Applying a Reconstruction Method to Cause of Death Series in Different Countries

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Keywords

Mortality data, Reconstruction method, Cause-of-death Data series, ICD

Description of the topic

Cause of death data are essential for demographic, epidemiological and public health research. The WHO Mortality Database has long been instrumental in providing global health data classified according to the International Classification of Diseases (ICD). However, the ICD undergoes periodic revisions, which can disrupt longitudinal studies. The Eurostat approach, which groups causes into 68 broad categories, offers greater temporal consistency but lacks the granularity required for detailed analysis and is limited by its shorter timeframe (from 1994 at best). The Human Cause-of-Death Data series (HCD)[1] addresses these discrepancies while adhering to principles of comparability, flexibility, accessibility, and reproducibility, ensuring researchers' access to high-quality, consistent data.

The origin of HCD traces back to the innovative work by Jacques Vallin and France Meslé at INED, who developed a method to reconstruct historical time series of deaths by cause adjusting for changes in the ICD (Vallin & Meslé, 1988). The method was a breakthrough, allowing for the detailed analysis of mortality trends over extended periods. Initially applied to French data for 1925-1978, the approach has since been adapted to fit different national contexts, underscoring the dynamic nature of demographic research and its adaptability to varying data quality and availability (Pechholdova et al, 2017).

Data

The main inputs for the Human Cause-of-Death Data series (HCD) are country-specific tabulations of death counts by five-year age groups and detailed causes of death for national populations. These data, which are initially produced by each country national statistics offices, are prepared and provided by the HCD's country specialists. Usually this is the result of independent research work.

Method

The method developed at INED in the 1980s is used as a guideline, but the work was tailored to each country independently. The method is described in detail in the article published by Pechholdová, Camarda, Meslé, and Vallin in 2017.

For each classification change, the method comprises three steps (Vallin and Meslé, 1988; Meslé and Vallin, 1996).

1. Setting up one *correspondence table* which lists, for each item of one classification, all the items of the other classification that are a priori equivalent in terms of medical content.
2. Building *fundamental associations* of items that identify the smallest possible number of items containing the same medical contents in both classifications and testing the consistency of the

[1] Developed conjointly at French Institute for Demographic Studies (INED) and the Max Planck Institute for Demographic Research (MPIDR) and integrated into Human Mortality Database (HMD)

associations over time using statistical testing (Barbieri, Chung, and Boe, 2008; Camarda, Pechholdová, and Meslé, 2015).

3. Setting up ex-post double-coding according to the structure of fundamental associations, to calculate the final transition coefficients.

The results derived from the medical logic of the classification rules have to be checked statistically, to detect and solve any remaining breaks in the series. Such checks are carried out visually by age group and sex and by using the statistical tools developed within the HCD team for this purpose. This study compares applying reconstruction method to cause-of-death series of different countries and shows that it should be variably applied depending on the epidemiologic situation of each country.

Findings. Case study - Alzheimer's disease

Alzheimer's disease is a leading cause of death in aging populations, with increasing life expectancy contributing to the rising incidence of age-related diseases. Although death rates are increasing in many developed countries, the pace of this increase varies. Do these trends correspond to different trends in the incidence of the disease, or are they due to revisions of the ICD and/or changes in classification rules? It is important to note that the 10th Revision of the ICD (ICD-10) was introduced at different times in these countries: in 1995 in Japan, 1999 in Spain, and 2000 in France.

When applying the INED reconstruction method, we create fundamental associations that show the correspondence between two revisions of classification. Medical knowledge is essential to accurately balance the association on both sides. In the case of Alzheimer's disease, a disease of the nervous system, the possible correlation is with mental and behavioral disorders, certain respiratory system diseases, senility, and even external accidental causes. These associations vary significantly by country, underscoring the importance of applying the reconstruction method individually for each population.

From Figure 1, mapping three fundamental associations for Alzheimer's disease in France, Spain, and Japan, distinct interrelations among cause groups are evident. In France, the exchange is straightforward, involving only Alzheimer's disease (G30) over both the old and new classifications. In Spain, the association is more complex, encompassing both diseases of the nervous system and mental and behavioral disorders. Notably, there is a pronounced relationship between Alzheimer's disease and various types of dementia (F01, F03). Graphs in the Appendix show an improvement in the diagnosis of Alzheimer's disease with the transition to the ICD-10 in 1999, followed by a resurgence in dementia post-2010. In Japan, the associations are the most complex, involving different chapters of diseases, including pneumonitis (J690), senility (R54), and inhalation accidents (W78, W79). A logarithmic scale was used to facilitate the comparison of the situation from several diseases on the same graph. Unlike in Spain, dementia is less significant in Japan, whereas senility frequently appears as a principal cause of death.

Conclusion. The reconstruction method allows adjusting cause-of-death series taking changes in the International Classification of Disease into account for a more accurate examination of trends in cause-specific mortality. However, the fundamental associations should be uniquely constructed for each country, as direct application of one country's correspondence table to another is inadvisable. This necessity stems from variations in medical practices, diagnostic advancements, and comorbidity trends.

Figure 1: Mapping fundamental associations between ICD9 and ICD10 for France, Spain and Japa

France

	ICD9
ICD10	3310
G300	
G301	
G308	
G309	

Spain

	ICD9									
ICD10	2904	2901	2908	2902	2903	**3310**	2900	2909	2953	3311
F010										
F011										
F012										
F013										
F018										
F019										
F03_										
F051										
F200										
G300										
G301										
G308										
G309										
G310										

Japan

	ICD9									
ICD10	2900	**2901**	2902	2908	2909	5070	**797_**	**911_**	**3310**	3311
F03_										
G300										
G301										
G308										
G309										
G310										
J690										
R54_										
W78_										
W79_										

ICD9	**List of causes**
2900	Senile dementia, uncomplicated
2901	Presenile dementia
2902	Senile dementia with delusional or depressive features
2903	Senile dementia with delirium
2904	Arteriosclerotic dementia
2908	Other specified senile psychotic conditions
2909	Unspecified senile psychotic condition
2953	Schizophrenic psychoses, Paranoid type
3310	**Alzheimer's disease**
3311	Pick's disease
5070	Pneumonitis, Due to inhalation of food or vomitus
797_	Senility without mention of psychosis
911_	Inhalation and ingestion of food causing obstruction of respiratory tract or suffocation

ICD10	**List of causes**
F010	Vascular dementia of acute onset
F011	Multi-infarct dementia
F012	Subcortical vascular dementia
F013	Mixed cortical and subcortical vascular dementia
F018	Other vascular dementia
F019	Vascular dementia, unspecified
F03_	Unspecified dementia
F051	Delirium superimposed on dementia
F200	Paranoid schizophrenia
G300	Alzheimer disease with early onset
G301	Alzheimer disease with late onset
G308	Other Alzheimer disease
G309	Alzheimer disease, unspecified
G310	Circumscribed brain atrophy
J690	Pneumonitis due to food and vomit
R54_	Senility
W78_	Inhalation of gastric contents
W79_	Inhalation and ingestion of food causing obstruction of respiratory tract

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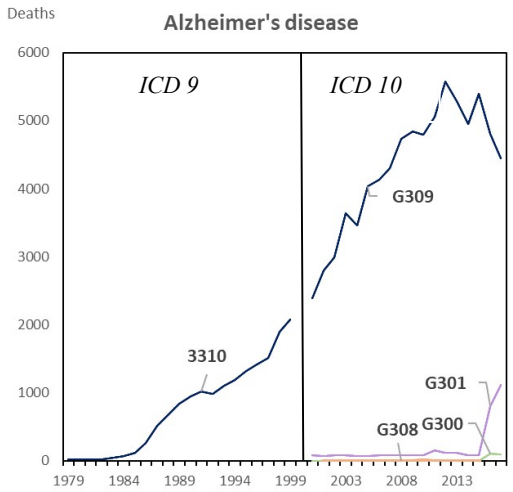
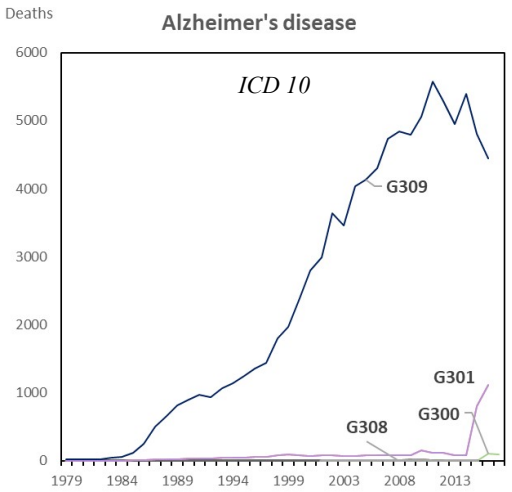
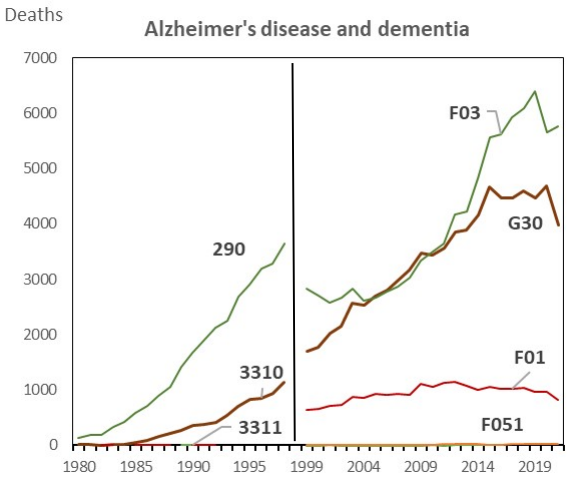
Annex



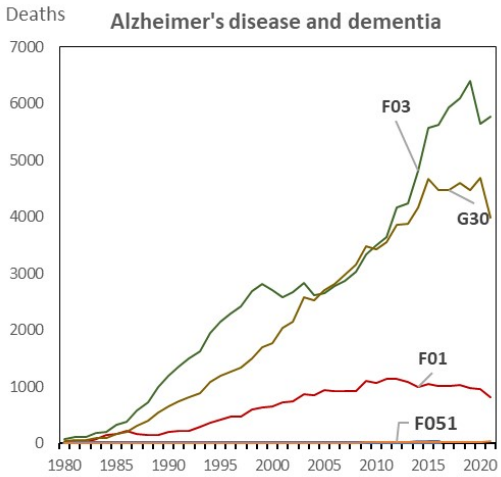
France: before reconcstruction



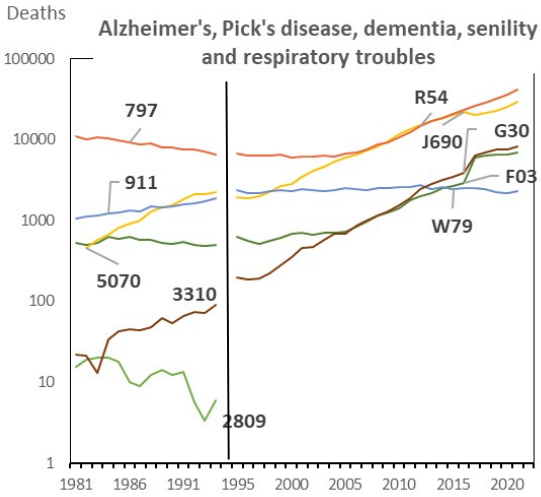
France: after reconstruction



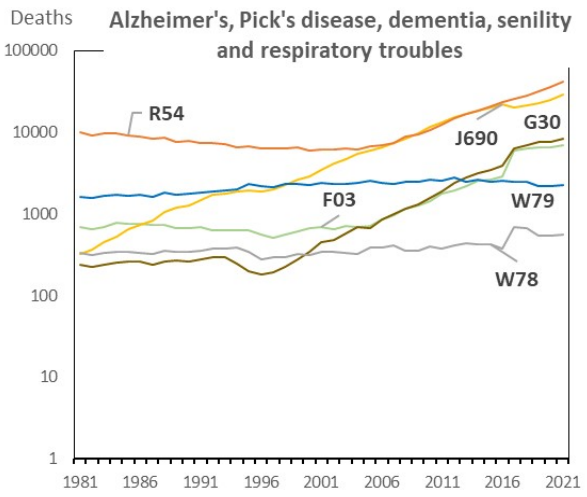
Spain: before reconcstruction



Spain: after reconstruction



Japan: before reconcstruction (log scale)



Japan: after reconstruction (log scale)