.8)	15	15.3 (8.1–22.6)	8.35 (3.71–18.8)	
85 or more	79 (6.3)	19	24.1 (14.4–33.7)	14.62 (6.64–32.20)	
MALE					
65–69	370 (45.3)	9	2.4 (0.9–4.0)	1	<0.001
70–74	217 (26.6)	5	2.3 (0.3–4.3)	0.95 (0.31–2.86)	
75–79	126 (15.4)	10	7.9 (3.2–12.7)	3.46 (1.37–8.72)	
80–84	71 (8.7)	8	11.3 (3.7–18.8)	5.09 (1.89–13.70)	
85 or more	33 (4.0)	5	15.2 (2.2–28.1)	7.16 (2.25–22.82)	
TOTAL					
65–69	889 (42.9)	20	2.3 (1.3–3.2)	1	<0.001
70–74	556 (26.8)	11	2.0 (0.8–3.1)	0.88 (0.42–1.84)	
75–79	346 (16.7)	27	7.8 (5.0–10.6)	3.68 (2.03–6.65)	
80–84	169 (8.2)	23	13.6 (8.4–18.8)	6.84 (3.66–12.78)	
85 or more	112 (5.4)	24	21.4 (13.7–29.1)	11.85 (6.29–22.31)	

¹p-value for trend

(95% CI 1.1–2.2), with a non-significant trend for higher prevalence among women (OR = 1.94, 95% CI 0.87–4.35; adjusted for age). The prevalence of VaD was 1.6% (95% CI 1.2–2.2) and was higher among men than women (OR = 2.17, 95% CI 1.09–4.33; adjusted for age). Prevalence of mixed dementia was 1.4% (95% CI 0.9–1.9) and affected a similar proportion of men and women (OR = 0.75, 95% CI 0.34–1.66; adjusted for age).

Low educational attainment and income were associated with increased risk of dementia, even after the analyses were controlled for gender and age group. Using no formal education as the reference category, the OR for those with one to three years of formal education and for those with four or more years were 0.75 and 0.19, respectively ($p < 0.001$, test for trend). When considering the lower income group as the reference, the OR for the income groups between US\$86 and US\$127, US\$128 and US\$246, and over US\$247 were 0.60, 0.34, and 0.27, respectively ($p < 0.001$, test for linear trend). Education and income did not change the association between age group and dementia. Gender was not associated with dementia even after taking education and income into account.

Discussion

The results of this study showed that the prevalence of dementia among disadvantaged people aged 65 years or over is approximately 5%, with similar prevalence for men and women in all age groups up to age 80 years, after which a larger proportion of women are affected. Low educational attainment and income were associated with increased risk of dementia. The implication of these findings will be discussed after consideration of the methodological aspects of our survey.

Methodological aspects

Non-participation was low (8.6%) and mostly due to refusals. The one-stage design avoided systematic losses between identification of eligible subjects and the assessment of cognitive status. Institutionalized older people were not included, but this is unlikely to have altered the prevalence estimate, as people from low socioeconomic status in São Paulo do not have access to residential services (nursing homes or hostels), which are run entirely by the private sector. Because the study aimed to assess the prevalence of dementia in a disadvantaged community, its results may fail to reflect accurately the situation for the entire population of São Paulo or Brazil. However, our results provide valuable information about the situation for a large proportion of older Brazilians.

Differences in prevalence estimates of dementia between studies may be explained by methodological differences. For example, the authors of a study carried out in four centres of China (Zhang *et al.*, 2005) attributed the higher prevalence of dementia in their study to ascertainment bias and small sample sizes of previous studies in East Asia. In the present study, the diagnosis of dementia was based on the use of a well-established protocol with robust

sensitivity and specificity (Scazufca *et al.*, 2002; Prince *et al.*, 2003). This protocol asks all informants about the cognitive and functional status of participants regardless of their cognitive status, which improves the quality of the information obtained (Prince *et al.*, 2003). We acknowledge that the classification of dementia subtypes could have been improved with the use of a more accurate clinical neurological evaluation and neuroimaging. However, it is now widely accepted that AD and VaD show significant overlap and that misclassification of these dementia subtypes might have limited clinical implications (Langa *et al.*, 2004). Inaccuracies in the ascertainment of age could have potentially biased the estimate of age-specific prevalence, although this was not a common occurrence in this study (uncertainty in relation to participants' ages occurred in only 39 subjects, and for 25 subjects it was limited to a maximum of two years).

Prevalence of dementia

The prevalence of dementia in our study is in the lower range of what has been reported by surveys conducted in developed economies (Hendrie *et al.*, 1995; Breitner *et al.*, 1999; Lobo *et al.*, 2000), but is similar to findings from four centers in China (Zhang *et al.*, 2005), and higher than in India, Nigeria and Sri Lanka (Hendrie *et al.*, 1995; Vas *et al.*, 2001; de Silva *et al.*, 2003; Shaji *et al.*, 2005). Our study sample had a relatively large proportion of people aged 65 to 69 years, and this may partly explain the relatively low prevalence of dementia when compared to developed countries. In fact, the standardized prevalence estimate that uses the United Nations World Population Prospect for developed countries (United Nations Department of Economic and Social Affairs, 2005) confirmed that our results are largely in agreement with those of Europe, North America and Australia.

We did not observe the typical exponential rise in the prevalence of dementia with increasing age reported by previous studies (Hendrie *et al.*, 1995; Lobo *et al.*, 2000). Instead, the prevalence of dementia in the age groups 65–69 and 70–74 years was all but identical. This finding might be due to the high prevalence of cerebrovascular disease and other comorbid conditions in this population (Lotufo, 2005), failure to compress morbidity into the very latter stages of life (aged 80+), high mortality among those with dementia (early censoring of cases), and limited access to health care (Lima-Costa *et al.*, 2003; Dufour and Piperata, 2004). However, lack of precision for age-specific prevalence estimates does not allow a firmer conclusion about these possibilities. Our findings are also consistent with those recently reported in a comprehensive review of dementia in the United Kingdom (Alzheimer's Society, 2007). The report confirmed that the prevalence of AD is higher among women (67% versus 55%), whereas VaD and mixed cases are more prevalent in men (31% versus 25%). Similar findings have been reported by others (for example, Alzheimer's Australia, 2003).

Numerous other studies support our finding that low educational attainment is associated with increased risk of dementia, as is low income (reviewed by Valenzuela and Sachdev, 2006). It is interesting that the association between dementia and poor education and low income was observed in this particularly deprived community, which has a substantially narrower range of education

and income than the samples recruited for the studies in developed countries. This suggests that even small gains in those factors could potentially lead to a significant reduction in the prevalence of dementia in the world.

With the progressive improvement of medical care in developing countries, more older adults with dementia will reach their 70s and 80s, resulting in a significant increase in the total number of people with dementia. If that is the case, the number of people with dementia living in developing countries by 2040 may be even higher than the expected 70% (Ferri *et al.*, 2005). In Brazil, as in many developing countries, there are only limited social policies and scarce resources to support health programs for older people (Lloyd-Sherlock, 2000), making family members, usually women, the most important source of care for people who develop dementia (10/66 Dementia Research Group, 2004). In large urban centers, family size is rapidly decreasing, and engagement in employment outside the home is needed, making provision of care by family members more difficult. Health care policies and programs accessible to disadvantaged older adults must be implemented as a matter of urgency to cater for the needs of this growing segment of the population of developing countries.

Conflict of interest

None.

Description of authors' roles

M. Scazufca and P. R. Menezes designed the study, supervised data collection, planned and carried out the statistical analyses, and drafted the paper. H. P. Vallada contributed to designing the study and drafting the paper. A. L. Crepaldi, V. D. Di Rienzo assisted with data collection and provided critical comments to an earlier draft of this paper. L. M. S. Coutinho contributed to data analysis and helped draft the manuscript. M. Pastor-Valero and O. P. Almeida contributed to the analysis of the data, interpretation of the results and drafting of the manuscript.

Acknowledgments

The study was funded by the Wellcome Trust, U.K. (grant code GR066133MA). M. Scazufca was supported by the Wellcome Trust and CNPq-Brazil during the development of this work. P. R. Menezes and H. P. Vallada were partly funded by CNPq-Brazil. We thank Professors Martin Prince, John R. M. Copeland and Paul McKeigue for helping with the acquisition of funding. We thank the research team that contributed to the data collection, Professor Paulo Lotufo and the staff of the University Hospital of the University of São Paulo for accommodating this project throughout the study period, all colleagues from the 10/66 Dementia Research Group who helped with the development of the protocol used in São Paulo, as well as the participants of the study.

References

- 10/66 Dementia Research Group** (2000a). Methodological issues for population-based research into dementia in developing countries: a position paper from the 10/66 Dementia Research Group. *International Journal of Geriatric Psychiatry*, 15, 21–30.
- 10/66 Dementia Research Group** (2000b). Dementia in developing countries: a consensus statement from the 10/66 Dementia Research Group. *International Journal of Geriatric Psychiatry*, 15, 14–20.
- 10/66 Dementia Research Group** (2004). Care arrangements for people with dementia in developing countries. *International Journal of Geriatric Psychiatry*, 19, 170–177.
- Alzheimer's Australia** (2003). *The Dementia Epidemic: Economic Impact and Positive Solutions for Australia*. <http://www.alzheimers.org.au/upload/EpidemicFullReportMarch2003.pdf>; accessed 20 March 2007.
- Alzheimer's Society** (2007). *Dementia UK: The Full Report*. http://www.alzheimers.org.uk/News_and_Campaigns/Campaigning/PDF/Dementia_UK_Full_Report.pdf; accessed 20 March 2007.
- American Psychiatric Association** (1994). *Diagnostic and Statistic Manual of Mental Disorders: DSM-IV*, 4th edn. Washington, DC: American Psychiatric Association.
- Breitner, J. C. et al.** (1999). APOE- ϵ 4 count predicts age when prevalence of AD increases, then declines: the Cache County Study. *Neurology*, 53, 321–331.
- Cohen, J. E.** (2003). Human population: the next half century. *Science*, 302, 1172–1175.
- Copeland, J. R., Dewey, M. E. and Griffiths-Jones, H. M.** (1986). A computerized psychiatric diagnostic system and case nomenclature for elderly subjects: GMS and AGE-CAT. *Psychological Medicine*, 16, 89–99.
- de Silva, H. A., Gunatilake, S. B. and Smith, A. D.** (2003). Prevalence of dementia in a semi-urban population in Sri Lanka: report from a regional survey. *International Journal of Geriatric Psychiatry*, 18, 711–715.
- Dewey, M. E. and Copeland, J. R.** (2001). Diagnosis of dementia from the history and aetiology schedule. *International Journal of Geriatric Psychiatry*, 16, 912–917.
- Dufour, D. L. and Piperata, B. A.** (2004). Rural-to-urban migration in Latin America: an update and thoughts on the model. *American Journal of Human Biology*, 16, 395–404.
- Ferri, C. P. et al.** (2005). Global prevalence of dementia: a Delphi consensus study. *Lancet*, 366, 2112–2117.
- Fries, J. F.** (1980). Aging, natural death, and the compression of morbidity. *New England Journal of Medicine*, 303, 130–135.
- Hall, K. S., Gao, S., Emsley, C. L., Ogunniyi, A. O., Morgan, O. and Hendrie, H. C.** (2000). Community screening interview for dementia (CSI 'D'); performance in five disparate study sites. *International Journal of Geriatric Psychiatry*, 15, 521–531.
- Hendrie, H. C. et al.** (1995). Prevalence of Alzheimer's disease and dementia in two communities: Nigerian Africans and African Americans. *American Journal of Psychiatry*, 152, 1485–1492.
- Herrera, E. Jr., Caramelli, P., Silveira, A. S. and Nitrini, R.** (2002). Epidemiologic survey of dementia in a community-dwelling Brazilian population. *Alzheimer Disease and Associated Disorders*, 16, 103–108.
- Hofman, A. et al.** (1991). The prevalence of dementia in Europe: a collaborative study of 1980–1990 findings. EURODEM Prevalence Research Group. *International Journal of Epidemiology*, 20, 736–748.
- Instituto Brasileiro de Geografia e Estatística** (2006). *Censo 2000: Brazil*. <http://www.ibge.gov.br/censo/>; accessed 20 March 2007
- Jorm, A. F., Korten, A. E. and Henderson, A. S.** (1987). The prevalence of dementia: a quantitative integration of the literature. *Acta Psychiatrica Scandinavica*, 76, 465–479.

- Langa, K. M., Foster, N. L. and Larson, E. B.** (2004). Mixed dementia: emerging concepts and therapeutic implications. *JAMA*, 292, 2901–2908.
- Lima-Costa, M. F., Barreto, S., Giatti, L. and Uchoa, E.** (2003). [Socioeconomic circumstances and health among the Brazilian elderly: a study using data from a National Household Survey]. *Cadernos de Saude Publica*, 19, 745–757.
- Lloyd-Sherlock, P.** (2000). Population ageing in developed and developing regions: implications for health policy. *Social Science and Medicine*, 51, 887–895.
- Lobo, A. et al.** (2000). Prevalence of dementia and major subtypes in Europe: a collaborative study of population-based cohorts. Neurologic Diseases in the Elderly Research Group. *Neurology*, 54, S4–S9.
- Lotufo, P. A.** (2005). Stroke in Brazil: a neglected disease. *São Paulo Medical Journal*, 123, 3–4.
- Marins, V. M., Almeida, R. M., Pereira, R. A. and Sichieri, R.** (2007). The association between socioeconomic indicators and cardiovascular disease risk factors in Rio de Janeiro, Brazil. *Journal of Biosocial Science*, 39, 221–229.
- Newman, A. B. et al.** (2005). Dementia and Alzheimer's disease incidence in relationship to cardiovascular disease in the Cardiovascular Health Study cohort. *Journal of the American Geriatrics Society*, 53, 1101–1107.
- Prince, M., Acosta, D., Chiu, H., Sczufca, M. and Varghese, M.** (2003). Dementia diagnosis in developing countries: a cross-cultural validation study. *Lancet*, 361, 909–917.
- Prince, M. et al.** (2004). Effects of education and culture on the validity of the Geriatric Mental State and its AGE-CAT algorithm. *British Journal of Psychiatry*, 185, 429–436.
- Sczufca, M. et al.** (2002). [Epidemiological research on dementia in developing countries]. *Revista de Saude Publica*, 36, 773–778.
- Secretaria do Governo da Prefeitura de São Paulo** (2004). *Sumário de Dados do Município de São Paulo 2004*. http://portal.prefeitura.sp.gov.br/secretarias/governo/sumario_dados; accessed 20 March 2007.
- Shaji, S., Bose, S. and Varghese, A.** (2005). Prevalence of dementia in an urban population in Kerala, India. *British Journal of Psychiatry*, 186, 136–140.
- StataCorp** (2005). *Stata Statistical Software, Release 9*. College Station, TX: StataCorp.
- United Nations Department of Economic and Social Affairs** (2002). *World Population Ageing 1950–2050*. <http://www.un.org/esa/population/publications/worldageing19502050/>; accessed 20 March 2007.
- United Nations Department of Economic and Social Affairs** (2005). *World Population Prospects: The 2004 Revision Population Dataset*. New York: United Nations.
- Valenzuela, M. J. and Sachdev, P.** (2006). Brain reserve and dementia: a systematic review. *Psychological Medicine*, 36, 441–454.
- Vas, C. J. et al.** (2001). Prevalence of dementia in an urban Indian population. *International Psychogeriatrics*, 13, 439–450.
- Welsh, K. A. et al.** (1994). The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part V. A normative study of the neuropsychological battery. *Neurology*, 44, 609–614.
- Zhang, Z. X. et al.** (2005). Dementia subtypes in China: prevalence in Beijing, Xian, Shanghai, and Chengdu. *Archives of Neurology*, 62, 447–453.