Supplementary Data

A Prognostic Algorithm for Heat-Related Mortality in Older Adults: Development in Milan

Table of Contents

- **Supplementary Table S1.** List of diagnoses recorded in hospital discharge records.
- **Supplementary Table S2.** List of the Anatomical Therapeutic Chemical (ATC) codes.
- **Supplementary Table S3.** List of exemptions.
- **Supplementary Table S4.** List of service centres.
- **Supplementary Figure S1.** Daily deaths and daily ambient temperature during summer 2022.
- **Supplementary Figure S2.** Daily deaths and daily ambient temperature during summer 2023.
- **Supplementary Figure S3.** Flow chart Development Cohort, 2022 (n=192 063) and External Validation Cohort, 2023 (n=181 509)
- **Supplementary Table S5.** Full risk profiles across four risk strata in the Development Cohort, 2022.
- **Supplementary Table S6.** A full risk profile for all risk categories in the External Validation Cohort, 2023.
- **Supplementary Table S7.** Mortality rates and rate ratios for the 2022 and 2023 cohorts during the overall period (15 July–15 September), heatwave days, and the remaining non-heatwave period
- **Supplementary Table S8.** Preliminary analysis of sample means and variances for Development Cohort.
- **Supplementary Table S9.** Preliminary analysis of sample means and variances for External Validation Cohort.
- **Supplementary Figure S4.** Calibration plot of the multivariable logistic regression model predicting heat-mortality risk, in the Development Cohort (A) and in the External Validation Cohort (B).

Supplementary Table S1

Hospital Discharge Sheets (HDS):

Lists of selected ICD9-CM diagnoses recorded in hospital discharge records. A cohort of hospital admissions from the past two years were considered for the diagnoses.

Table S1	
Codes	**Description ICD-IX**
140-239	Tumors
240-246	Thyroid disorders
250-259	Disorders of other endocrine glands
270-279	Other metabolic and immune disorders
280-289	Diseases of the blood and blood-forming organs
290-302	Mental disorders (psychosis, neurosis, personality disorders)
303-316	Substance dependence, physical disorders caused by psychological factors
330-341	Hereditary and degenerative diseases of the central nervous system (Parkinson's disease, multiple sclerosis, ALS, Huntington's disease, etc.)
342-344	Hemiplegia and hemiparesis, Cerebral palsy, Other paralytic syndromes
345-349	Epilepsy, migraine, and other disorders of the central nervous system
350-359	Disorders of the peripheral nervous system
362-365	Other diseases of the retina, chorioretinal inflammation, disorders of the iris and ciliary body, glaucoma
390-398	Acute rheumatic fever, chronic rheumatic heart disease
401-405	High blood pressure
410-412	Acute myocardial infarction, other acute and subacute forms of ischemic heart disease, previous myocardial infarction
413-414	Other acute and subacute forms of ischemic heart disease, angina pectoris
415-417	Diseases of the pulmonary circulation
420-429	Other diseases of the heart
430-438	Cerebrovascular diseases
440-448	Diseases of arteries, arterioles, and capillaries
451-459	Diseases of veins and lymphatic vessels and other diseases of the circulatory system
480-487	Pneumonia and influenza
490-505	Chronic obstructive pulmonary disease; Pneumoconiosis
508	Respiratory conditions caused by other and unspecified external agents
510-519	Other diseases of the respiratory system
555-558	Non-infectious enteritis and colitis
581-588	Chronic glomerulonephritis, nephritis, and nephropathy, not specified as acute or chronic, acute/chronic renal failure, unspecified renal failure, disorders caused by reduced renal function
640-648	Complications mainly related to pregnancy
650-659	Normal delivery and other indications for hospitalization during pregnancy, labor, and delivery
670-677	Complications of the puerperium
710-739	Diseases of the musculoskeletal system and connective tissue
740-759	Congenital malformations
780-789	Ill-defined symptoms, signs, and conditions
790-796	Non-specific abnormal findings

797-799	Ill-defined and unknown causes of morbidity and mortality
980-989	Toxic effects of substances of mainly non-medicinal origin
991-992	Other and unspecified effects of external causes, effects of cold, effects of heat and light
994.2, 994.3, 994.4, 994.5, 995.8	Effects of hunger, effects of thirst, exhaustion due to exposure to the environment, exhaustion due to excessive exertion, specified adverse effects not classified elsewhere
3940-3971 or (7463-7466) +424	Valvular pathology
V08, V10, V11, V12, V13, V16, V17, V18, V20, V21, V22, V23, V27, V30-V39, V40.2, V40.3, V40.9, V42.0, V42.1, V42.6, V42.7, V42.81, V42.82, V42.83, V42.9, V43.2, V43.3, V43.4, V46.0, V46.1, V47.2, V56.31, V56.32, V56.8, V57.0, V58.0, V58.1, V58.61, V58.62, V58.69, V60.0, V60.1, V60.2, V60.3, V60.4, V60.6, V60.8, V60.9, V62.8, V62.89, V66.1, V66.2, V66.3, V66.7, V83.02	Other

Supplementary Table S2

Pharmaceutical Flows (all outpatient prescription records).

Outpatient prescriptions issued from January 1st of the current year were analysed. Treatment duration was defined as the time between first and last dispensing (minimum 7 days if coincident), and coverage was computed as dispensed Defined Daily Doses (DDDs) per treatment duration; only treatments with >50% coverage were included. Treatments initiated in the previous year with ≤12 boxes or in the current year with duration ≤7 days were excluded

Table S2	
Pharmaceutical Group	**Anatomical Therapeutic Chemical (ATC) Codes**
Group 01 Antiepileptic drugs	'N03AA01';'N03AA02'; 'N03AB**'; 'N03AD**';'N03AE**'; 'N03AF**'; 'N03AG**'; 'N03AX**';
Group 02 Antiparkinsonians drugs	'N04AA02'; 'N04BA01', 'N04BA02', 'N04BA03', 'N04BA04', 'N04BA05'; 'N04BX02';
Group 03 Antithrombotic drugs	'A01AD05', 'A01AD05', 'B01AC06', 'N02BA01', 'N02BA51', 'N02BA71', 'B01AC06', 'C10BX01', 'C10BX02', 'M01BA03,' 'B01AC04', 'B01AC05';
Group 04 Beta blockers drugs	'C07AB02','C07AB03','C07AB04','C07AB05','C07AB07','C07AB08','C07AB11','C07AB12','C07BB04','C07BB03','C07CB03','C07CB53','C07BB07','C07AG02','C07AG01','C07BG01','C07CG01','C07BB52','C07CB02','C07AA03','C07CA03','C07AA05','C07BA05','C07AA07', 'C07AA57','C07BA07','C07AA06', 'C07BA06', 'C07DA06';
Group 05 Renin-angiotensin system inhibitors drugs	'C09A***','C09AA01','C09AA02','C09AA03','C09AA04','C09AA05','C09AA06','C09AA07','C09AA08','C09AA09','C09AA10','C09AA11','C09AA12','C09AA13','C09AA15','C09AA16';'C09BA**';'C09BB**';'C09BX**';
Group 06 Vasodilators drugs	'C01DA08', 'C01DA14', 'C01DA58', 'C01DA02', 'C01DA52', 'C01DA05', 'C01DA55'
Group 07 Anti-migraine drugs	'N02CA01','N02CA02','N02CA04','N02CA07','N02CA51','N02CA52','N02CA72'; 'N02CC01','N02CC02','N02CC03','N02CC04','N02CC05','N02CC06','N02CC07', 'N02CC08'; 'N02CD01', 'N02CD02','N02CD03', 'N02CD05','N02CD06';
Group 08 Glucocorticoids drugs	'D07AC15', 'R03BA01', 'D07AC17', 'R03BA05', 'A07EA07'
Group 09 Non-steroidal anti-inflammatory and antirheumatic drugs (NSAIDs)	'M01AB**'; 'M01AC**'; 'M01AE**'; 'M01AH**';
Group 10 Diuretics drugs	'C03BA04', 'C03EA06', 'C03CA01', 'C03EB01', 'C03AA03', 'C03AB03', 'C03AX01', 'C03EA01', 'C03BA11', 'C03BA08', 'C03EA12', 'C03CA04'
Group 11 COPD drugs	'D07AC15', 'R01AD01', 'R03BA01', 'G02CA03', 'R03AC04', 'R03AK03', 'R03CC04', 'R01AX03', 'R03BB01', 'R01AD04', 'R03BA03', 'D07AC17', 'R01AD08', 'R03BA05', 'R03AC02', 'R03AK04', 'R03CC02', 'R03AC12', 'R03AK06'

Group 12 Antidiabetics drugs	'A10BB02','A10BB01','A10BB09','A10BB12','A10BB07','A10BB08',' A10AB01', 'A10AB04', 'A10AB05', 'A10AC01', 'A10AC04', 'A10AD01', 'A10AD04', 'A10AD05', 'A10AE01', 'A10BA02', 'A10BD02', 'A10BG03', A10BD03', 'A10BG02'
Group 13 Statins drugs	'C10AA05','C10AA55','C10AA04','C10AA03','C10AA53','C10AA07',' C10AA01','C10AA51','C10AA02';'C10BA**'; 'C10BX**';
Group 14 Antivertigo drugs	'N07CA03'
Group 15 Antidementia, sympathomimetics	'N06DA02', 'N06DA04', 'N06DA03', 'R01AB**', 'R03CA02'
Group 16 Antipsychotics, anxiolytics and hypnotics drugs	'N05AD01', 'N05BA12', 'N05AL05', 'N05BA08','N05AD06', 'N05AA01', 'N05AX09', 'N05AH02', 'A03CA04', 'N05BA01', 'N05AB01', 'N05AB02', 'N05AA02', 'N05BA06', 'N05BA56', 'N05CD08','N05AH03', 'N05AC01', 'N05AG02','N05AD05', N05AH04', 'N05AX08', 'N05AL01', 'N05AL07', 'N05AL03', 'N05AL03', 'N05AL05','N05AC02', 'N05AB06','N05CF02','N05CG01','N05AF05','A03AA**','A03AB**',' N05AD01','M03BC01','N01AF**', 'N01AG**', 'N04AB02', 'N05AA**', 'N05AB**', 'N05AC**', 'N05AD'; 'N05AN01'; 'N05AH02', 'N05AH03','N05AH04', 'N05AH05', 'N05AH06';
Group 17 Thyroid hormones	'H03AA01', 'H03AA02', 'H03AA03'
Group 18 Antihypertensive drugs	'C02A***','C02AB**','C02AC**';'C02C***','C02CA**';'C02D***','C 02DC**', 'C02DD**';'C02K***', 'C02KX**';
Group 19 Anticholinergics drugs	'R03BB01', 'R03BB04', 'R03BB05', 'R03BB06', 'R03BB07','S01FA01';
Group 20 Antidepressants drugs	'N06AA04','N06AA06','N06AA09','N06AA10','N06AA16','N06AA21'; 'N06AB03','N06AB04','N06AB05','N06AB06','N06AB08','N06AB10';
Group 21 Carbonic-anhydrase inhibitors drugs	'S01EC01', 'S01EC03,'S01EC04, 'S01EC54';
Group 22 Digitalis glycosides drugs	'C01AA05';
Group 23 Antiarrhythmics, Class IA drugs	'C01BA03';
Group 24 Antianginal drugs	'C01EB17','C01EB18','C10AA07';
Group 25 Anti-gout drugs	'M04AC01';
Group 26 Antineoplastic and immunomodulatory drugs	'L01A***';'L01B***';'L01C***';'L01D***';'L01E***'; 'L01F***';'L01X***'; 'L02A***'; 'L02B***';'L03A***'; 'L04A***';
Group 27 Anticholinesterases drugs	'N07AA01', 'N07AA02';
Group 28 Opioids drugs	'N02AB02','N02AB03','N07BC02; 'N02AA01'; 'N02AJ**'; 'N02AA**';
Group 29 Antibacterial for systemic use drugs	'J01A***';'J01B***';'J01C***';'J01D***';'J01E***';'J01F***';'J01G** *';'J01M***';'J01R***'; 'J01X***';

Supplementary Table S3

Exemption Information Flow

Only the valid and active exemptions are considered for the cohort, as follows:

Table S3	
Codes	**Exemption By Pathology**
C01, S01	Disabled people lacking support or caregivers, formerly IC13
C02, S02	Disabled people with support or caregivers, formerly IC14
C03, S03	Disabled people 67-99%, formerly IC20 and IC21
0A02.394,0A02.395, 0A02.396, 0A02.397, 0A02.V42.2, 0A02.V43.3, 0A02.414, 0A02.416, 0A02.417, 0A02.426, 0A02.427, 0A02.433, 0A02.434, 0A02.557.1, 0A02.444, 0A02.452	Heart and pulmonary diseases
0B02.433, 0B02.434, 0B02.437	Diseases of the cerebral circulation
0C02.441.2, 0C02.441.4, 0C02.441.7, 0C02.447.1, 0C02.557.1, 0C02.442, 0C02.444, 0C02.452, 0C02.453	Vascular diseases
001.	Acromegaly and gigantism
003.	Autoimmune haemolytic anaemia
006.	Rheumatoid arthritis
007.	Asthma
008.	cirrhosis of the liver, biliary cirrhosis
011.	Dementia
012.	Diabetes Insipidus
013.	Diabetes Mellitus
014.	addiction to narcotic drugs, psychotropic substances, and alcohol
016.	Chronic (active) hepatitis
017.	Epilepsy
020.	HIV infection
021.	Heart failure (NYHA Class III and IV)
022.	Chronic adrenal insufficiency (Addison's disease)
023.	Chronic renal failure
024.	Chronic respiratory failure
025.	Hypercholesterolemia
026.	Hyperparathyroidism, hypoparathyroidism
027.	Congenital hypothyroidism, severe acquired hypothyroidism
028.	Systemic lupus erythematosus
029.	Alzheimer's disease
030.	Sjögren's disease
0A31, 031	Arterial hypertension with and without organ damage
032.	Cushing's disease or syndrome
035.	Graves' disease, other forms of hyperthyroidism
036.	Buerger's disease
038.	Parkinson's disease and other extrapyramidal disorders

039.	Pituitary dwarfism
041.	Optic neuromyelitis
044.	Psychosis
046.	Multiple sclerosis
049.	Individuals with multiple diseases with organ impairment
052.	Individuals who have undergone organ transplantation (kidney, heart, lung, intestine, liver, pancreas, or bone marrow).
054.	Ankylosing spondylitis
056.	Hashimoto's thyroiditis
057.	Chronic obstructive pulmonary disease (COPD) in the "moderate," "severe," and "very severe" clinical stages
061.	Chronic kidney disease
RM0120	Systemic sclerosis
RG0080	Giant cell arteritis
RFG101	Myasthenia gravis
RDG020	Hereditary coagulation disorders
037.731.0	Paget's disease
0C02.444	Circulatory system disorders (excluding Budd-Chiari syndrome).
RHG010	Idiopathic pulmonary fibrosis
RCG100	Familial hemochromatosis
RF0100	Amyotrophic lateral sclerosis
RDG031	Chronic immune thrombocytopenic purpura
RDG010	Hereditary anemias
RCG130	Systemic amyloidosis
L01	Workers with a civil disability rating between 80% and 100%.
RF0170	Progressive supranuclear palsy
RF0080	Huntington's disease
RFG070	Congenital hereditary myopathies
RG0090	Takayasu's arteritis
RF0110	Primary lateral sclerosis
018.277.0	Cystic fibrosis
RCG110	Porphyria
0C02.447.6	Unspecified arteritis
RGG010	Thrombotic thrombocytopenic purpura
RG0030	Polyarteritis nodosa
0C02.453	Thrombophilia
E01-E05 E30 E40	Exemptions are based on income and chronic disease.

Supplementary Table S4

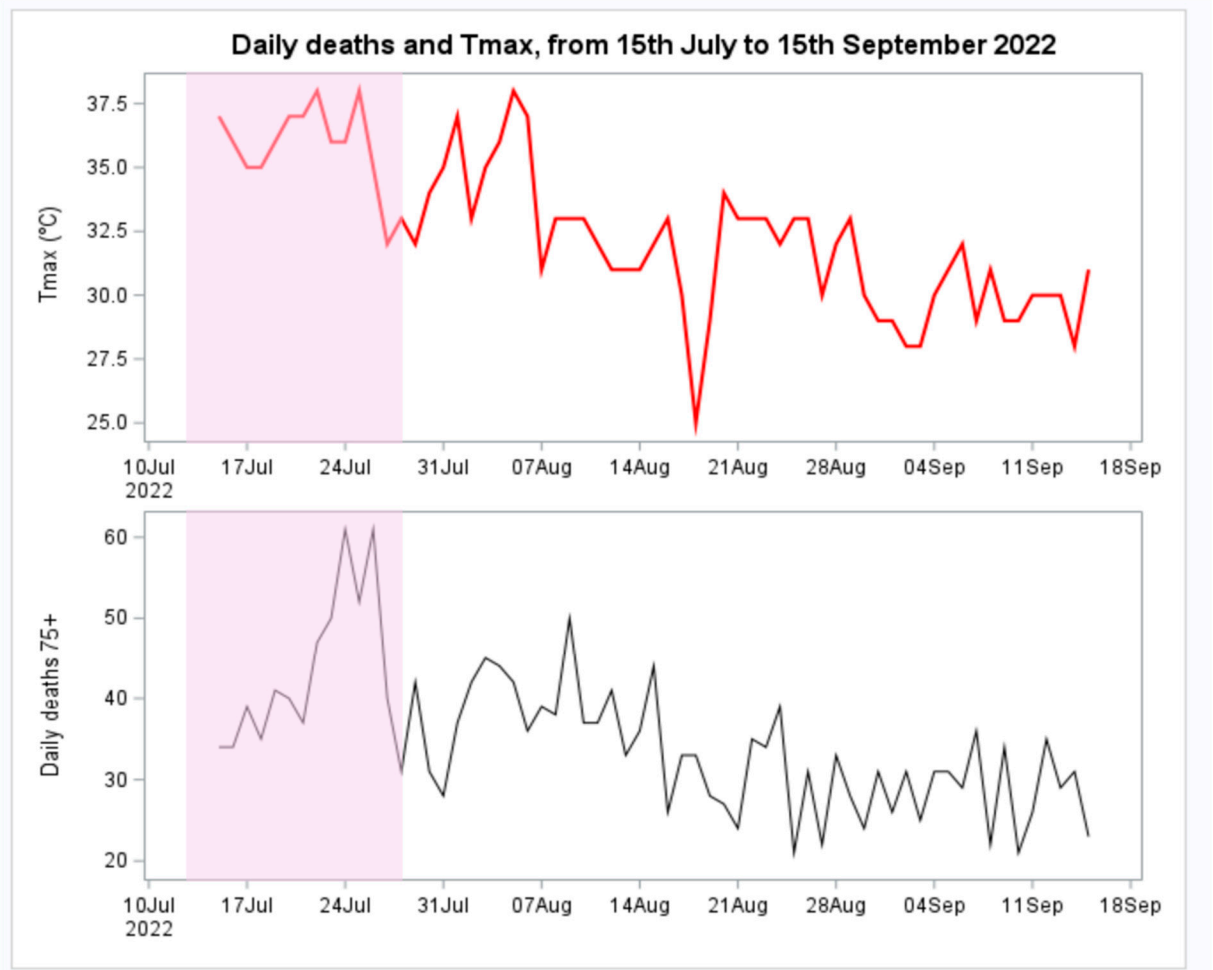
Social and healthcare flows

In the social and healthcare flows associated with the cohort starting from 1st January of the previous year before this analysis, subjects linked to the following centres are considered:

Table S4	
CDI	Integrated Day Centres (IDCs) for the elderly
CDD	Integrated Day Centres (IDCs) for people with disabilities
CSS	Health and Social Care Community
RSA	Residential Care Home for the Elderly
RIA	Outpatient rehabilitation, formerly Article 26
HOS	Hospice
RSD	Residential Care Homes for People with Disabilities
INT	Intermediate Care
ADI/ADP	Local authorities and general practitioners schedule Integrated Home Care.
CPd	Home palliative care
CPs	Semi-residential palliative care

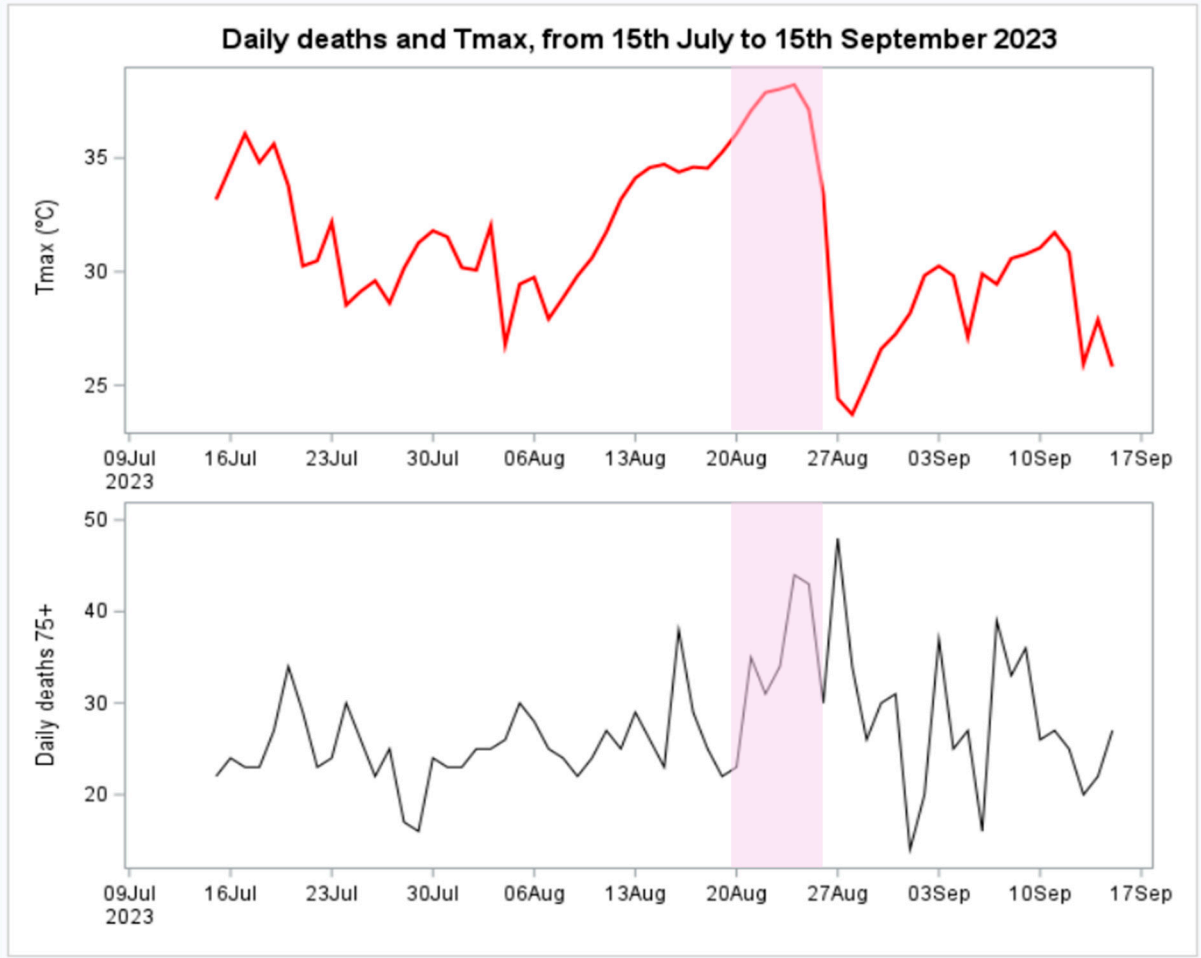
Supplementary Figure S1.

Daily maximum temperature (Tmax) and daily deaths among individuals aged ≥75 years in Milan, 15 July–15 September 2022, in the Development Cohort. The pink shaded area indicates the heatwave period (15–25 July), as defined by the National Heat-Health warning system.



Supplementary Figure S2.

Daily maximum temperature (Tmax) and daily deaths among individuals aged ≥75 years in Milan, 15 July–15 September 2023, in the Externa Validation Cohort. The pink shaded area indicates the heatwave period (20–25 August), as defined by the National Heat-Health warning system.



Supplementary Figure S3. Flow chart Development Cohort, 2022 (n=192 063) and External Validation Cohort, 2023 (n=181 509)



Supplementary Table S5

Table S5. Full risk profiles across four risk strata in the Development Cohort, 2022.

Characteristic	Predictive Algorithm for heat-related deaths, n (%)								
	Development Cohort, 2022 (n=192 063)								
	Baseline Risk		Intermediate Risk		High Risk		Very High Risk		Deaths from all causes*
	N (%)	% deaths	N (%)	% deaths	N (%)	% deaths	N (%)	% deaths	
Gender									
Female	20 376 (61.94)	0.46	32 808 (63.74)	1.04	38 719 (58.66)	1.19	26 996 (64.76)	1.45	1 286 (1.08)
Male	12 520 (38.06)	0.41	18 666 (36.26)	1.07	27 289 (41.34)	1.15	14 689 (35.24)	2.40	917 (1.25)
Age									
75-84	22 026 (66.96)	0.18	33 327 (64.75)	0.43	42 917 (65.02)	0.55	24 663 (59.17)	1.03	675 (0.55)
≥85	10 870 (33.04)	0.97	18 147 (35.25)	2.20	23 091 (34.98)	2.32	17 022 (40.83)	2.87	1 528 (2.21)
Ill	0	-	21 413 (41.60)	0.74	57 834 (87.62)	0.88	41 542 (99.66)	1.79	1 411 (1.17)
Treated	0	-	18 685 (36.30)	0.93	53 783 (81.48)	0.99	39 421 (94.57)	1.75	1 394 (1.25)
Deprived	0	-	12 149 (23.60)	0.37	7 856 (11.90)	1.21	24 904 (59.74)	1.02	395 (0.88)
Disabled	0	-	3 677 (7.14)	2.60	12 833 (19.44)	3.44	26 108 (62.63)	5.30	1 317 (3.09)
Chronic condition(s)									
0	21 744 (66.10)	0.32	11 279 (21.91)	0.83	2 806 (4.25)	1.02	903 (2.17)	0.97	242 (0.78)
1	8 256 (25.10)	0.48	19 023 (36.96)	0.96	13 203 (20.00)	1.06	5 660 (13.58)	1.25	388 (0.93)
2-3	2 677 (8.14)	1.05	17 389 (33.77)	1.21	30 924 (46.83)	1.34	17 803 (42.71)	1.44	790 (1.26)
3+	219 (0.67)	3.65	3 783 (7.35)	1.74	19 075 (28.90)	1.85	17 319 (41.55)	2.62	783 (2.46)
Lives alone									
Yes	11 125 (33.82)	0.67	21 015 (40.83)	1.14	25 248 (38.25)	1.32	19 000 (45.58)	1.66	962 (1.26)
No	21 771 (66.18)	0.33	30 459 (59.17)	0.99	40 760 (61.75)	1.08	22 685 (54.42)	1.89	1 241 (1.07)

* Daily deaths from all causes based on the International Classification of Diseases, 10th Revision (ICD-10; I00-I99)

Supplementary Table S6

Table S6. Full risk profiles across four risk strata in the External Validation Cohort, 2023.

Characteristic	Predictive Algorithm for heat-related deaths, n (%)								
	External Validation Cohort 2023 (n=181 509)								
	Baseline Risk		Intermediate Risk		High Risk		Very High Risk		Deaths from all causes*
	N (%)	% deaths	N (%)	% deaths	N (%)	% deaths	N (%)	% deaths	
Gender									
Female	16 302 (63.63)	0.34	30 457 (64.16)	0.84	37 921 (58.37)	1.02	28 020 (64.49)	1.07	994 (0.88)
Male	9 316 (36.37)	0.43	17 014 (35.84)	0.77	27 049 (41.63)	1.01	15 430 (35.51)	1.75	717 (1.04)
Age									
75-84	18 730 (73.11)	0.15	31 231 (65.79)	0.37	41 335 (63.62)	0.46	24 601 (56.62)	0.79	529 (0.46)
≥85	6 888 (26.89)	0.97	16 240 (34.21)	1.67	23 635 (36.38)	1.98	18 849 (43.38)	1.99	1 182 (1.80)
Ill	0	-	21 818 (45.96)	0.62	58 103 (89.43)	0.80	43 278 (99.60)	1.31	1 168 (0.95)
Treated	0	-	15 578 (32.82)	0.60	51 307 (78.97)	0.78	40 679 (93.62)	1.32	1 032 (0.96)
Deprived	0	-	10 375 (21.86)	0.23	7 838 (12.06)	1.16	25 516 (58.72)	1.78	314 (0.72)
Disabled	0	-	3 553 (7.48)	4.02	12 817 (19.73)	3.06	28 311 (65.16)	1.79	1 042 (2.33)
Chronic condition(s)									
0	16 086 (62.79)	0.22	9 644 (20.32)	0.59	2 803 (4.31)	0.88	912 (2.10)	0.56	162 (0.56)
1	6 998 (27.32)	0.50	17 757 (37.41)	0.86	12 610(19.41)	0.92	5 570 (12.82)	0.99	281 (0.81)
2-3	2 381 (9.29)	0.88	16 720 (35.22)	0.87	30 549 (47.02)	1.21	18 582 (42.77)	1.02	634 (0.99)
3+	153 (0.60)	2.61	3 350(7.06)	1.67	19 008 (29.26)	1.23	18 386 (42.32)	1.85	634 (1.84)
Lives alone									
Yes	11 133 (43.46)	0.46	20 582 (43.36)	1.89	25 128 (38.68)	1.05	19 999 (46.03)	1.36	713 (0.93)
No	14 485 (56.54)	0.30	26 889 (56.64)	0.72	39 842 (61.32)	1.00	23 451 (53.97)	1.26	998 (0.95)

* Daily deaths from all causes based on the International Classification of Diseases, 10th Revision (ICD-10; I00-I99)

Supplementary Table S7

Preliminary analysis of sample means and variances in the Development Cohort, 2022.

Table S7. Preliminary analysis of sample means and variances on Development Cohort, 2022 (n=192 063).

Risks Strata	Variabile	Average
1. Baseline	Mean	0.00
	Variance	0.00
2. Intermediate	Mean	0.01
	Variance	0.01
3. High	Mean	0.01
	Variance	0.01
4. Very High	Mean	0.02
	Variance	0.02

Supplementary Table S8

Preliminary analysis of sample means and variances in the External Validation Cohort, 2023.

Table S8. Preliminary analysis of sample means and variances on External Validation Cohort 2023 (n=181 509).

Risks Strata	Variabile	Average
1. Baseline	Mean	0.00
	Variance	0.00
2. Intermediate	Mean	0.01
	Variance	0.01
3. High	Mean	0.01
	Variance	0.01
4. Very High	Mean	0.01
	Variance	0.01

Supplementary Table S9

Table S9. Mortality rates and rate ratios for the 2022 and 2023 cohorts during the overall period (15 July–15 September), heatwave days, and the remaining non-heatwave period

Cohort and population at risk							Estimate set *		Estimate set #	
Cohort	**Thermal period**	**Days**	**Risk stratum**	**Subjects at start**	**Deaths**	**Person-days at risk**	**Mortality rate per 10,000 person-days (95% CI)**	**Rate ratio vs baseline* (95% CI)**	**Mortality rate per 10,000 person-days (95% CI)**	**Rate ratio vs baseline# (95% CI)**
2022	All period	15 July - 15 Sep 2022	Baseline	32896	145	5638,28	257(179–369)	Ref	284 (198–407)	Ref
2022	All period	15 July - 15 Sep 2022	Intermediate	51474	542	8813,37	615 (510–741)	2.39 (1.59–3.59)	664 (551–804)	2.31 (1.92–2.77)
2022	All period	15 July - 15 Sep 2022	High	66008	772	11310,07	683 (584–798)	2.65 (1.79–3.93)	739 (631–866)	2.54 (2.13–3.03)
2022	All period	15 July - 15 Sep 2022	Very high	41685	744	7122,80	1044 (891–1225)	4.06 (2.73–6.03)	1062 (902–1250)	3.63 (3.04–4.35)
2022	Heatwave	15–25 July	Baseline	32896	22	1076,38	204 (100–416)	Ref	225 (111–456)	Ref
2022	Heatwave	15–25 July	Intermediate	51474	141	1686,74	836 (631–1107)	4.09 (1.91–8.78)	900 (677–1197)	4.01 (1.88–8.55)
2022	Heatwave	15–25 July	High	66008	159	2165,72	734 (563–656)	3.59 (1.74–7.42)	792 (606–1035)	3.53 (1.66–7.47)
2022	Heatwave	15–25 July	Very high	41685	148	1367,20	1183 (823–1424)	5.30 (2.47–11.34)	1095 (827–1449)	4.88 (2.29–10.38)
2022	Non-heatwave	Remaining study days	Baseline	32874	123	4565,33	252 (167–380)	Ref	278 (184–418)	Ref
2022	Non-heatwave	Remaining study days	Intermediate	51333	401	7149,17	543 (434–679)	2.15 (1.35–3.43)	588 (470–736)	2.12 (1.33–3.36)
2022	Non-heatwave	Remaining study days	High	65849	613	9158,79	650 (542–778)	2.58 (1.65–4.03)	703 (586–844)	2.53 (1.63–3.95)
2022	Non-heatwave	Remaining study days	Very high	41537	596	5768,97	1001 (833–1202)	3.97 (2.54–6.22)	1018 (844–1229)	3.67 (2.35–5.73)

2023	All period	15 July - 15 Sep 2023	Baseline	25618	95	4393,59	216 (141–330)	Ref	267 (176–405)	Ref
2023	All period	15 July - 15 Sep 2023	Intermediate	47471	387	8076,64	477 (387–589)	2.21 (1.38–3.55)	528 (428–651)	1.97 (1.57–2.46)
2023	All period	15 July - 15 Sep 2023	High	64970	660	11041,95	596 (508–700)	2.76 (1.75–4.34)	629 (534–739)	2.33 (1.88–2.89)
2023	All period	15 July - 15 Sep 2023	Very high	43450	569	7363,31	770 (648–916)	3.57 (2.26–5.64)	756 (633–902)	2.82 (2.26–3.50)
2023	Heatwave	20–25 August 2023	Baseline	25570	11	418,75	263 (109–629)	Ref	315 (131–756)	
2023	Heatwave	20–25 August 2023	Intermediate	47258	45	770,60	584 (379–899)	2.22 (0.84–5.89)	611 (392–952)	1.94 (0.73–5.13)
2023	Heatwave	20–25 August 2023	High	64626	87	1053,45	826 (605–1127)	3.14 (1.24–7.94)	829 (597–1150)	2.63 (1.04–6.65)
2023	Heatwave	20–25 August 2023	Very high	43147	67	702,45	954 (670–1359)	3.63 (1.42–9.32)	857 (588–1251)	2.72 (1.06–6.99)
2023	Non-heatwave	Remaining study days	Baseline	25618	84	3977,77	211 (78–580)	Ref	315 (131–756)	Ref
2023	Non-heatwave	Remaining study days	Intermediate	47471	342	7321,17	467 (283–771)	2.21 (0.72–6.83)	611 (392–951)	1.98 (0.65–6.05)
2023	Non-heatwave	Remaining study days	High	64970	573	10008,56	573 (389–843)	2.71 (0.92–8.00)	829 (597–1150)	2.32 (0.79–6.76)
2023	Non-heatwave	Remaining study days	Very high	43450	502	6673,49	752 (498–1137)	3.56 (1.20–10.62)	857 (588–1251)	2.85 (0.97–8.40)

* not adjusted
# adjusted for sex, age class and living alone

Heatwave days were defined according to the National Heat-Health Warning System. Mortality rates were calculated as deaths per 10,000 person-days at risk. This analysis was descriptive and was not used for model fitting

Supplementary Figure S4.

Calibration plot of the multivariable logistic regression model predicting heat-mortality risk, in the Development Cohort (A) and in the External Validation Cohort (B).

