Using life expectancy to improve prediction of the numbers of demented people

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Aims

- To improve the precision of the future numbers of demented persons
- To provide a set of worldwide forecasts using mortality modeling.

Method

1. A critical review of the published estimations of present and future numbers of demented persons.

Results: Findings for phase I

Several weaknesses have been identified in existing works:

1 - Prevalence rates of dementia are influenced by survival rates

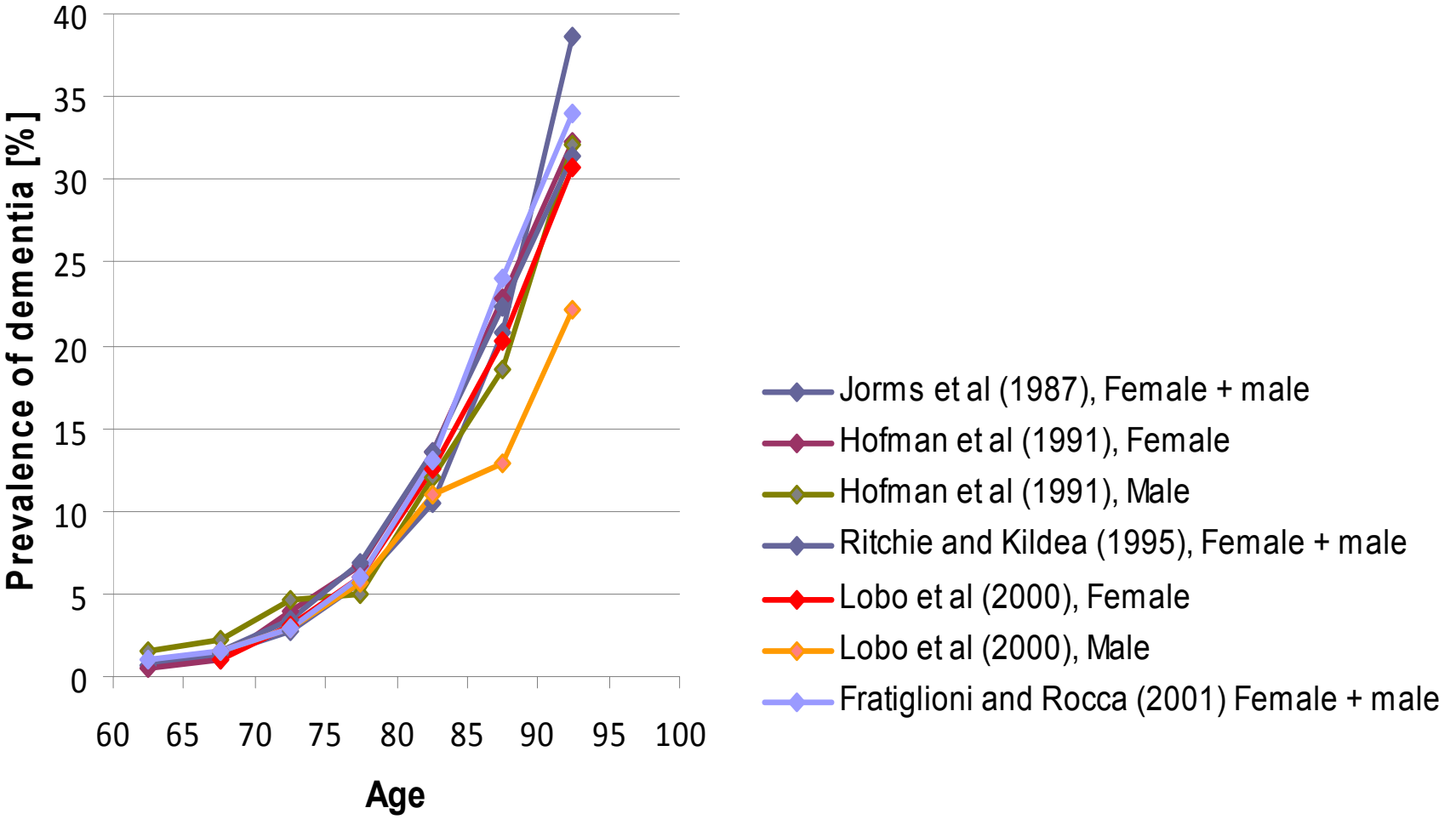
- IR provide a better measure of the dementia risk,

But, almost all projections of future numbers of demented persons are based on age-specific prevalence rates.

Results: Findings for phase I

1. The rate of future growth in the number of demented persons depends on :
   - the growth in the number of oldest old people
   - not on variation in estimates of dementia rate (Fig 1)

Figure 1: Prevalence of dementia according to the main published meta-analyses



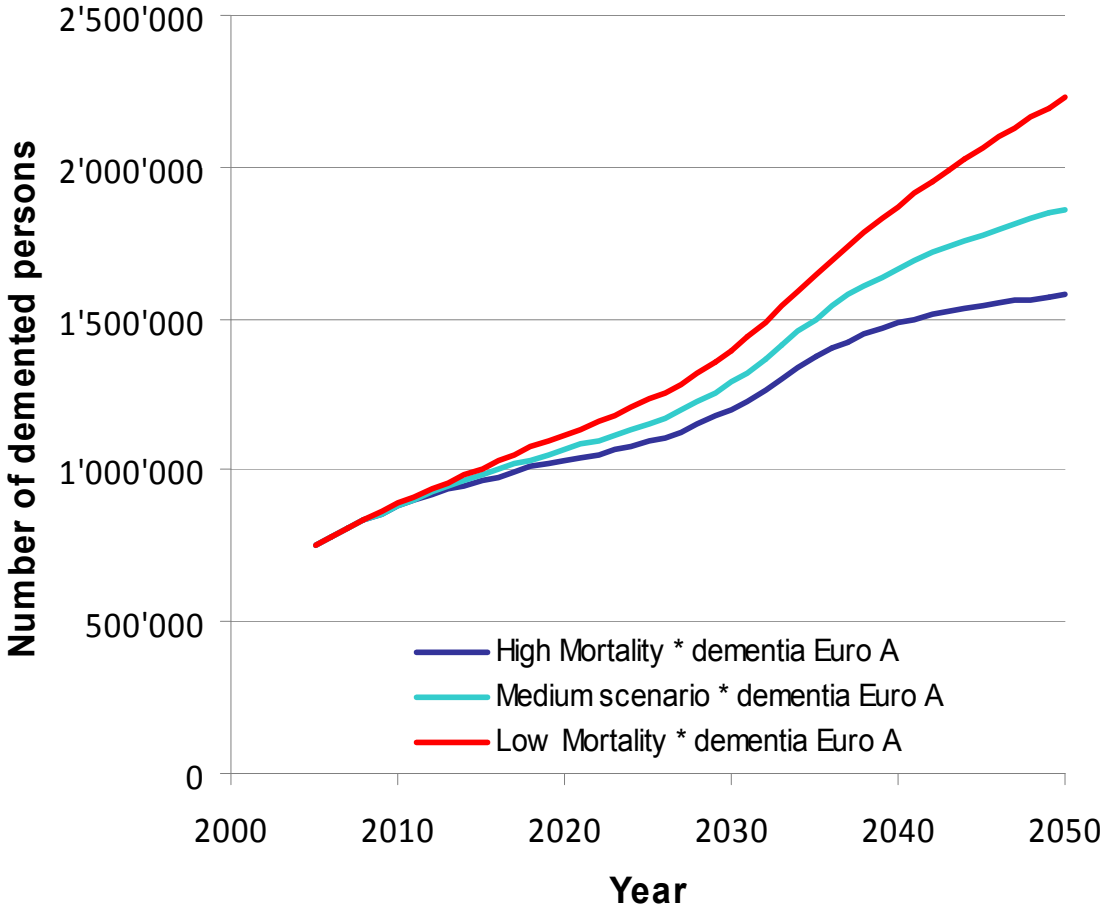
Results: Findings for phase I

2 The rate of future growth in the number of demented persons depends on :

- the growth in the number of oldest old people
- not on variation in estimates of dementia rate (Fig 1)

Uncertainty comes from the demographic scenarios (Fig 2)

Figure 2: Estimated annual numbers of prevalent cases of dementia in France, using 3 population projection scenarios (INSEE) with the consensus estimates for the WHO Region EURO A prevalence of dementia by age, both sexes (**C. P. Ferri *et al.*, *Lancet* 366, 2112:2005**)



Results: Findings for phase I

2 The rate of future growth in the number of demented persons depends on :

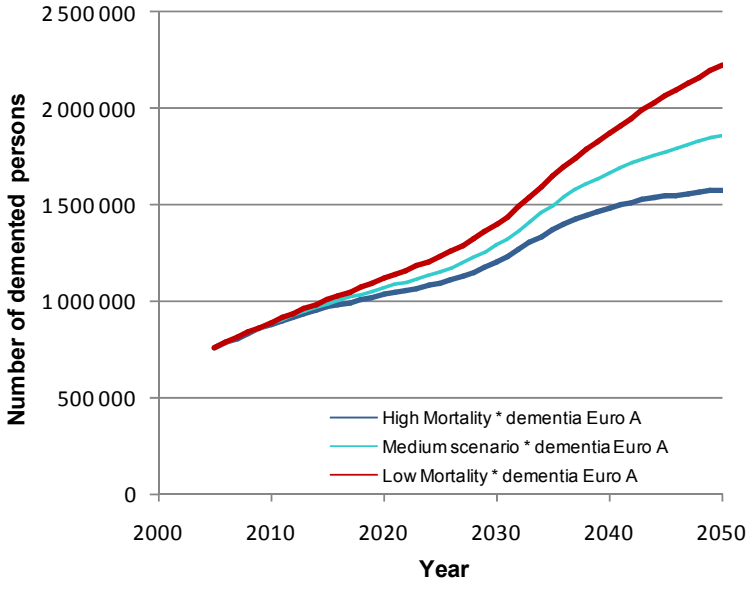
- the growth in the number of oldest old people
- not on variation in estimates of dementia rate (Fig 1)

Uncertainty comes from the demographic scenarios (Fig 2)

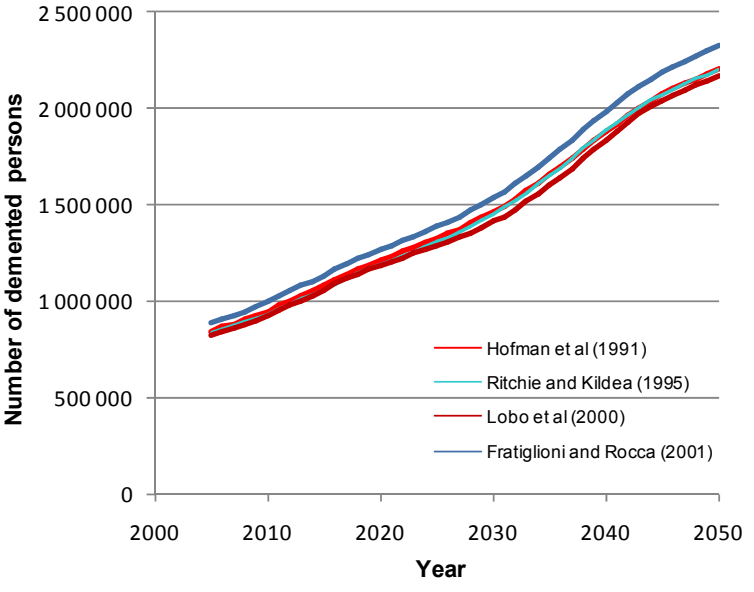
But, almost all research efforts were directed to refine age-specific prevalence rates through meta-analyses or Delphi consensus.

Figure 3: Population projection scenarios (INSEE) and prevalence of dementia in France

a - 3 population projections



b - « low mortality scenario» and 3 different meta-analyses



Results: Findings for phase I

3 Although age-specific prevalence rates might increase over time due to improvement in the relative survival probability of the demented, prevalence rates are considered constant from 1950 to 2050.

Such projections assume there is no change over time in prevalence and incidence rates, only changes in the age structure of the population and numbers of oldest old.

Results: Findings for phase I

4 The increase in dementia rates with age cannot be exponential because such a pattern is in contradiction with the observed mortality trajectory and with prevalence of dementia observed at age 100 (Table 1)

Table 1: Studies addressing the prevalence or incidence of dementia amongst the oldest old (**T. Perls, *Experimental gerontology* 39, 1587:2004**)

Study	Comments
Dutch population-based centenarian study	10 centenarians in a population of 100,000 people were *all* noted to have clinically evident dementia (Thomassen et al., 1999). Expansion of the study to a population of 250,000 lead to finding 15 of 17 centenarians to have dementia (Blansjaar et al., 2000)
Swedish population-based study of people age ≥ 77 yr	The prevalence of dementia amongst the 94 subjects age ≥ 95 yr was 48% (30% for men and 50% for women) (von Strauss, et al., 1999)
Canadian Study of Health and Aging	Dementia prevalence of subjects age ≥ 95 yr ($n = 104$) was 58%. The rate of increase in prevalence slowed at very advanced ages (Ebly et al., 1994)
Study of Japanese Americans in King County, Washington	Dementia prevalence for subjects age ≥ 95 yr was 74% (Graves et al., 1996)
MRC-ALPHA Study, of older people in Liverpool	Dementia prevalence amongst centenarians was 47% (Copeland et al., 1999)
Northern Italian Centenarian Study	Dementia was diagnosed in 62% of 92 centenarians (Ravaglia et al., 1999)
Finnish population-based centenarian study	56% of 179 centenarians had cognitive impairment (Sobel et al., 1995)
Meta-analysis of nine epidemiologic studies of dementia among people age ≥ 80 yr	Prevalence of dementia leveled off at around age 95 yr at a rate of 40% (Ritchie and Kildea, 1995)
New England Centenarian (population-based) Study	Cognitive impairment prevalence was 79% (Silver et al., 2001)
Danish Centenarian Study	Dementia prevalence was 67% (Andersen-Ranberg, et al., 2001)
Coordinated study of dementia prevalence among centenarians in Sweden, Georgia (USA), and Japan	Dementia prevalences ranged from 40 to 63% (Hagberg, et al., 2001)
Heidelberg Centenarian Study	Cognitive impairment prevalence was 75% (Kliegel et al., 2004)
French Centenarian Study	Dementia prevalence was 65% among female and 42% among male centenarians (Robine et al., 2003)

Results: Findings for phase I

4 Logistic, quadratic or intermediary trajectories are more realistic (Fig 4.1), but due to the scarcity of actual data above the age of 85 y, the hypothesis of an exponential trajectory for both incidence and prevalence was retained by almost all studies with a doubling in the prevalence rate every 5-year (Fig 4.2).

Figure 4.1: Differents trajectories of dementia prevalence by age

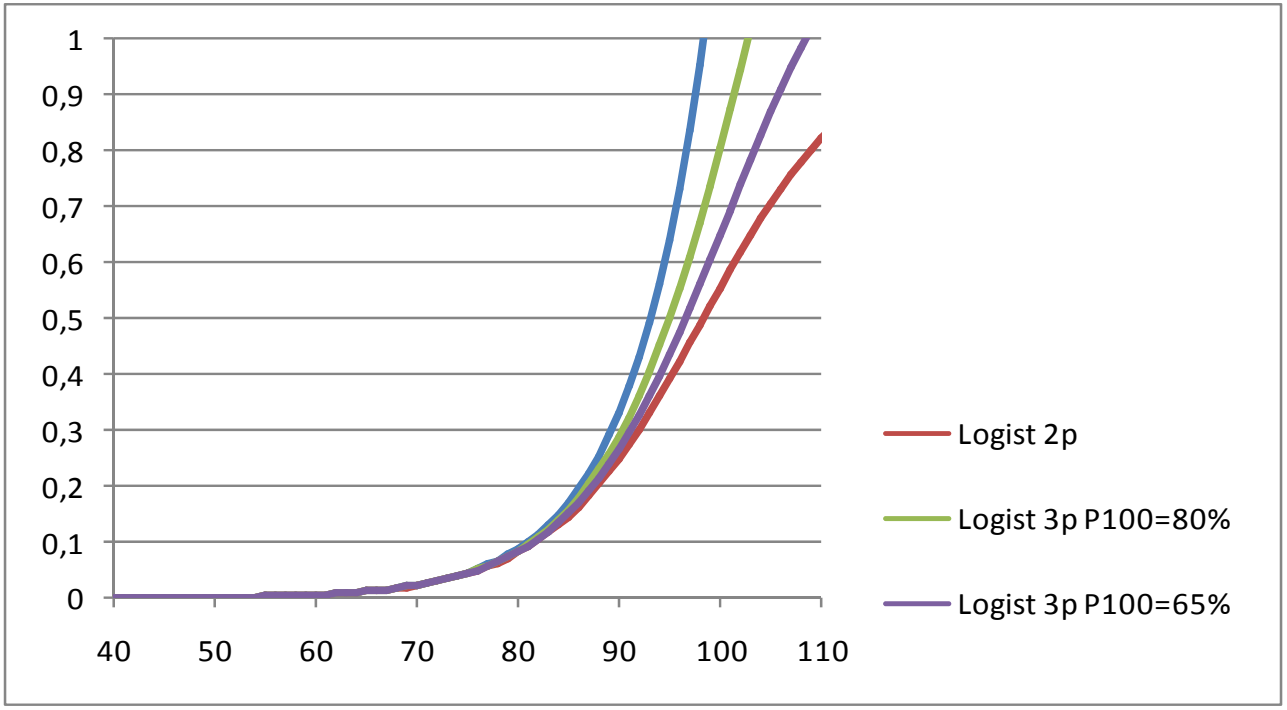
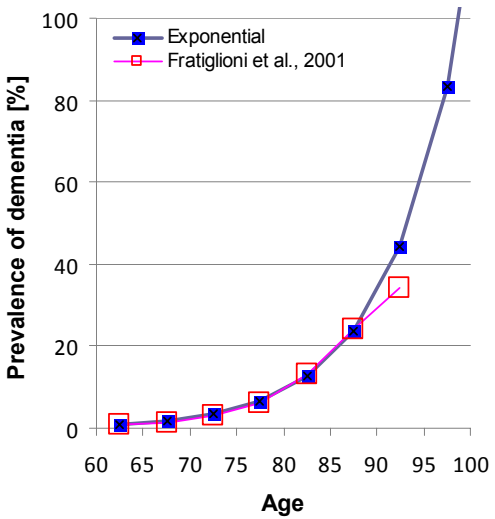
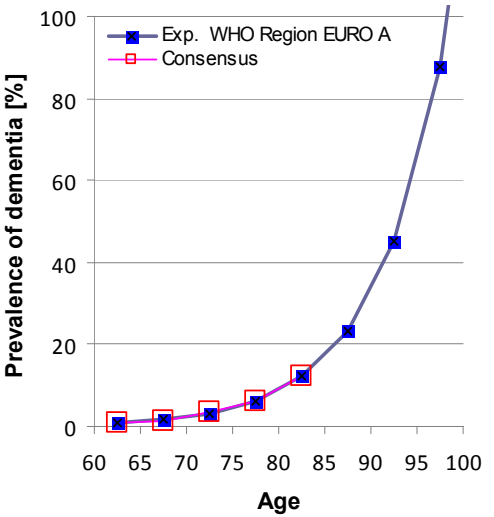


Figure 4.2: Prevalence of dementia (both sexes) and associated exponential trajectory from age 60 to 100

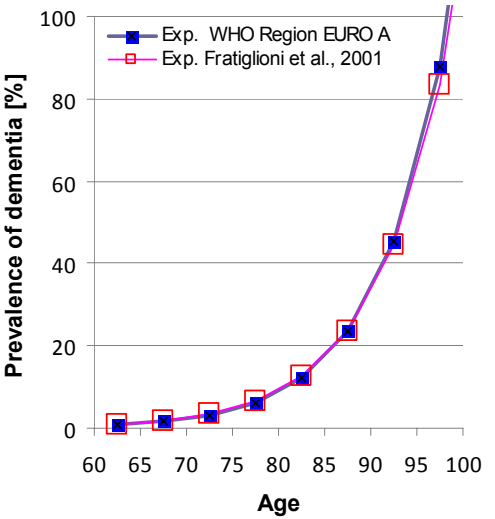
a - Meta-analysis [1]



b Consensus estimates for EURO A [2]



c: Consensus versus meta-analysis



1. L. Fratiglioni, W. Rocca, in *Handbook of Neuropsychology,* F. Boller, S. Cappa, Eds. (Elsevier, Amsterdam, 2001), pp. 193–215.

2. C. P. Ferri *et al.*, *Lancet* **366**, 2112 (2005)

Results: Findings for phase I

5 Although it has been suggested that differential in survival was the cause, it has been admitted that the age-specific prevalence rates truly vary by world region while studies are rare in developing countries.

Discussion:

Discussion of the next phases

- Prevalence estimates appear to be the weakest elements of the projected numbers of demented persons.
- Main achievement of the reviewed studies was in the selection of comparable prevalence studies for the meta-analyses.

Discussion:

During the next phases, the logic will be reversed and the projections will be based on mortality for which we have much more data than for the incidence or prevalence of dementia.

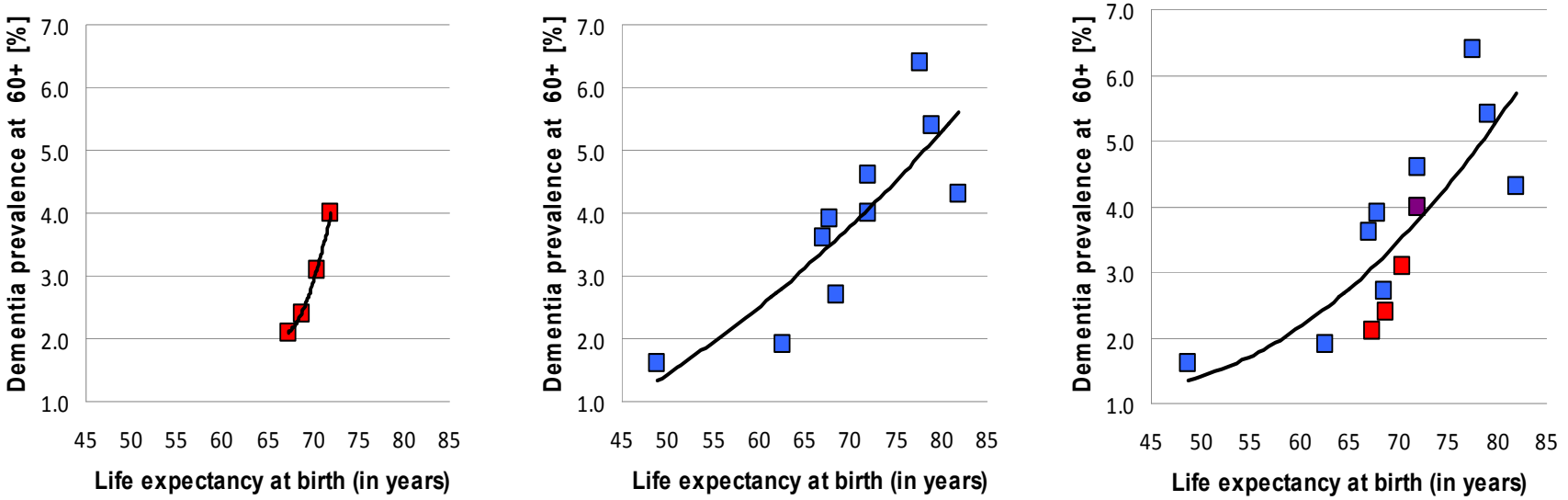
Discussion:

A 3 steps approach :

1 to specify the relationships between LE at age 60 and prevalence of dementia (Fig 5)

Figure 5: Chronological and cross sectional relationship between the life expectancy at birth and the prevalence of dementia at age 60+

a - China from 1985 to 2005[10] **b- Various regions of the world[2] in 2000-2005** **c - Overlay fig. a + b**



(10) M. J. Dong *et al.*, *Age and ageing* **36**, 619 (2007)
(2) C. P. Ferri *et al.*, *Lancet* **366**, 2112 (2005)

Discussion:

Fig 5 suggests a similar pattern for the chronological relationship between LE at birth and the prevalence of dementia at age 60+ in China from 1985 to 2005 and for the cross sectional relationship for various regions of the world in 2000-2005.

Discussion:

A 3 steps approach :

1. to specify the relationships between the LE at age 60 and prevalence of dementia (Fig 5)
2. to put most of the research effort in forecasting future mortality levels
3. to infer from step 1+2 the future numbers of demented persons

Discussion: main advantage

No need for hypothesis regarding:

- age-specific prevalence rates change over time (as being constant),
- age trajectory (as being exponential)
- regional variation

Discussion: rational

The actual regional mortality level and differential between demented and non demented persons determine the prevalence level and the shape of the age trajectory of dementia

Discussion: working hypothesis

Changes in mortality levels (summarized by life expectancy):

- modify the differential in survival between demented and non demented people
- impact on the age-specific prevalence rates of dementia

Discussion: working hypothesis

- Different mortality levels may explain different age-specific prevalence rates among world regions.
- Differential survival – and age variation in differential survival - may explain alternative age trajectories for the prevalence of dementia.

Conclusion

- The ultimate advantage of this approach, focusing on mortality forecasts, is to better take into account the oldest old segment of the population which is the fastest growing one.
- Accordingly, the ongoing work consists in finding the best fitting statistical models linking prevalence indicators with LE at different ages.

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