Pooled analyses of all-cause mortality indicates low excess mortality in Europe in the winter of 2013/14, in particular amongst the elderly.

Mortality in a population has a regular seasonal pattern, with higher mortality during the winter months than the summer months. This seasonality in mortality is driven predominately by deaths among the elderly and this pattern can be ascribed to various factors including seasonal transmission of influenza, as well as increased deaths from bacterial infections, such as pneumonia, and cardiovascular diseases in the winter. During periods with extreme cold weather, increases in mortality may be observed, which may be explained by a direct effect of "cold snaps" on the risk of death, especially among elderly and vulnerable parts of the population.

Analyses of all-cause mortality from 15 European countries participating in the EuroMOMO network (www.euromomo.eu) shows that the 2013/14 winter season was unusual compared to the 2009/10 to 2012/13 seasons (Figure 1) as no significant excess mortality was seen in Europe. In fact, data from the EuroMOMO network shows that mortality was below the forecasted number of death level.

There were considerable variations in the mortality pattern over the seasons between age groups (see Figure 2 and Table 1). The highest mortality per 100.000 population was seen for adults, 15 to 64 years of age where mortality in the 2013/14 winter season was 1.7 per 100,000 above the baseline (2,641 deaths). This figure, however, is the lowest number of deaths compared with the previous four seasons. In young children below 5 years, there was no marked difference between the winter of 2013/14 and previous winter seasons except 2009/10 where the excess was 0.8/100,000 compared to 1.7/100,000 this year. In children 5 to 14 years, the excess was 0.2 per 100,000 population (50 deaths), which is lower than observed in previous winter seasons.

Among the elderly, aged 65 or older, the number of deaths was 5607 (equivalent to 13 per 100,000 population) below the forecasted baseline. This is in contrast to the previous four winters where there was a significant excess mortality among elderly. The excess mortality was most pronounced in the winter 2012/13, where there was an excess above the baseline of 133 per 100,000 population; corresponding to an estimate of 57,387 excess deaths.

These results are produced by a statistical model analysing all-cause mortality. By using deaths from all causes as an outcome, we avoid the issues related to delays in registration of cause-of-death and uncertainties regarding underreporting of influenza and other infections as a cause of death. However, the approach is also subject to a number of limitations. Increases in mortality from one cause of death may be outnumbered by decreases in other causes of deaths. Nevertheless, the analysis provides an overall and rapid assessment of excess mortality. It is likely that the absence of excess mortality among the elderly and the relatively low mortality in the age group 15 to 64 can be attributed to the fact that influenza transmission in 2013/14 was limited and dominated by A(H1N1)pdm09, where the impact of influenza in the elderly is reduced due to underlying cross-protective immunity, as previously observed during the 2009/10 influenza pandemic.

By contrast, there was extensive transmission of both influenza A(H3N2), A(H1N1) and B in the winter of 2012/13 across Europe. Influenza A(H3N2) is known to cause excess deaths among the elderly (2;3). The relatively high mortality in school age children during the 2009 influenza pandemic and first post-pandemic years are likely to be effects of pandemic influenza A(H1N1).

This report represents the first brief descriptive winter excess mortality summary provided by the EuroMOMO network. Interpretation of the data is qualitative based on the knowledge of past events and the transmission of influenza which is known to impact considerably on all-cause mortality.

Quantitative analyses assessing the impact of influenza on mortality will follow from the FluMOMO project, where influenza activity will be included in the statistical model to directly estimate the effect of influenza, controlled for the effect of extreme ambient temperatures.

Table 1 – Pooled analysis of excess deaths during the winter season (week 40 – week 20) per 100,000 inhabitants . The numbers are expressed as rate of deaths above the forecasted (expected) baseline produced by the EuroMOMO statistical algorithm. Numbers in brackets are 95% confidence intervals (data from week 26, 2014)

Winter season	0 - 4		5 - 14		15 - 64		65 +		Total	
2009/10	0.8	(0.1;1.6)	0.4	(0.2;0.6)	2,9	(2,4;3,4)	23,8	(15,9;31,7)	6,4	(4,8;7,9)
2010/11	1.2	(0.5;2.0)	0.5	(0.4;0.7)	4,8	(4,3;5,2)	43,6	(35,8;51,5)	11,5	(9,9;13,0)
2011/12	1.9	(1.1;2.7)	0.3	(0.2;0.5)	2,3	(1,9;2,8)	110,1	(102,2;118,0)	22,0	(20,4;23,6)
2012/13	1.5	(0.8;2.3)	0.5	(0.3;0.7)	4,8	(4,4;5,3)	133,0	(125,0;141,0)	28,0	(26,5;29,6)
2013/14	1.7	(1.0;2.5)	0.2	(0.0;0.4)	1,7	(1,2;2,1)	-13,0	(-21,0;-5,0)	-1,4	(-3,0;0,2)

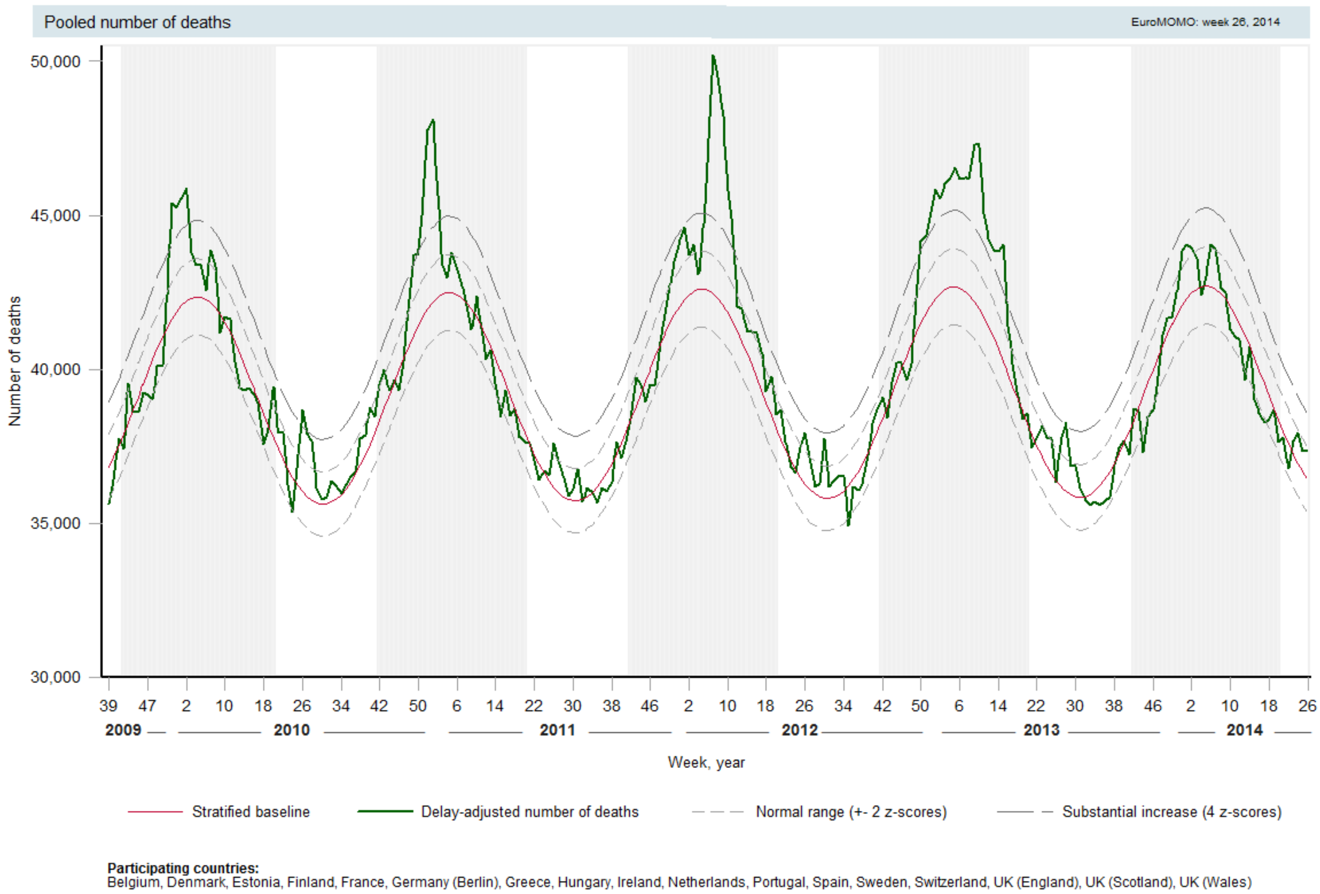

Figure 1 - Pooled weekly total number of all-cause deaths, expected deaths (baseline), 2 and 4 z-score levels, 2009-2014, In grey: Period included in the analysis of the winter seasons.

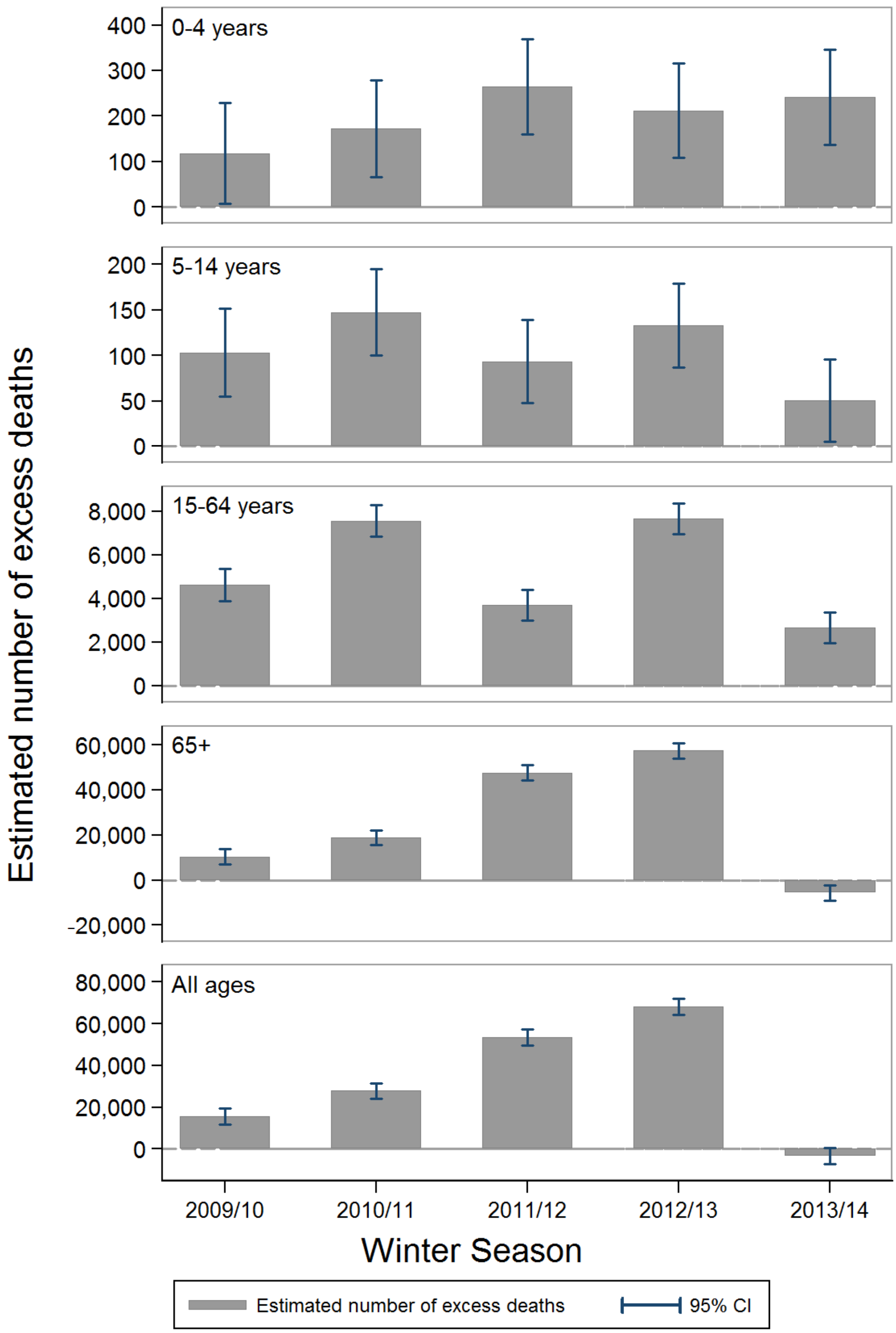

Figure 2 - Estimated number of excess deaths by age group for winter seasons 2009/10 to 2013/14

Background and methods

EuroMOMO is a network for monitoring weekly all-cause mortality across participating European countries in order to detect mortality in excess of normal seasonal mortality levels in a timely manner, EuroMOMO has been monitoring weekly excess all-cause mortality continuously since the H1N1 pandemic in 2009. The number of participating countries or regions of countries has increased over the five years and is currently 18, thus covering a large geographical areas in Europe from north to south and east to west.

Although EuroMOMO's first aim is to detect and report acute weekly excess mortality above normal seasonal levels in a timely manner, annual pooled estimates of winter excess mortality may be useful to assess the burden of epidemics and to compare seasons; this is what is presented in this report.

Definitions

- **Winter season** was defined as the period from week 40 to week 20 the following year.
- **Excess deaths** were defined as observed deaths minus expected deaths
- **Excess mortality rates** were calculated, thus allowing comparison of mortality patterns between different populations and time periods.

Pooling and model

A common statistical algorithm (A-MOMO) is used in each of the EuroMOMO-participating countries to generate weekly estimates of age group-specific excess number of deaths, and z-scores are used to compare across countries. The algorithm is a time-series Poisson regression model with number of weekly deaths as a dependent variable adjusting for trend and seasonal variation. The algorithm also corrects for the delay observed between data collection and data processing in each country.

For the present analyses we used the weekly stratified EuroMOMO pooled method (1). Data from 2009 week 39 to 2014 week 39, where data was available from all participating countries, were used to model total and age group specific (<5, 5–14, 15–64 and ≥65 years) weekly numbers of expected (baseline) and excess deaths, stratified by participating countries.

Population numbers was obtained from EuroSTAT and used to calculate mortality rates.

For this report, data from the following countries or region of countries were used in the analysis: Belgium, Denmark, Estonia, Finland, France, Germany (Berlin), Greece (7 counties), Hungary, Ireland, Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom (England, Scotland and Wales). This represented an underlying population of 242.981 million inhabitants.