Iechyd Cyhoeddus Cymru
Public Health Wales

Cold Weather Mortality Monitoring in Wales

Annual Surveillance Report 2025

22nd May 2026

Key findings

1. Cold days were linked with more deaths.

During winter 2024/25 (31st October 2024 – 31st March 2025), Wales had 78 cold days. On these days, there were **around six more deaths each day** than on the rest of the 74 winter days. The long cold spell in January (27 days) saw the highest daily numbers. These patterns show timing only; they do **not** prove that the cold directly caused deaths.

2. Older people and some communities were more affected.

People aged **85 and over** had the highest number of deaths. After accounting for age, **women showed higher death rates on cold days**, while there was no difference in mortality between cold and non-cold days in men. Higher death rates on cold versus non-cold days were also observed:

- in **some deprivation groups** (WIMD 2 and 5),
- in **three health boards** (Hywel Dda, Aneurin Bevan, Powys), and
- in **urban areas**.

3. Overall, the winter was not unusual.

Despite the cold spells, the **total number of deaths** across the winter was still **within the normal range**, based on recent years. This means winter as a whole was **not exceptional**.

Important to know:

These findings are **descriptive** and should not be taken as evidence of cause and effect. The report looks only at what happens **within each group** on cold days compared with non-cold days. It does **not** compare one group with another, because that would require more complex statistical modelling. The analysis also does **not** include information on **indoor temperatures, housing conditions, or levels of flu**, so the findings should be interpreted as an early surveillance picture rather than an explanation of why changes occur.

Executive Summary

Cold periods

During the 2024/25 winter season across Wales, **78 days** met the operational definition of a **cold period** (mean temperature ≤ 2 °C for ≥ 2 consecutive days), and the remaining **74 days** were classified as **non-cold**. **January 2025** contained the longest continuous spell (**27 days**). Although winter 2024/25 was marginally milder than the 1991–2020 climatological baseline overall, cold exposure remains a recurrent public-health concern.

Interpretation and scope

Given the surveillance purpose of this first annual report, we used a simple descriptive comparison of **immediate (same day) associations** between cold periods and mortality. **Lagged and non-linear effects** will be assessed in planned **Distributed Lag Non-linear Models (DLNMs)** in subsequent analytical work. Findings are **descriptive**, not causal.

Overall mortality

Across 31 October 2024 to 31 March 2025, **daily all cause deaths were higher on cold days** than on noncold days (**106 vs 100 per day; Δ≈+6/day**). During the prolonged January spell, the daily average rose to **115** compared with **101** on other cold days. Whole winter mortality (**15,705 deaths**) remained **within the expected historical range** when set against the prespecified five year winter baseline (excluding pandemic winters), so the season was **not exceptional in aggregate**. *(These are temporal associations within routine surveillance.)*

Demographic patterns

The highest **age specific** daily burden occurred among people **aged ≥85 years** (crude age specific rates). After **age standardisation**, **female** daily mortality was **higher on cold vs noncold days**, whereas **male** rates showed **no clear difference**. Differences by deprivation were evident in **WIMD quintiles 2 and 5**; no consistent deprivation gradient was observed across all quintiles.

Geographical variation

Age-standardised analyses showed higher daily mortality on cold days in **Hywel Dda University Health Board**, **Aneurin Bevan University Health Board**, and **Powys Teaching Health Board**; other health boards showed no clear differences. Comparing rurality, **urban areas** showed a small increase on cold days, while **rural areas** did not. These patterns likely reflect underlying **population structure and baseline rates** and should not be interpreted causally.

Settings (location of death)

During cold periods overall deaths increased across all settings, with only very small shifts in the distribution; hospitals and hospices accounting for about 1% more of all deaths and care homes, private homes and other places slightly fewer. This may reflect changes in care-seeking and illness severity rather than differences in indoor temperatures.

Key limitations

- This is a descriptive, unadjusted analysis, showing only within-group differences (cold vs non-cold days). It does not compare groups with each other or show cause and effect.
- National temperature series may mask local micro-climates; analyses are not stratified by health board temperature.
- Indoor temperatures, housing characteristics, and fuel poverty are not measured, so the report cannot identify cold homes or indoor exposure.
- This report did not compare the 2024/25 cold period with previous winters.
- Ethnicity was not included in this report and should be considered in future analyses.

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1. Introduction

Cold weather can pose serious public health risks, causing 'excess' deaths in winter compared to the rest of the year. The winter of 2024/25 in Wales was slightly milder than the 1991–2020 average, with a mean temperature anomaly of +0.5°C, driven by a very warm December and a colder January. Rainfall was around 94% of average, making it drier than the previous winter, though December was wetter than normal [1]. Two named storms, Darragh (December) and Éowyn (January) brought severe winds, with Éowyn the most significant UK windstorm in over a decade [2-3]. This pattern reflects a broader climate trend of milder and wetter winters linked to climate change [4].

Cold exposure continues to pose a significant public health risk in Wales, with long-term surveillance data indicating that approximately 16,474 deaths between 1988 and 2022 were associated with the coldest days; temperatures between 8 and 20 degrees Celsius had the lowest mortality risk [5]. In the winter of 2022/23 alone, 285 excess deaths were linked to cold and damp housing conditions, underscoring the role of environmental and socioeconomic factors in seasonal mortality [6]. Vulnerable populations including older adults, individuals with chronic illnesses, and those experiencing fuel poverty are disproportionately affected, as inadequate heating and poor housing insulation exacerbate risks for cardiovascular, respiratory, and mental health conditions [7-8]. These findings highlight the urgent need for enhanced surveillance to inform targeted public health action.

This report aims to quantify and evaluate the immediate impact of cold on mortality comparing cold periods to non-cold periods in Wales during the winter of 2024/25. It examines variations in mortality by age group, sex, health board, location of death, rural/urban classification, and socioeconomic status (as measured by Welsh Index of Multiple Deprivation (WIMD) quintiles). The analysis compares 2024/25 winter mortality data with the five-year average (excluding the COVID-19 pandemic years winter) to assess the excess mortality attributable to cold weather.

2. Methods

Mortality data was sourced from Digital Health & Care Wales (DHCW) covering the winter period of 2024/25 (31st October 2024 – 31st March 2025). Temperature data was sourced from Open-Meteo for the same period. Welsh health boards, age, sex, Welsh Index of Multiple Deprivation (WIMD), and urban/rural population data for crude death rate comparisons were obtained from 2024 mid-year population estimates for Wales provided by the Office for National Statistics (ONS). Rural-urban status was assigned using the ONS 2021 Rural-Urban Classification for small area geographies and WIMD using WIMD 2025 LSOA classification.

2.1. Cold period definition

In England, UK Health Security Agency (UKHSA) in collaboration with the Met Office issue Cold Weather Alerts when the average temperature is forecasted to fall below 2°C for more than 48 hours [9]. For purpose of this analysis, a cold period (cold spell) was defined as any interval during which the average temperature in Wales was ≤ 2 °C for at least two consecutive days [9–10].

Cold period was identified using the Wales regional series-mean temperature (Wales central mean temperature). This national-level temperature was used to determine whether any intervals met predefined cold period threshold. If an all-Wales cold period is not detected, regional (local health board) temperature series would then be assessed to identify any localised events not captured nationally. The non-cold period (the comparator) includes all days outside the cold period in the 2024/25 winter season.

2.2. Study Population

The study population includes all deaths where the deceased person's place of death was recorded as Wales, as defined by the current census boundaries. These deaths are classified as Welsh deaths and form the basis for analysis within this report.

2.3. Data Analysis

All data analyses for this surveillance report were conducted using R version 4.5.1 within the RStudio environment. Mortality data for Wales were then imported into RStudio with key variables that included year, age, sex, health board, socioeconomic status, rural urban classification, and location of death.

Daily meteorological data (mean temperature) for Wales and Welsh health boards for the report period, were sourced from Open-Meteo and integrated into the analysis. Cold and non-cold periods were defined and linked to the mortality dataset to assess the impact of cold weather compared to non-cold period on mortality outcomes. Additionally, mid-year population estimates were matched to the mortality data by relevant demographic and geographic categories to enable the calculation of mortality rates.

Descriptive epidemiological methods were employed to examine mortality associated with cold weather. The analysis included mortality counts, proportions, means, long-term averages, crude mortality rates (CMR), age-standardised mortality rates (ASMRs), and 95% confidence intervals (CI) to support comparisons across population subgroups during cold periods compared to non-cold period.

ASMRs were calculated using direct standardisation with the 2013 European Standard Population. All direct standardised rates were produced using the *calculate_dsr* function from the PHEIndicatorMethods package. Confidence intervals for ASMRs were calculated using the Dobson method [11]. Age standardised rates were generated for comparisons by sex, WIMD, Welsh health boards, and rurality.

CMRs were employed in mortality comparison analyses by age group because several age groups had small numbers or zero deaths. This ensured stable rate estimation while retaining age specific patterns.

Given the surveillance purpose of this first annual report, we used a simple descriptive comparison of same day mortality on cold vs non-cold days to maximise clarity and reproducibility; more complex models (e.g., DLNMs to capture delayed/nonlinear effects) are planned for future analytic cycles as data and capacity develop.

3. Summary of findings

3.1. Cold period

During the 2024/25 winter season in Wales at the national level, a total of **78 days** met the defined threshold for cold period. January 2025 was the most affected month, with **27 days** recording mean temperatures that met a cold day threshold, marking it as the longest continuous period of cold episodes.

3.2. Overall mortality

During the 2024/25 winter season across Wales, mortality was significantly higher during the cold period with an estimated **8,278 all-cause deaths** and a daily average of **106 deaths per day** during the **78 days** of cold period, compared to **7,427** all-cause deaths and an average of **100 deaths per day** during the **74 days** of non-cold period (31st October 2024 to 31st March 2025) as shown in Figure 1 and Table 1.

During the prolonged cold spell in January 2025, the daily average increased further to **115 deaths per day**, significantly above the **101 deaths per day** observed during other cold days. This suggests an additional mortality impact associated with extended low-temperature exposure.

Overall, the findings show consistent excess mortality during cold periods, with the highest rates observed during the prolonged cold spell. While this suggests an association between cold weather and excess mortality, causality cannot be inferred due to the lack of adjustment for confounders and absence of longitudinal comparison.

Table 1: Winter 2024/25 mortality by cold and non-cold periods, including prolonged cold days.

Measure	Cold period (95% CI)	Non-cold period (95% CI)	Prolonged cold (Jan 2025) (95% CI)	Other cold days (95% CI)
Total number of deaths	8,278 (8,100-8,456)	7,427 (7,258-7,596)	-	-
Average daily number of deaths	106 (103-109)	100 (97-104)	115 (111-119)	101 (98-105)

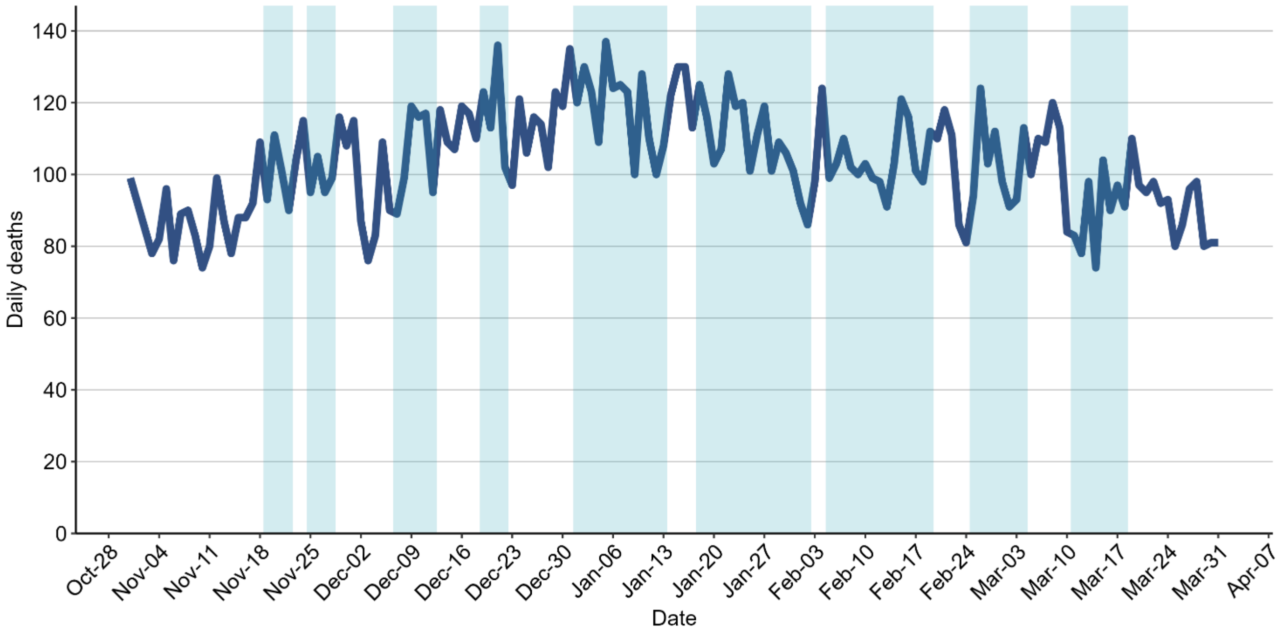

Figure 1 – Daily number of all-cause deaths in Wales, 2024/25 winter season (31st October 2024 to 31st March 2025). The line represents the daily number of deaths and aqua shading depicts the Cold periods (cold spell).

A total of **15,705** all-cause deaths were recorded in Wales during the 2024/25 winter season. While the mortality in Dec 2024 / Jan 2025 appears to be higher than the 5-year average (Figure 2), the total all-cause deaths during the 2024/25 winter season falls within the 95% confidence interval when compared to the five-year baseline average of **14,258** deaths (95% CI: **12,465** to **16,051**), derived from the winter seasons of 2015/16 to 2018/19 and 2023/24. The baseline data excludes the pandemic-affected winter seasons (2019/20 and 2020/21). The mortality observed in 2024/25 winter did not exceed historical winter trends. However, no comparative analysis was conducted to assess the impact of the 78-day cold period in 2024/25 relative to similar periods in previous years. As such, the data do not support attributing the observed mortality levels to cold weather exposure during this period (Figure 2).

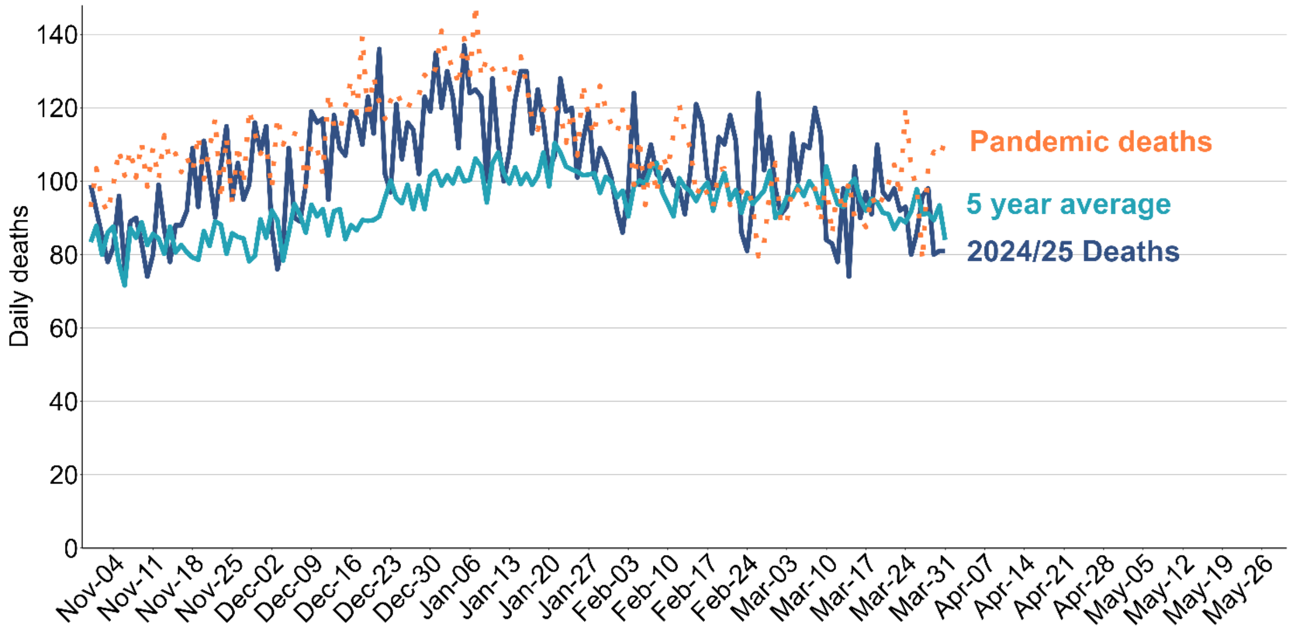

Figure 2 – Daily number of deaths in Wales, 2024/25 winter, and the mean daily deaths for five-year winter season (2015/16 to 2018/19 and 2023/24) and the average daily deaths during the pandemic winter season (2019/20 and 2020/21).

3.3. Demographic factors

During the cold period compared to the non-cold period, there was no statistically significant difference in daily average age-specific all-cause crude mortality rates. However, individuals aged 85 years and older experienced the highest daily average mortality burden, with **47 deaths** per 100,000 population (95% CI: **32** to **61**) during the cold period compared to **44 deaths** per 100,000 of population (95% CI: **30** to **58**) during the non-cold period, indicating a higher CMR in this age group (Figure 3).

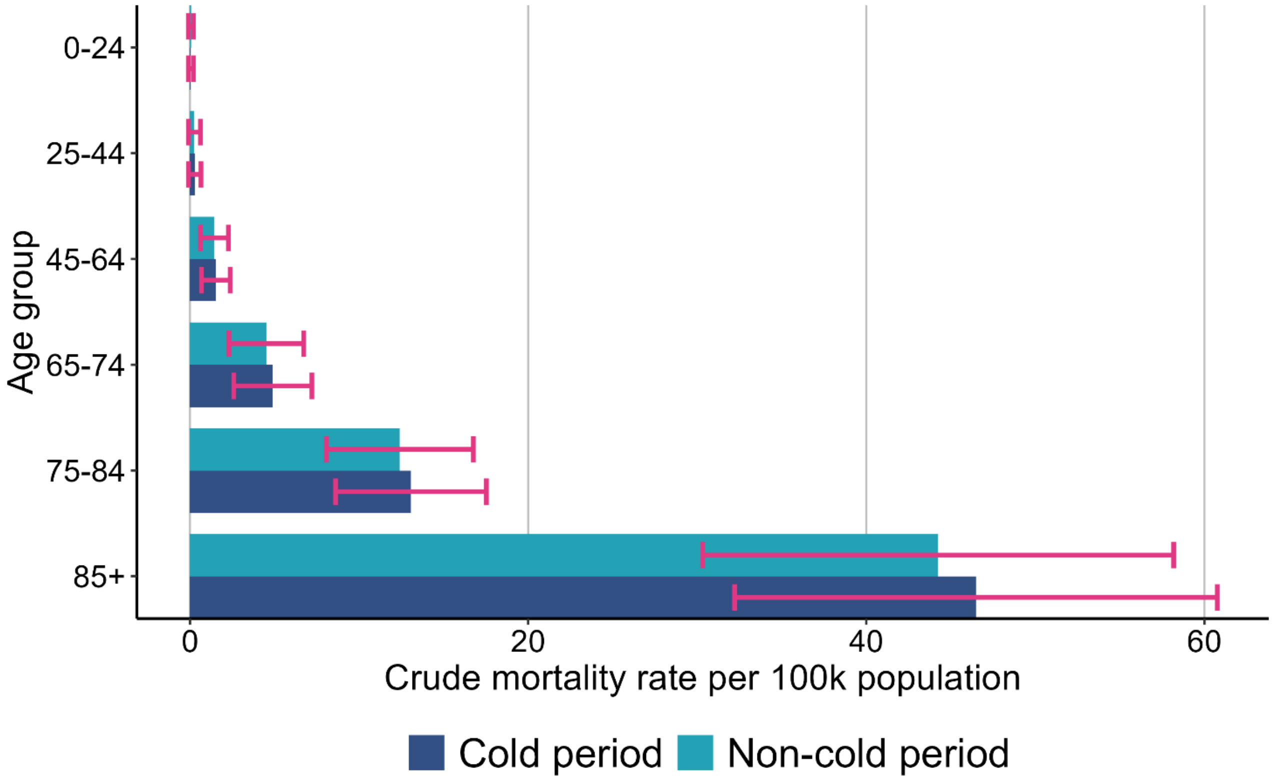

Figure 3 – Daily average all-cause deaths per 100,000 population by age group during the cold period (royal blue bars) compared to non- cold period (aqua bars) in 2024/25 winter season. The pink lines represent the 95% confidence interval.

The median age at death did not differ between the cold versus non-cold periods (**81 years** for females and **77 years** for males). Among females, age-standardised all-cause average daily mortality rates were significantly higher during the cold period with **2.8 deaths per 100k population (95% CI: 2.7 – 2.9)** compared with non-cold period, **2.5 deaths per 100k population (95% CI: 2.5 – 2.6)**. Among males, no statistically significant difference was observed between periods (Figure 4).

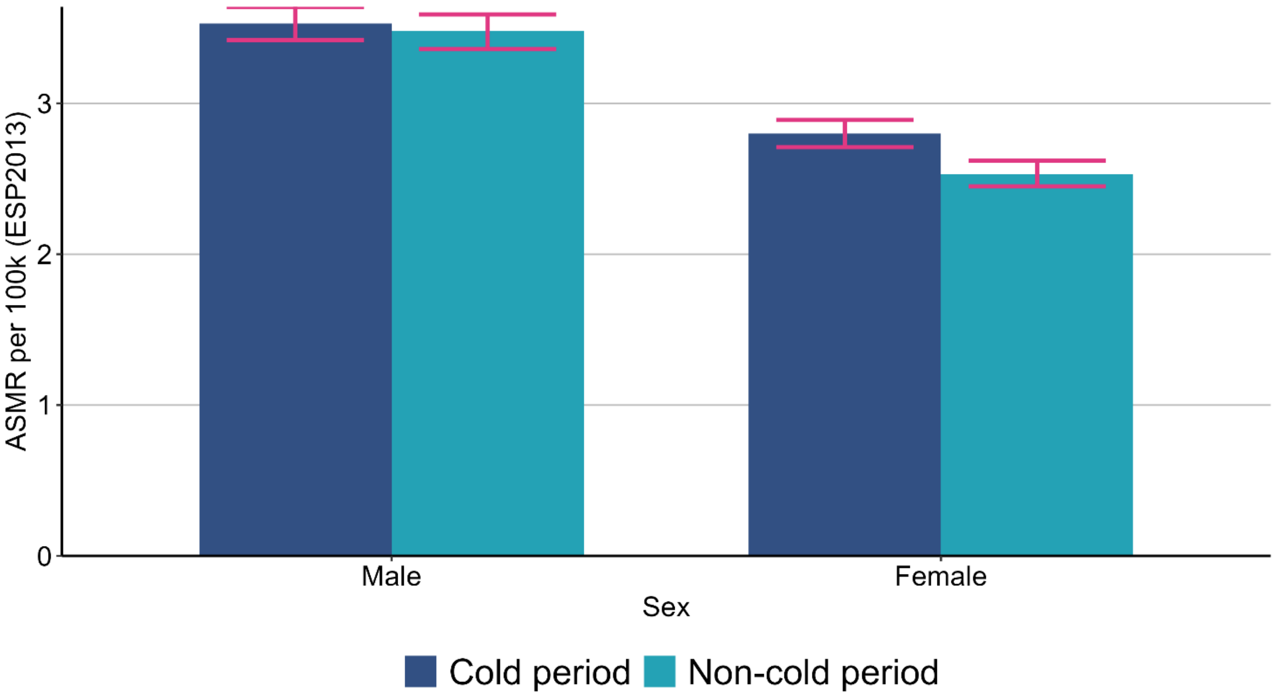

Figure 4 – Daily average all-cause ASMR per 100,000 population by sex during the cold period (royal blue bars) compared to non- cold period (aqua bars) in 2024/25 winter season. The pink lines represent the 95% confidence interval.

Note: Bars show subgroup-specific rates and within-group cold vs non-cold differences. They are not between-group comparisons; such inference requires lagged/confounder-adjusted models.

Age-standardised daily average mortality rates differed between cold and non-cold periods in specific WIMD quintiles. Statistically significant difference was observed in WIMD quintile 2 (second most deprived quintile) and WIMD quintile 5 (least deprived quintile). In WIMD quintile 2, during the cold period daily average ASMR was **2.9 deaths per 100,000 (95% CI: 2.7 – 3.1)** compared to non-cold period with **2.3 deaths per 100,000 (95% CI: 2.1 – 2.4).** In WIMD quintile 5 during the cold period, daily average ASMR **was 4.9 deaths per 100,000 (95% CI: 4.7 – 5.1)** compared to non-cold period with **4.1 deaths per 100,000 (95% CI: 3.9 – 4.3)**. No statistically significant differences were observed in WIMD 1, 3 and 4 as shown in Figure 5.

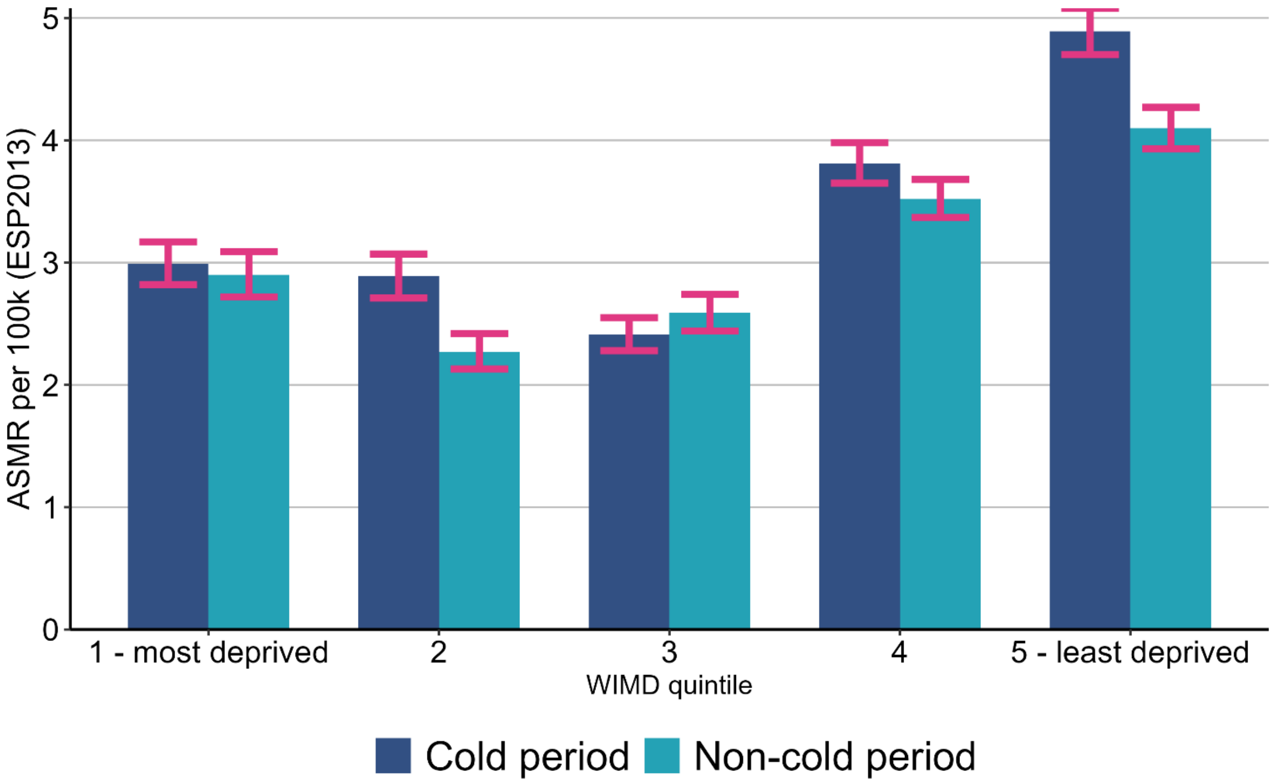

Figure 5 – Daily average all-cause ASMR (per 100,000 population) by deprivation quintile (WIMD) during the cold period (royal blue bars) compared to non- cold period (aqua bars) in 2024/25 winter season. 1= most deprived, 5= least deprived. The pink lines represent the 95% confidence interval.

Note: Bars show subgroup-specific rates and within-group cold vs non-cold differences. They are not between-group comparisons; such inference requires lagged/confounder-adjusted models.

3.4. Geographical variation

Statistically significant differences in daily average age-standardised all-cause mortality rates between the cold and non-cold periods were identified in three health boards: **Hywel Dda University Health Board (UHB), Aneurin Bevan UHB, and Powys Teaching Health Board (THB)**.

In Hywel Dda UHB, the daily average ASMR during the cold period was **3.8 deaths per 100,000 population (95% CI: 3.6–4.0)** compared with **3.1 deaths per 100,000 (95% CI: 2.9–3.3)** during the non-cold period. Aneurin Bevan UHB reported **3.7 deaths per 100,000 (95% CI: 3.5–3.9)** in the cold period compared with **3.2 deaths per 100,000 (95% CI: 3.0–3.3)** in the non-cold period. In Powys THB, the cold-period ASMR was **2.7 deaths per 100,000 (95% CI: 2.4–3.1)** compared with **2.0 deaths per 100,000 (95% CI: 1.7–2.3)** during the non-cold period. No statistically significant differences were observed in the remaining health boards (Figure 6).

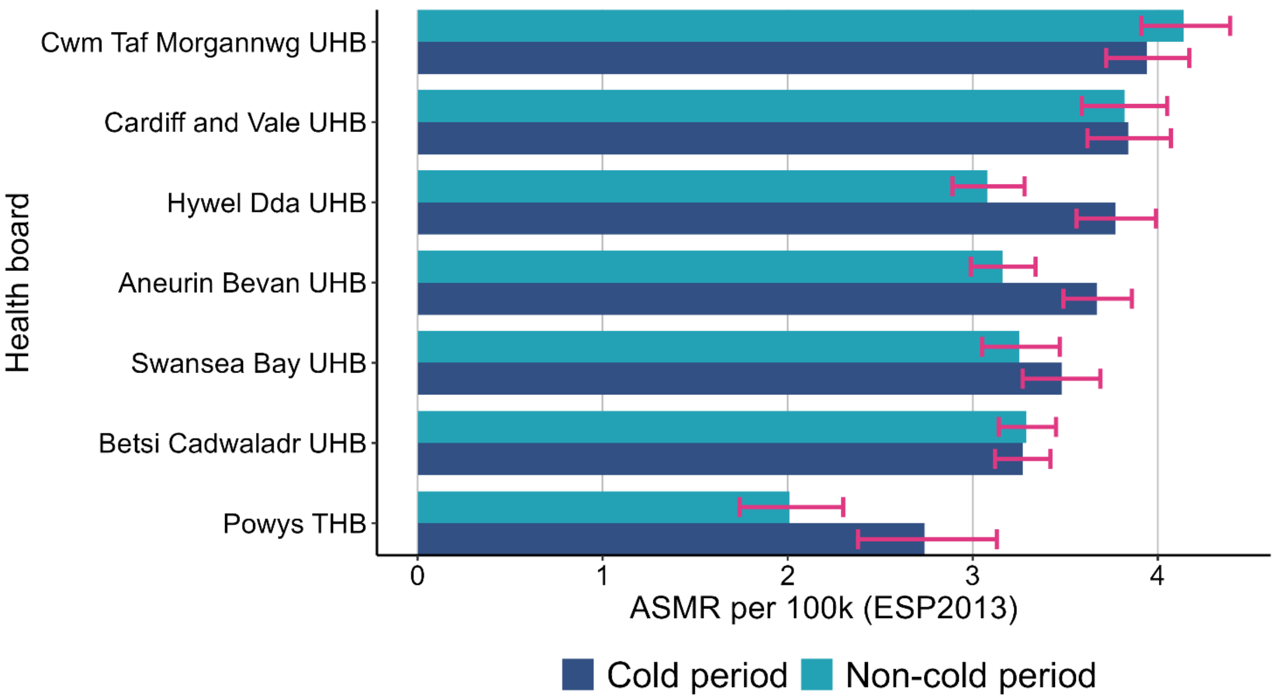

Figure 6 – Daily average all-cause ASMR (per 100,000 population) by health board during the cold period (royal blue bars) compared to non- cold period (aqua bars) in 2024/25 winter season. The pink lines represent the 95% confidence interval.

Note: Bars show subgroup-specific rates and within-group cold vs non-cold differences. They are not between-group comparisons; such inference requires lagged/confounder-adjusted models.

During the 2024/25 winter season in Wales, when comparing cold period with non-cold period by rurality, urban areas reported a statistically significant difference in daily average age-standardised all-cause mortality rates with **3.7 deaths per 100,000 (95% CI:**

3.6 – 3.8) during the cold period compared **with 3.5 deaths per 100,000 (95% CI: 3.4 – 3.6)** during the non-cold period. In rural areas, no significant difference was observed between periods (Figure 7).

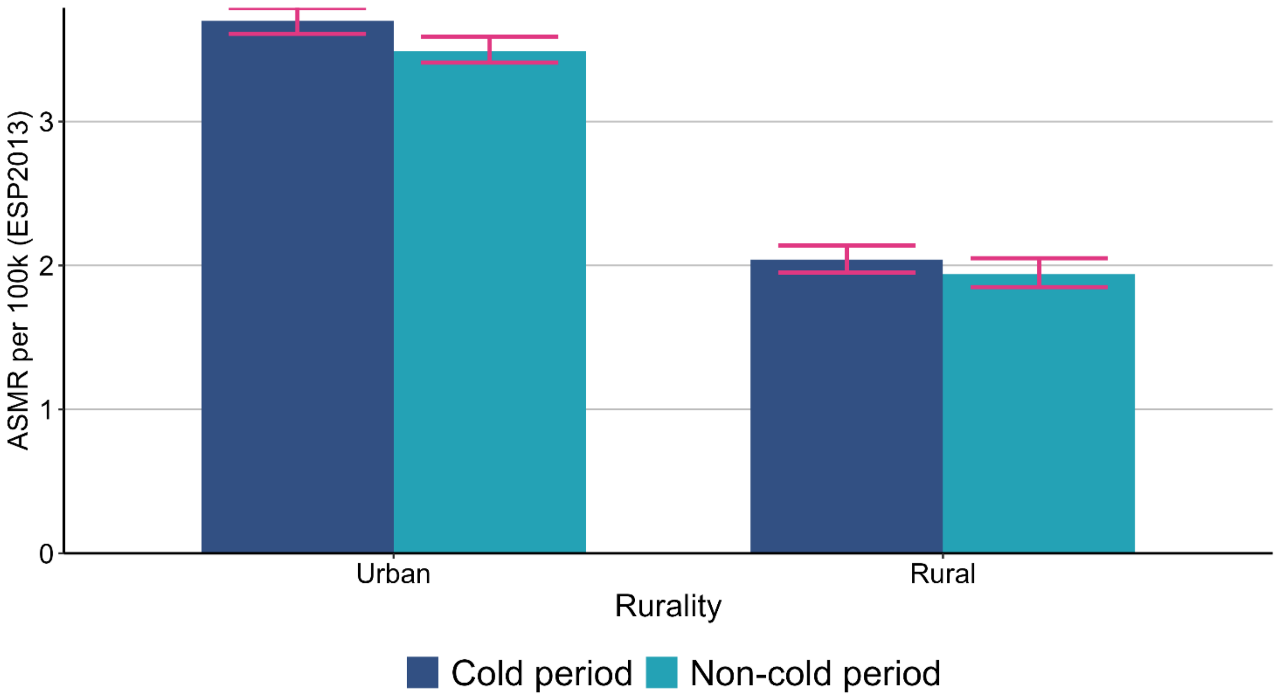

Figure 7 – Daily average all-cause ASMR (per 100,000 population) by rural/urban classification during the cold period (royal blue bars) compared to non- cold period (aqua bars) in 2024/25 winter season. The pink lines represent the 95% confidence interval.

Note: Bars show subgroup-specific rates and within-group cold vs non-cold differences. They are not between-group comparisons; such inference requires lagged/confounder-adjusted models.

3.5. Settings

When comparing cold and non-cold periods, the overall number of deaths increased across all settings, reflecting higher mortality during colder weather. The distribution of deaths by place of death remained broadly similar, and there were no statistically significant differences in the proportion of deaths occurring in each setting.

However, small shifts in the relative share of deaths were observed. During the cold period, hospitals and hospices accounted for around one percentage point (1%) higher of all deaths compared with the non-cold period, whilst the proportions occurring in care homes, people's own homes, and other places were slightly lower (Table 2 and Figure 8)[1]. These small proportional changes may reflect differences in care-seeking patterns, acuity, and baseline mortality distribution, rather than temperature conditions within these settings.

Table 2: Proportion and number of deaths by location of occurrence during cold and non-cold periods, Winter 2024/25, Wales.

Setting	Proportion (%) of deaths by episode (95% CI)		Total number of deaths by episode (95% CI)	
	Cold period	Non-cold period	Cold period	Non-cold period
Care home	16.6% (15.8–17.4)	17.8% (16.9–18.7)	1,371 (1,298–1,444)	1,324 (1,253–1,395)
Home	29.9% (28.9–30.9)	30.2% (29.2–31.2)	2,473 (2,376–2,570)	2,241 (2,148–2,334)
Hospice	3.0% (2.6–3.4)	2.5% (2.1–2.9)	247 (216–278)	182 (156–208)
Hospital	47.5% (46.4–48.6)	46.5% (45.4–47.6)	3,934 (3,811–4,057)	3,457 (3,342–3,572)
Other places	3.0% (2.7–3.5)	3.0% (2.6–3.4)	253 (222–284)	222 (193–251)

[1] *Location of death may not accurately reflect place of residence. Individuals living in care homes or private residences may have been transferred to hospitals prior to death, potentially leading to an overrepresentation of hospital deaths and an underrepresentation of deaths in community settings. This limitation should be considered when interpreting place-specific mortality trends.*

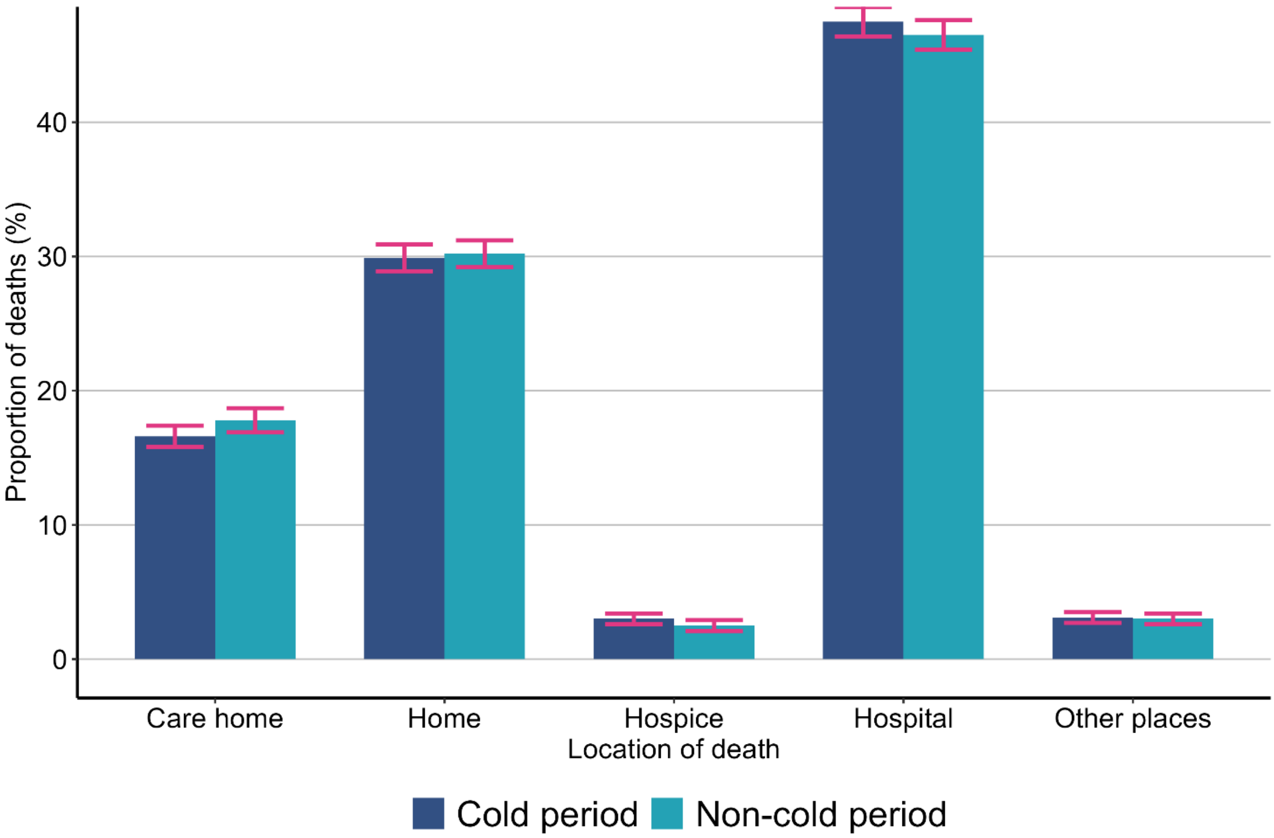

Figure 8 – Proportion of all-cause mortality by location of death during the cold period (royal blue bars) compared to non- cold period (aqua bars) in 2024/25 winter season. The pink lines represent the 95% confidence interval.

4. Limitations

- No adjustment for confounders: The analysis does not adjust for factors such as influenza and other respiratory infections, chronic disease burden, ethnicity, or differences in healthcare access, all of which may influence winter mortality independently of cold weather. As such, observed differences cannot be attributed solely to cold exposure.
- Descriptive only; no between-group comparisons: Subgroup results show within-group differences (cold vs non-cold days) only. We did not compare groups with each other (e.g., WIMD quintiles or rural/urban areas), as this would require lagged models and adjustment for key confounders (including influenza, chronic conditions, indoor temperature, housing efficiency and heating fuel type), beyond the scope of this surveillance cycle.
- No comparison with previous winters: We did not assess whether the 78-day cold period in 2024/25 differed from cold spells in earlier years. This limits interpretation of whether the patterns observed are unusual or consistent with long-term trends.
- Geography and exposure: national temperature series may mask local microclimates; analyses are not stratified by health board temperature.
- Lack of indoor temperature and home-heating data: The dataset does not include information on indoor temperatures, heating behaviour, or cold homes. The report therefore cannot assess exposure to cold indoor environments or account for household-level factors that influence winter health risks.
- Housing conditions not captured: Indicators of housing quality, insulation, energy efficiency, heating adequacy, and fuel poverty are not available in the mortality and population datasets used. Although wider evidence highlights the importance of these factors in Wales, they cannot be examined directly in this report.

5. Conclusion

The 2024/25 winter season in Wales was marked by multiple cold spells, including an extended 27-day spell in January 2025. Daily all-cause mortality was consistently higher during cold periods compared with non-cold periods, with the highest daily averages observed during the prolonged January spell. These findings demonstrate a clear temporal association between cold weather and increased mortality during the winter period.

Overall winter mortality remained within expected historical bounds, indicating that the season was not exceptional in aggregate. The impact of cold weather varied across population groups and geographies. Individuals aged 85 years and older experienced the highest age-specific mortality burden, consistent with known vulnerability in older populations. After age-standardisation, an increase in all-cause mortality during cold periods was observed among females, while no clear difference was seen among males.

Differences were also observed across socioeconomic groups. Higher age-standardised mortality during cold periods was identified in the second most deprived and the least deprived WIMD quintiles, with no clear pattern in other quintiles. This indicates that the relationship between cold and mortality does not follow a simple deprivation gradient and is likely influenced by population age structure, environmental factors, and wider social vulnerabilities.

At health board level, higher age-standardised mortality on cold days was observed in Hywel Dda UHB, Aneurin Bevan UHB, and Powys THB, while other health boards showed no clear differences. This suggests regional variation in how cold conditions affect population health. Urban areas experienced a small increase in mortality during cold periods, whereas rural areas showed no difference.

A small shift in the distribution of deaths by place was observed, with hospitals and hospices accounting for around one percentage point more of deaths during cold periods; however, these differences are modest and should be interpreted cautiously, as they may not indicate changes in care pathways and may instead reflect underlying population needs, patterns of service use, or broader winter pressures.

Overall, the findings indicate that alongside variable exposures, cold-related impacts on mortality are also not uniform across Wales. This surveillance describes immediate (same-day) associations only; it does not capture lagged effects or adjust for confounders such as respiratory infection activity, or access to care. Indoor temperature, housing quality, cold homes, and ethnicity were not measured and should be considered in future analytical work. Continued surveillance alongside targeted public health interventions remains important to mitigate cold-related health risks, particularly among vulnerable populations.

6. Recommendations

1. **Maintain and enhance routine winter surveillance.**
   Continue annual monitoring the public health impacts of cold weather in Wales, tracking trends against multi-year baselines to identify emerging signals of risk.

2. **Strengthen epidemiological methods to estimate risk and attribution.**
   a. Apply Distributed Lag Non-linear Models (DLNM) to quantify the immediate and delayed effects of cold, estimate risk ratios, and calculate attributable fractions, reflecting non-linear temperature–mortality relationships.
   b. Where possible, model confounders and co-exposures systematically (e.g., influenza/other respiratory activity, storms) to assess whether excess daily deaths during cold periods persist after adjustment.

3. **Share findings for coordinated refinement.**
   Present the surveillance outputs to the PHW Climate Change Surveillance Subgroup for methodological review, consideration in the development of public health action, and prioritisation of next analytical work.

4. **Future analytic epidemiology.**
   A research study to investigate why Wales shows an inverse deprivation pattern in cold-related mortality compared with England, by examining how age structure, rurality, housing age and energy efficiency, and heating fuel type interact with cold exposure across areas [12, 13]. This work would test whether the higher cold-related mortality observed in some least-deprived, potentially rural/coastal areas, reflects their older population profiles, older and harder-to-heat housing stock, and off-gas heating systems, as suggested by Welsh demographic evidence and housing-warmth findings [14, 15], and by multi-city European evidence on cold effects and lags [16].

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8. Further information and contact details.

About Public Health Wales

Public Health Wales exists to protect and improve health and wellbeing and reduce health inequalities for people in Wales. We work locally, nationally, and internationally, with our partners and communities.

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Voluntary Application of the Code of Practice for Statistics

This report by Public Health Wales is not classified as official statistics, but it voluntarily follows the UK Statistics Authority's Code of Practice for Statistics. We apply the principles of trustworthiness, quality, and value to ensure transparency, scientific integrity, and public benefit.

Trustworthiness: Produced by Public Health Wales analysts using reproducible and transparent methods.

Quality: Based on published Office for National Statistics (ONS) mortality data and meteorological data, analysed using standard epidemiological techniques.

Value: Provides evidence on the impact of cold weather on mortality in Wales, supporting public health policy, emergency planning, and climate adaptation efforts.

We welcome feedback to support continuous improvement of future outputs.