조사/감시 보고
eISSN 2586-0860
https://doi.org/10.56786/PHWR.2026.19.2.2

PHWR Public Health Weekly Report

경북권 한랭질환 발생 특성, 2019–2025년

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초 록

목적: 본 연구는 기후변화에 따른 건강 영향 중 겨울철 한랭질환 발생 양상을 분석하고, 대구·경북 지역의 특성을 중심으로 지역사회 기반 예방 전략 마련을 위한 기초자료를 제공하는 데 목적이 있다.

방법: 질병관리청의 「한랭질환 응급실감시체계」 자료 중 2019–2020절기부터 2024–2025절기까지의 6개 절기 겨울철 데이터를 활용하였다. 발생 지역을 기준으로 대구·경북 지역의 환자 규모, 인구 10만 명당 신고 건수, 시간대, 발생 장소, 질환 종류, 진료 결과 등을 분석하였으며, 전국 자료와 비교하여 지역적 특성을 파악하였다.

결과: 6개 절기 동안 전국 한랭질환자는 총 2,217명이었으며, 대구는 43명(10만 명당 0.30명), 경북은 223명(10만 명당 1.43명)으로 나타났다. 한랭질환은 주로 오전 6–9시 사이, 실외에서 발생하였고 고령층에서 인구 10만 명당 신고 건수가 현저히 높았다. 특히 경북의 90세 이상 연령군에서는 10만 명당 17.54명의 환자가 신고되었다. 전체 환자의 75.8%는 저체온증이었고, 2.3%는 사망하였다.

결론: 온난화에도 불구하고 겨울철 한파로 인한 한랭질환 발생은 지속되고 있으며, 고령층에서 건강 피해가 집중되고 있다. 지역별 위험요인을 반영한 맞춤형 대응과 예방 중심의 감시체계 운영이 요구된다.

주요 검색어: 한랭질환; 경북권; 저체온증; 한파

서 론

한반도 100년의 기후변화와 관련한 2018년 국립기상과학원의 연구보고서에 따르면 최근 30년 기온은 20세기 초(1912–1941년)보다 1.4℃ 상승하였고, 여름은 98일에서 117일로 19일 길어지고 겨울은 109일에서 91일로 짧아졌다고 보고하고 있다[1]. 특히나 2024년이 우리나라 113년의 관측 기간 중 가장 더운 해로 공식적인 인정을 받았으며[2], 온열질환자 수도 3,704명으로 2011년에 감시체계가 운영된 이후 두 번째로 높은 수준이었다[3]. 일반 국민에게도 온난화가 체감되면서 이에 따른 여러 영역의 피해에 대한 관심도 높아지고 있다. 농업 부문에서는 생육온도일수가 증가하고 냉·난방 실시가 필요한 기간이 달라질 수 있고, 호우 총량과 건조강도의 증가 등도 전망된다[4]. 건강 부문에도 영향이 예상되는데, 날씨에 따른 스트레스의 증가, 열사병 발생 위험지수의 상승 등이 대표적이다[4].

Received October 16, 2025 Revised November 18, 2025 Accepted December 2, 2025
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핵심요약

① 이전에 알려진 내용은?

폭염과 한파 등 기후에 의한 건강 폐해를 최소화하기 위해 질병관리청은 온열질환과 한랭질환의 발생 현황에 대한 감시체계를 운영하고 있다.

② 새로이 알게 된 내용은?

온난화 영향으로 매년 온열질환자는 증가하고 있지만 한랭질환자가 감소했다고 보기는 어려우며, 발생 규모로는 온열질환에 비해 한랭질환으로 인한 환자가 적은 편이나 상대적인 사망 비율이 높고 입원 등 후속 진료를 필요로 하는 경우가 더 많다.

③ 시사점은?

온난화에도 불구하고 겨울철 한파로 인한 한랭질환 발생은 지속되고 있어 지역사회를 중심으로 한파로 인한 건강 폐해를 예방하기 위한 전략 마련이 필요하다.

연 평균기온이 전반적으로 상승하고 여름철이 길어지면서 폭염일수, 열대야일수 증가도 관찰되고 있는데 겨울철 극한기후현상은 감소한 지표도 있지만 증가한 지표도 있었다. 1998년부터 2017년까지의 한랭일수, 한랭야일수, 결빙일수, 서리일수 등과 2008-2017년 사이 결과를 비교하면 모두 다소 증가한 것으로 관측되었다[1]. 또한, 최근 50년간의 겨울철 평균기온, 평균최저기온 등의 변화를 볼 때 겨울철 기온도 상승하는 방향으로 진행되고 있지만 짧은 기간 동안 발생하는 기습적인 강한 한파는 여전히 존재하고 있다. 직전의 겨울인 2024년 12월부터 2025년 2월까지의 전국 평균기온은 0.4℃로 평년과 비슷한 수준이었지만, 2월에는 평균기온이 -0.5℃로 최근 10년 중 가장 낮았고 일주일 이상 지속된 추위도 두 차례 발생하였다[5]. 질병관리청은 폭염에 따른 건강 폐해 수준을 감시하는 것과 같은 방식으로 2013년 12월부터 겨울철 동안 한랭질환의 발생과 이와 관련된 사망자에 대한 응급실 기반의 감시체계를 운영해 왔다[6]. 감시기간은 매년 12월 1일부터 익년 2월 말일까지로 90일 동안이며, 평균적으로 400여 명의 환자가 발생한 것으로 보고되고 있다.

본 연구에서는 한랭질환 감시체계가 운영되는 시점에 맞춰 이전 연도의 한랭질환 발생 추이를 분석하고 경북권질병대응센터에서 관할하고 있는 대구, 경북 지역의 환자 발생 현황과 한랭질환자 및 관련 사망자 발생을 예방하는 데 필요한 기초자료를 마련하기 위해 실시되었다. 이를 토대로 지방자치단체와 지역 내 관계기관과 문제 인식을 공유하고 개선 목표, 중점 관심 대상, 관리 방법 설정 등에 참고하고자 한다.

방 법

1. 분석 자료원

본 연구에서는 질병관리청「한랭질환 응급실감시체계」를 통해 신고·보고된 원자료를 제공받아 분석하였다. 응급실을 통한 한랭질환에 대한 감시체계는 2013년부터 운영됐으나 2019년 2월까지의 자료에서는 신고 기준으로만 지역을 구분할 수 있기 때문에 발생 지역을 기준으로 시·도별 분석을 할 수 있도록 2019년 12월 이후의 자료만 이용해서 분석하였다. 한 해의 겨울이 12월에 시작하여 다음 해 2월까지 이어지므로 연도 개념은 절기라는 표현을 사용하여 구분하였다. 즉, 2019년 12월 1일부터 2020년 2월까지의 한 해 겨울은 2019-2020절기라고 표시하였다. 2019-2020절기부터 포함하여 2024-2025절기까지 6개 겨울철 자료를 활용하였다.

본 신고체계에서의 한랭질환은 저체온증, 동상, 동창, 침수병, 침족병 등을 포함하는 것으로, 보충 표 1 (available online)과 같이 정리할 수 있다.

2. 분석 방법

발생 규모의 변화는 절기별로 분리하여 분석하였으나 대구, 경북 등 시·도별 환자 규모가 작아 발생 시간, 장소, 진료결과, 질환 등에 따른 분석은 6개 절기를 통합하여 분석하였다. 자료에서 제공하고 있는 지역 정보는 총 3가지로 한랭질

환이 발생한 지역, 환자의 거주 지역, 그리고 신고 지역 등이었다. 본 연구에서는 발생 지역을 기준으로 분석하였으며 인구 10만 명당 신고 건수 산출에는 각 절기의 12월 주민등록인구 정보를 활용하여 분석하였다.

결 과

2019–2020절기 이후 2024–2025절기까지 6개 절기 중 발생한 한랭질환자 수는 전국적으로 총 2,217명이었으며 평균적으로 절기 당 369.5명(최소 300명, 최대 447명)이었다(표 1). 한랭질환 감시체계를 운영하는 3개월 중에 절기와 상관없이 2월 환자가 가장 적었고, 12월과 1월에 발생하는 환자가 상대적으로 많았다. 대구의 한랭질환자 수는 6개 절기 모두 합해 43명으로 절기 당 평균 7.2명이었으며(최소 4명, 최대 12명), 경북은 총 223명으로 절기 당 평균은 37.2명(최소 22명, 최대 44명)이었다.

6개 절기를 통합하여 분석해 보면, 전국적으로 인구 10만 명당 신고 건수는 0.72명이었으며 남자가 0.99명, 여자가 0.44명으로 남자의 신고 건수가 높았다(표 2). 연령별로는 10세 미만을 제외하면 30대에서 가장 낮았고, 고령일수록 높아

표 1. 대구 및 경북 한랭질환 신고 건수(2019–2025절기)

지역·월	2019–2020	2020–2021	2021–2022	2022–2023	2023–2024	2024–2025	6개년 합계
전국							
전체	303	433	300	447	400	334	2,217
	(0.58)[a]	(0.84)	(0.58)	(0.87)	(0.78)	(0.65)	(0.72)
12월	127	141	112	177	163	114	834
	(0.25)	(0.27)	(0.22)	(0.34)	(0.32)	(0.22)	(0.27)
1월	96	236	109	199	149	122	911
	(0.19)	(0.46)	(0.21)	(0.39)	(0.29)	(0.24)	(0.29)
2월	80	56	79	71	88	98	472
	(0.15)	(0.11)	(0.15)	(0.14)	(0.17)	(0.19)	(0.15)
대구							
전체	6	5	12	8	8	4	43
	(0.25)	(0.21)	(0.50)	(0.34)	(0.34)	(0.17)	(0.30)
12월	4	2	4	4	4	-	18
	(0.17)	(0.08)	(0.17)	(0.17)	(0.17)	-	(0.13)
1월	2	3	5	2	2	2	16
	(0.08)	(0.12)	(0.21)	(0.08)	(0.08)	(0.08)	(0.11)
2월	-	-	3	2	2	2	9
	-	-	(0.13)	(0.08)	(0.08)	(0.08)	(0.06)
경북							
전체	22	41	43	34	44	39	223
	(0.83)	(1.55)	(1.64)	(1.31)	(1.72)	(1.54)	(1.43)
12월	11	18	12	14	15	15	85
	(0.42)	(0.68)	(0.46)	(0.54)	(0.59)	(0.59)	(0.55)
1월	5	17	22	15	15	18	92
	(0.19)	(0.64)	(0.84)	(0.58)	(0.59)	(0.71)	(0.59)
2월	6	6	9	5	14	6	46
	(0.23)	(0.23)	(0.34)	(0.19)	(0.55)	(0.24)	(0.30)

단위: 명, 인구 10만 명당 명. [a]괄호 안의 값은 인구 10만 명당 신고 건수임.

표 2. 대구 및 경북 발생 한랭질환자의 연령별 분포(2019–2025절기 통합)

발생 시·도	전국			대구			경북		
	전체	남자	여자	전체	남자	여자	전체	남자	여자
전체	2,217	1,527	690	43	34	9	223	136	87
	(0.72)[a)]	(0.99)	(0.44)	(0.30)	(0.48)	(0.12)	(1.43)	(1.73)	(1.13)
0–9세	24	17	7	-	-	-	-	-	-
	(0.11)	(0.15)	(0.07)	-	-	-	-	-	-
10–19세	117	92	25	4	3	1	9	8	1
	(0.41)	(0.63)	(0.18)	(0.30)	(0.44)	(0.16)	(0.68)	(1.15)	(0.16)
20–29세	177	138	39	1	1	-	11	10	1
	(0.46)	(0.68)	(0.21)	(0.06)	(0.10)	-	(0.69)	(1.11)	(0.15)
30–39세	134	103	31	1	1	-	5	3	2
	(0.33)	(0.49)	(0.16)	(0.06)	(0.11)	-	(0.30)	(0.34)	(0.26)
40–49세	175	131	44	5	3	2	18	12	6
	(0.36)	(0.53)	(0.18)	(0.23)	(0.28)	(0.18)	(0.81)	(1.04)	(0.57)
50–59세	343	282	61	9	9	-	41	35	6
	(0.66)	(1.08)	(0.24)	(0.36)	(0.73)	-	(1.51)	(2.49)	(0.46)
60–69세	392	326	66	7	6	1	38	28	10
	(0.90)	(1.53)	(0.30)	(0.34)	(0.60)	(0.09)	(1.46)	(2.15)	(0.77)
70–79세	302	188	114	8	6	2	27	17	10
	(1.31)	(1.79)	(0.91)	(0.72)	(1.23)	(0.32)	(1.81)	(2.50)	(1.23)
80–89세	421	212	209	5	3	2	51	20	31
	(3.69)	(5.16)	(2.86)	(0.95)	(1.60)	(0.59)	(5.93)	(6.96)	(5.41)
90세 이상	132	38	94	3	2	1	23	3	20
	(7.53)	(9.55)	(6.93)	(4.37)	(12.89)	(1.88)	(17.54)	(11.07)	(19.23)

단위: 명, 인구 10만 명당 명. [a)]괄호 안의 값은 인구 10만 명당 신고 건수임.

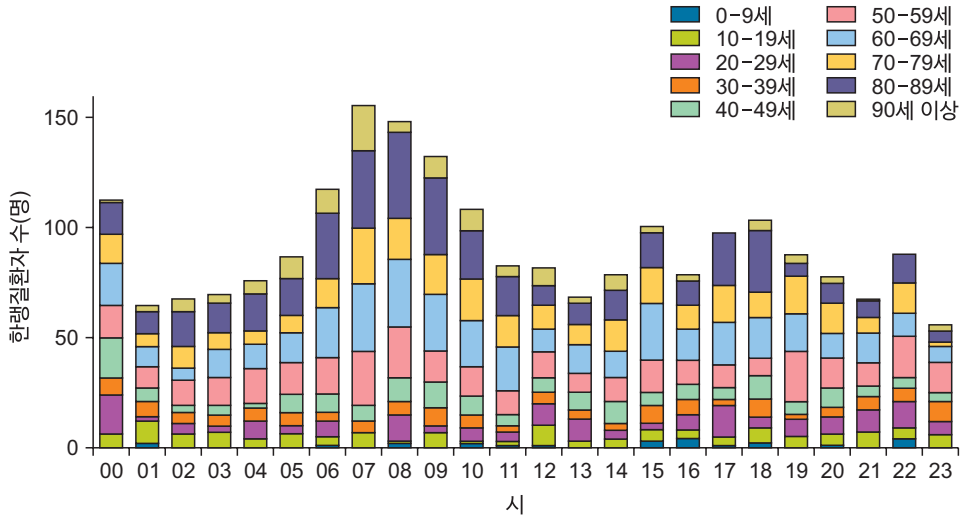

그림 1. 한랭질환 발생 시간별 환자 분포(2019–2025절기 통합)

표 3. 한랭질환 발생 시간별·장소별 환자 분포(2019–2025절기 통합)

구분	전국		대구		경북	
	환자 수(명)	분율(%)	환자 수(명)	분율(%)	환자 수(명)	분율(%)
전체	2,217	100.0	43	100.0	223	100.0
시간별						
00–03시	246	11.1	7	16.3	25	11.2
03–06시	233	10.5	6	14.0	24	10.8
06–09시	423	19.1	9	20.9	53	23.8
09–12시	325	14.7	7	16.3	32	14.3
12–15시	230	10.4	3	7.0	23	10.3
15–18시	278	12.5	1	2.3	23	10.3
18–21시	270	12.2	7	16.3	24	10.8
21–24시	212	9.6	3	7.0	19	8.5
장소별						
실내	489	22.1	13	30.2	50	22.4
집	348	15.7	9	20.9	43	19.3
실내 작업장	15	0.7	-	-	-	-
건물	76	3.4	3	7.0	5	2.2
실내 기타	50	2.3	1	2.3	2	0.9
실외	1,728	77.9	30	69.8	173	77.6
실외 작업장	90	4.1	-	-	6	2.7
논밭	65	2.9	1	2.3	11	4.9
운동장(공원)	39	1.8	-	-	2	0.9
주거지 주변	342	15.4	8	18.6	32	14.3
길가	571	25.8	14	32.6	45	20.2
강가, 해변	185	8.3	-	-	36	16.1
산	178	8.0	2	4.7	10	4.5
스케이트장	1	0.0	-	-	-	-
스키장	34	1.5	-	-	-	-
실외 기타	223	10.1	5	11.6	31	13.9

져 90세 이상에서 인구 10만 명당 7.53명이 한랭질환자로 신고되었다. 대구의 인구 10만 명당 신고 건수는 0.30명으로 전국에 비해 낮았으나 경북은 1.43명으로 전국의 2배 수준이었다. 경북에서도 고령군에서 많이 발생하는 경향을 보였으며, 80–89세 인구 10만 명당 5.93명이 환자로 신고되었고, 90세 이상 연령군에서는 17.54명 수준이었다.

전국적으로 한랭질환자가 가장 많이 발생한 시간은 오전 7시부터 8시 사이였고, 아침 시간대에 많이 발생하고 낮에는 상대적으로 감소하는 경향을 보였으며, 연령군에 따라 환자가 많이 발생하는 시간에 큰 차이는 없었다(그림 1). 대구와 경북에서 신고된 환자는 전국에 비해 숫자가 적기 때문에 3시간씩 묶어서 분석했는데 전국적으로도 오전 6시에서 9시 사이에 발생한 환자가 가장 많았으며(19.1%), 같은 시간대에 대구(20.9%)와 경북(23.8%)에서도 가장 많은 환자가 발생하였다(표 3). 장소로 구분할 때는 전국적으로 실외가 77.9%를 차지했으며 구체적인 장소 중에는 길가가 25.8%로 한랭질환이 가장 많이 발생하는 장소였고, 집(15.7%)과 주거지 주변(15.4%)도 비중이 높았다. 대구도 유사하게 길가에서 발생한 경우가 32.6%로 가장 높았고, 집(20.9%), 주거지 주변(18.6%) 순이었으며 경북도 이 세 장소에서 발생한 경우가 많

았는데, 강가와 해변에서 발생한 환자도 16.1%로 높은 편이었다.

질환의 종류에 따라서는 전국적으로 저체온증 환자가 75.8%로 가장 많았고, 그 다음이 표재성 동상이었다(보충 표 2; available online). 대구와 경북은 약 90%가 저체온증이었다. 진료 결과별로는 전국적으로 퇴원 또는 무단 퇴원 환자가 56.8%로 가장 많았으며, 입원 혹은 전원이 41.0%, 사망 환자가 6개 절기 동안 50명으로 2.3%였다(보충 표 3; available online). 대구에서는 46.5%의 환자가 퇴원하고, 53.5%의 환자가 입원 또는 전원으로 후속 진료를 받았으며 경북은 58.7%가 퇴원 또는 무단 퇴원하였고, 39.0%의 환자가 입원 또는 전원하였으며, 2.2%의 환자가 사망하였다.

결 론

한랭질환은 추위에 장시간 노출되어 발생하는 저체온증, 동상, 동창 등을 의미하며 질병관리청에서는 기후와 관련된 건강 피해로 판단하여 폭염에 의한 온열질환과 마찬가지로 한파에 의한 한랭질환에 대한 발생 현황을 감시해 오고 있다. 기후와 관련된 질환의 발생 현황을 감시하고 빠르게 공유하는 주요 이유는 신속한 정보 공유를 통해서 국민의 주의를 환기하고 예방 활동을 유도함으로써 건강 피해를 최소화하고자 하는 것이다. 온열질환의 경우 사망 환자는 2024년을 기준으로 전체 환자 중 1% 미만이고, 약 75%의 환자가 퇴원했다고 신고되었다[3]. 반면, 한랭질환으로 응급실에 내원한 환자 중 퇴원 환자는 60% 미만이고, 입원 또는 전원이 40%, 사망이 2% 가량이다. 환자 수로는 온열질환이 한랭질환의 15배 정도이며 절대적인 사망자도 온열질환이 더 많지만 한파로 인한 건강 피해도 간과할 수 없음을 나타내는 결과라고 할 수 있다.

전국 17개 시·도별 인구 10만 명당 신고 건수를 비교해 보면 상대적으로 도 지역에서 높은 경향을 보이고, 시 지역이 낮은 편이다[6]. 이번 연구에서도 대구는 인구 10만 명당 신고 건수 면에서 전국보다 낮고 경북은 전국의 2배 수준이었는데, 도 지역 중에서도 강원 다음으로 높은 순위이다[6]. 경북의 월별 최저기온은 전국 평균과 비교했을 때 특별히 낮은 편은 아니지만 고령 인구가 많다는 특성이 있다. 2024년 주민등록인구를 기준으로 70세 이상 인구 분율은 전국이 12.9%, 대구가 13.5%였으며, 경북은 17.4%였다[7]. 연령군 중 80대에서 한랭질환자가 가장 많았고, 인구 10만 명당 신고 건수도 고령군으로 갈수록 가파르게 상승하는 경향을 보였다. 추위 외에도 적절한 실내 온도 유지, 방한·방수용품의 활용, 야외 활동 자제 등 한랭질환의 발생 위험과 관련된 여러 요인이 있기 때문에 기온만으로 위험지역을 판단하는 데는 한계가 있다. 소득수준, 고령과 기저질환, 음주 등도 한랭질환 위험을 높이는 주요 요인인데[8], 연령은 비교적 정확히 확인할 수 있지만 응급실에서 음주 상태나 기저질환은 환자의 의식 상태, 협조 수준 등에 따라 조사가 불가한 경우가 많기 때문에 응답 결과가 있는 환자만의 결과로 전체 결과처럼 해석하는 데는 주의가 필요하다.

발생 시간은 오전 6시부터 9시 사이에 가장 많은 환자가 발생하였고 상대적으로 오후보다 오전 시간에 발생한 환자가 많았는데, 시간상 기온이 낮은 시간이기도 하고 발생 시간이 추위에 노출된 시간을 의미하는 게 아님을 고려하면 밤새 장시간 추위에 노출된 환자가 오전에 발견된 경우도 포함되었을 것으로 보인다. 발생 장소는 실외로 구분했을 때 온열질환과 마찬가지로 실외에서의 발생 빈도가 높았지만 집에서 발생한 환자도 15.7%로 높은 순위를 차지하였다. 국토연구원에서 발표한 2023년 4-6월 모빌리티 빅데이터(20-60대의 스마트폰 앱을 활용하여 구축) 분석 결과에서 집 밖에서 보내는 시간을 24시간 중 10.3시간으로 보고하고 있으며[9], 이는 집에서 머무는 시간이 절대적으로 길다는 의미를 반영하고 있다고도 할 수 있다.

온난화에 대한 체감도가 높아지고 온열질환자에 비해 한랭질환자의 발생 규모가 작아 상대적으로 한랭질환에 대한 관

심이 낮을 수 있지만 앞서 언급한 바와 같이 한랭질환에 따른 중증도를 고려할 때 한랭질환 예방 및 관리를 위한 조치도 소홀할 수 없을 것으로 보인다. 특히 전지구적으로 평균 기온이 상승하고 폭염일수가 증가함에도 불구하고 극한 한파가 여전히 발생하고 있고 한랭질환자의 뚜렷한 감소가 확인된 것이 아니므로 추위에 따른 건강 피해에 대해서도 지속적인 관심이 필요할 것이다. 온열질환은 가장 더운 시간이 활동이 많은 시간이므로 마을회관 등에 냉방비 지원 등으로 공동의 더위 피난처를 운영할 수 있지만 한랭질환은 각자 집에 머무는 시간이 가장 많은 환자가 발생하는 시간이므로 공동시설을 통한 대처가 어렵다는 점이 고려되어야 할 것이다. 특히, 전국적인 수준에 비해 경북에서는 집에서 많은 환자가 발생하고 있다는 점을 고려한다면 실내에서 적절한 난방을 할 수 있도록 홍보하고 난방비 지출이 어려운 가정에 대한 효율적인 지원 대책이 검토될 필요가 있겠다.

Declarations

Ethics Statement: Not applicable.

Funding Source: None.

Acknowledgments: None.

Conflict of Interest: The authors have no conflicts of interest to declare.

Author Contributions: Data curation: SHK. Formal analysis: SHK. Writing – original draft: YMS. Writing – review & editing: YMS, SHK.

Supplementary Materials

Supplementary data are available online.

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Surveillance Report

Reported Cases of Cold-related Illnesses in Daegu and Gyeongbuk, Republic of Korea, 2019–2025

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ABSTRACT

Objectives: We assessed the impacts of climate change on cold-related illness occurrence patterns during winter to provide foundational data for developing community-based prevention strategies, focusing on the Daegu and Gyeongbuk regions.

Methods: Data from the Cold-Related Illness Emergency Department Surveillance System of the Korea Disease Control and Prevention Agency spanning six winter seasons (2019–2020 to 2024–2025) were analyzed. Number of patients, cases per 100,000 people, time of onset, place of occurrence, type of occurrence, and clinical outcomes were examined within the Daegu and Gyeongbuk regions for patterns related to region of occurrence, and compared with nationwide data to identify regional characteristics.

Results: During the six assessed winter seasons, 2,217 cold-related illnesses were reported nationwide. Daegu reported 43 cases (0.30 per 100,000 population) and Gyeongbuk reported 223 cases (1.43 per 100,000 population). Most cases occurred outdoors, between 6:00 and 9:00 a.m., with number of cases per 100,000 individuals being markedly higher among older adults. In particular, reported cases among the ≥90-year age group in Gyeongbuk was 17.54 per 100,000 population. Hypothermia accounted for 75.8% of all cases and the mortality rate was 2.3%.

Conclusions: Despite global warming, cold-related illnesses during winter cold waves continue to occur, with health impacts concentrated among the elderly population. Region-specific risk factors should be reflected in tailored response measures, and prevention-oriented surveillance systems need to be strengthened.

Key words: Cold-related illness; Gyeongbuk region; Hypothermia; Cold wave

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Introduction

According to a report in 2018 by the National Institute of Meteorological Research on 100 years of climate change on the Korean Peninsula, temperatures have increased by 1.4°C over the past 30 years compared with those in the early 20th century (1912–1941). The length of the summer season has increased by 19 days from 98 to 117 days, whereas that of the winter season has decreased from 109 to 91 days [1]. 2024 was officially recognized as the hottest year in the 113-year

Key messages

① What is known previously?

To minimize the health impacts associated with extreme weather events such as heat waves and cold spells, the Korea Disease Control and Prevention Agency operates surveillance systems that monitor the occurrence of heat- and cold-related illnesses.

② What new information is presented?

Although the number of heat-related illnesses has been increasing annually owing to global warming, it is difficult to conclude that the number of cold-related illnesses has decreased. Compared to heat-related illnesses, cold-related occur less frequently but show a relatively higher mortality rate and a greater need for hospitalization and subsequent medical care.

③ What are implications?

Despite global warming, the occurrence of cold-related illnesses during winter cold spells persists, highlighting the need to develop community-based preventive strategies to mitigate these health risks.

observation history of the Republic of Korea [2], and the number of patients with heat-related illnesses reached 3,704, the second-highest level since the inception of the surveillance system in 2011 [3]. As global warming becomes a more prominent issue in public discourse, concerns regarding its deleterious consequences across various sectors are mounting. The agricultural sector anticipates an augmentation in the number of growing degree days, a modification in the period requiring heating and cooling, and an escalation in both total rainfall and drought intensity [4]. Moreover, adverse effects on health are expected, with increased stress owing to weather and a rise in the heatstroke risk index being the most salient examples [4].

As average annual temperatures have generally increased and summers have lengthened, an increase in the number of days with extreme heat and tropical nights has also been observed. Although certain indicators of extreme winter weather phenomena have decreased, others have increased. A comparison of cold days, cold night/days, freezing days, and frost days from 1998 to 2017 with those from 2008 to 2017 reveals that they have increased to some extent [1]. Furthermore, although winter temperatures have exhibited an upward trend over the past 50 years, as evidenced by changes in both the average winter and average minimum temperatures, sudden, intense cold snaps over brief periods continue to occur. The national average temperature from December 2024 to February 2025 was 0.4°C, which was comparable with the long-term average. However, in February, an average temperature of –0.5°C was observed, marking the lowest recorded temperature in the past decade. This was further compounded by two instances of cold snaps lasting more than a week [5]. The Korea Disease Control and Prevention Agency (KDCA) has operated an emergency room-based surveillance system for cold-related illnesses and associated deaths during the winter months since December 2013, emulating its approach to monitoring the level of health hazards caused by heatwaves [6]. The surveillance period spans a duration of 90 days and is conducted annually from December 1 to the end of February. During this period, approximately 400 patients are reported on average.

In this study, we aimed to analyze the trends in cold-related illness cases from 2019–2025, coinciding with the initiation of the cold-related illness surveillance system. This information is aimed at providing foundational data to facilitate the prevention of cold-related illnesses and deaths among patients and understanding the current status of patient occurrences in the Daegu and Gyeongbuk regions under the jurisdiction of

Table 1. Reported cases per 100,000 population of cold-related illness in Daegu and Gyeongbuk (2019–2025 season)

Cities and provinces/mo	2019–2020	2020–2021	2021–2022	2022–2023	2023–2024	2024–2025	Total of 6 seasons
Nationwide							
Total	303	433	300	447	400	334	2,217
	(0.58)[a]	(0.84)	(0.58)	(0.87)	(0.78)	(0.65)	(0.72)
December	127	141	112	177	163	114	834
	(0.25)	(0.27)	(0.22)	(0.34)	(0.32)	(0.22)	(0.27)
January	96	236	109	199	149	122	911
	(0.19)	(0.46)	(0.21)	(0.39)	(0.29)	(0.24)	(0.29)
February	80	56	79	71	88	98	472
	(0.15)	(0.11)	(0.15)	(0.14)	(0.17)	(0.19)	(0.15)
Daegu							
Total	6	5	12	8	8	4	43
	(0.25)	(0.21)	(0.50)	(0.34)	(0.34)	(0.17)	(0.30)
December	4	2	4	4	4	-	18
	(0.17)	(0.08)	(0.17)	(0.17)	(0.17)	-	(0.13)
January	2	3	5	2	2	2	16
	(0.08)	(0.12)	(0.21)	(0.08)	(0.08)	(0.08)	(0.11)
February	-	-	3	2	2	2	9
	-	-	(0.13)	(0.08)	(0.08)	(0.08)	(0.06)
Gyeongbuk							
Total	22	41	43	34	44	39	223
	(0.83)	(1.55)	(1.64)	(1.31)	(1.72)	(1.54)	(1.43)
December	11	18	12	14	15	15	85
	(0.42)	(0.68)	(0.46)	(0.54)	(0.59)	(0.59)	(0.55)
January	5	17	22	15	15	18	92
	(0.19)	(0.64)	(0.84)	(0.58)	(0.59)	(0.71)	(0.59)
February	6	6	9	5	14	6	46
	(0.23)	(0.23)	(0.34)	(0.19)	(0.55)	(0.24)	(0.30)

Values are presented as cases, cases per 100,000 population. [a]Values in parentheses are reported cases per 100,000 population.

the Gyeongbuk Regional Disease Response Center. Overall, we aim to share awareness of the problem with local governments and relevant agencies within the region. Moreover, this study can serve as a point of reference for establishing goals for improvement, key areas of focus, and management methods.

Methods

1. Data Source

In this study, we utilized the raw data provided by the KDCA's Cold-Related Illness Emergency Department Surveillance System, focusing specifically on cases of cold-related illnesses. The surveillance system for cold-related illnesses through emergency rooms has been in operation since 2013. However, data up to February 2019 only provided regional

differentiation based on the reporting criteria. Consequently, the analysis was limited to data from December 2019 onward, enabling the execution of metropolitan city-/province-level analysis based on the location of occurrence. As winter extends from December to February of the subsequent year, the concept of a year was delineated through seasons. In particular, the winter season spanning from December 1, 2019 to February, 2020 was designated as the 2019–2020 season. Data from six winter seasons, including the 2019–2020 season through the 2024–2025 season, were used.

Cold-related illnesses in this reporting system include hypothermia, frostbite, chilblains, immersion foot, and frostnip, as summarized in Supplementary Table 1 (available online).

2. Analytical Methods

Changes in the outbreak scale were analyzed separately by season; however, owing to the limited number of patients per city or province, such as Daegu and Gyeongbuk, analyses based on the time of occurrence, location, treatment outcomes, and disease type were conducted by combining all six seasons. The data provided three types of regional information: areas where cold-related illnesses occurred, patients' residential regions, and reporting regions. In this study, we analyzed data based on the region of occurrence. The number of reported cases per 100,000 individuals was calculated using the resident registration population data for December in each season for analysis.

Table 2. Age distribution of patients with cold-related illness in Daegu and Gyeongbuk (merge of 2019–2025 season)

Cities and provinces	Nationwide			Daegu			Gyeongbuk		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total	2,217	1,527	690	43	34	9	223	136	87
	(0.72)[a]	(0.99)	(0.44)	(0.30)	(0.48)	(0.12)	(1.43)	(1.73)	(1.13)
0–9 yr	24	17	7	-	-	-	-	-	-
	(0.11)	(0.15)	(0.07)	-	-	-	-	-	-
10–19 yr	117	92	25	4	3	1	9	8	1
	(0.41)	(0.63)	(0.18)	(0.30)	(0.44)	(0.16)	(0.68)	(1.15)	(0.16)
20–29 yr	177	138	39	1	1	-	11	10	1
	(0.46)	(0.68)	(0.21)	(0.06)	(0.10)	-	(0.69)	(1.11)	(0.15)
30–39 yr	134	103	31	1	1	-	5	3	2
	(0.33)	(0.49)	(0.16)	(0.06)	(0.11)	-	(0.30)	(0.34)	(0.26)
40–49 yr	175	131	44	5	3	2	18	12	6
	(0.36)	(0.53)	(0.18)	(0.23)	(0.28)	(0.18)	(0.81)	(1.04)	(0.57)
50–59 yr	343	282	61	9	9	-	41	35	6
	(0.66)	(1.08)	(0.24)	(0.36)	(0.73)	-	(1.51)	(2.49)	(0.46)
60–69 yr	392	326	66	7	6	1	38	28	10
	(0.90)	(1.53)	(0.30)	(0.34)	(0.60)	(0.09)	(1.46)	(2.15)	(0.77)
70–79 yr	302	188	114	8	6	2	27	17	10
	(1.31)	(1.79)	(0.91)	(0.72)	(1.23)	(0.32)	(1.81)	(2.50)	(1.23)
80–89 yr	421	212	209	5	3	2	51	20	31
	(3.69)	(5.16)	(2.86)	(0.95)	(1.60)	(0.59)	(5.93)	(6.96)	(5.41)
≥90 yr	132	38	94	3	2	1	23	3	20
	(7.53)	(9.55)	(6.93)	(4.37)	(12.89)	(1.88)	(17.54)	(11.07)	(19.23)

Values are presented as cases, cases per 100,000 population. [a]Values in parentheses are reported cases per 100,000 population.

Results

From the 2019–2020 through the 2024–2025 season, a total of 2,217 cases of cold-related illnesses occurred nationwide across six seasons, averaging 369.5 cases per season (minimum 300, maximum 447) (Table 1). During the 3-month period of operating the cold-related illness surveillance system, the lowest number of patients was observed in February, irrespective of the season, whereas comparatively higher numbers of patients were observed in December and January. The total number of patients with cold-related illnesses in Daegu was 43 across all six seasons, with an average of 7.2 per season (minimum 4, maximum 12). In Gyeongbuk, the total was 223, averaging 37.2 per season (minimum 22, maximum 44).

When all six seasons are analyzed together, the numbers of reported cases per 100,000 individuals nationwide were 0.72, with 0.99 and 0.44 cases for male and female, respectively, indicating a higher incidence among male than female (Table 2). The incidence was lowest among those in their thirties, excluding those under 10 years of age. The incidence increased with age, reaching a peak value of 7.53 cases per 100,000 individuals among those aged 90 years and above. The number of reported cases per 100,000 people in Daegu was 0.30, lower than the national average. Meanwhile, Gyeongbuk recorded 1.43 cases per 100,000 individuals, twice the national level. In Gyeongbuk, the incidence was also notably high in the older age groups, with 5.93 and 17.54 reported cases per 100,000 individuals aged 80–89 years and 90 years and older, respectively.

The highest incidence of cold-related illnesses on a nationwide scale occurred between 7:00 and 8:00 a.m., with the majority of cases occurring during morning. A decline in cases was observed as the day progressed. No noticeable difference was observed in the peak occurrence times across the various age groups (Figure 1). The numbers of patients reported in Daegu and Gyeongbuk were lower than the national total; therefore, they were grouped and analyzed in 3-hours intervals. On a national scale, the highest number of patients was recorded between 6:00 and 9:00 a.m. (19.1%), and the highest patient counts were concurrently observed in Daegu (20.9%) and Gyeongbuk (23.8%) during this time period (Table 3). Based on location, the outdoors accounted for 77.9% of cold-related

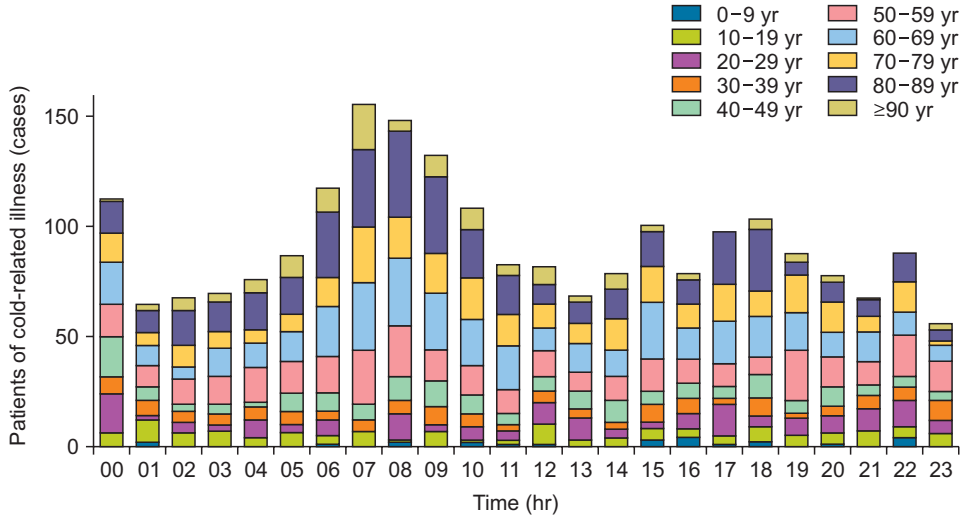

Figure 1. Distribution of patients with cold-related illness by time of onset (merge of 2019–2025 season)

illnesses nationwide. In particular, roadsides were the most common location for cold-related illnesses at 25.8%, followed by homes (15.7%) and residential areas (15.4%). A similar trend was observed in Daegu, where cases occurring on the roadside accounted for the highest proportion at 32.6%, followed by those at homes (20.9%) and residential areas (18.6%). Within Gyeongbuk, a high frequency of cases was observed in these three locations, whereas patients observed in proximity to rivers and beaches accounted for a relatively high percentage of 16.1%.

Based on the type of condition, hypothermia accounted for the highest percentage of patients nationwide at 75.8%, followed by superficial frostbite (Supplementary Table 2; available online). Approximately 90% of cases in Daegu and Gyeongbuk were hypothermia. With respect to the outcomes of treatment, nationally, the largest proportion was accounted for by patients discharged or those who left without authorization (56.8%), whereas those admitted or transferred constituted 41.0%

Table 3. Distribution of patients with cold-related illness by time and place of onset (merge of 2019–2025 season)

Time and place	Nationwide		Daegu		Gyeongbuk	
	Patient	Rate (%)	Patient	Rate (%)	Patient	Rate (%)
Total	2,217	100.0	43	100.0	223	100.0
By time						
00–03 hr	246	11.1	7	16.3	25	11.2
03–06 hr	233	10.5	6	14.0	24	10.8
06–09 hr	423	19.1	9	20.9	53	23.8
09–12 hr	325	14.7	7	16.3	32	14.3
12–15 hr	230	10.4	3	7.0	23	10.3
15–18 hr	278	12.5	1	2.3	23	10.3
18–21 hr	270	12.2	7	16.3	24	10.8
21–24 hr	212	9.6	3	7.0	19	8.5
By place						
Indoor	489	22.1	13	30.2	50	22.4
Home	348	15.7	9	20.9	43	19.3
Indoor workplace	15	0.7	-	-	-	-
Building	76	3.4	3	7.0	5	2.2
Indoor, others	50	2.3	1	2.3	2	0.9
Outdoor	1,728	77.9	30	69.8	173	77.6
Outdoor workplace	90	4.1	-	-	6	2.7
Field	65	2.9	1	2.3	11	4.9
Playground (park)	39	1.8	-	-	2	0.9
Near residential area	342	15.4	8	18.6	32	14.3
Roadside	571	25.8	14	32.6	45	20.2
Riverside, beach	185	8.3	-	-	36	16.1
Mountains	178	8.0	2	4.7	10	4.5
Skating rink	1	0.0	-	-	-	-
Ski resort	34	1.5	-	-	-	-
Outdoor, others	223	10.1	5	11.6	31	13.9

of the total. The total number of deaths across the six seasons was 50 patients, accounting for 2.3% of the total sample (Supplementary Table 3; available online). In Daegu, 46.5% of patients were discharged, whereas 53.5% received follow-up care through hospitalization or transfer. In Gyeongbuk, 58.7% of patients were discharged or left without authorization, 39.0% were hospitalized or transferred, and 2.2% died.

Conclusions

Cold-related illnesses refer to conditions, such as hypothermia, frostbite, and chilblains, all of which are caused by prolonged exposure to low temperatures. The KDCA is responsible for monitoring the occurrence of cold-related illnesses during periods of cold waves, classifying them as climate-related health hazards, akin to its monitoring of heat-related illnesses during heatwaves. The primary rationale for the close observation and accelerated dissemination of climate-related diseases is to mitigate health damage by enhancing public awareness and promoting preventative measures through the expeditious exchange of information. Deaths from heat-related illnesses accounted for less than 1% of all patients in 2024, and approximately 75% of patients were reported to have been discharged [3]. Conversely, among patients who presented to the emergency room with cold-related illnesses, less than 60% were discharged, whereas approximately 40% required hospitalization or transfer, and approximately 2% died. The number of patients with heat-related illnesses is approximately 15-fold higher than that with cold-related illnesses, and the absolute number of deaths is also higher for heat-related illnesses. However, the findings of this study underscore the heightened risk of heat-related illnesses and deaths.

A comparison of reported cases per 100,000 individuals across 17 cities and provinces nationwide shows a relatively higher trend in provincial areas and lower trend in metropolitan areas [6]. In this study, we also found that the reported cases per 100,000 individuals in Daegu were lower than the national average, whereas those in Gyeongbuk were twice the national level, ranking second highest among provinces after Gangwon [6]. Although the monthly minimum temperatures in Gyeongbuk are not particularly low compared with the national average, the region has a large older-adult population. According to the 2024 resident registration population, the proportions of individuals aged 70 years and older were 12.9, 13.5, and 17.4% in the nation, Daegu, and Gyeongbuk, respectively [7]. Among age groups, the highest number of cold-related illnesses occurred in those aged 80 years and older. Furthermore, a pronounced upward trend was observed in reported cases per 100,000 individuals with increasing age, underscoring the significance of this health concern across diverse age groups. In addition to low temperatures, several other factors are associated with the risk of cold-related illnesses, such as the maintenance of appropriate indoor temperatures, use of cold-proof and waterproof gear, and limitation of outdoor activities. Therefore, reliance on temperature as the sole determinant of high-risk areas is inadequate. A multitude of factors have been identified as major contributors to an increased risk of cold-related illnesses. These factors include the income level, advanced age, presence of underlying medical conditions, and alcohol consumption [8]. Although age can be determined with a reasonable degree of accuracy, assessing a patient's state of drinking or underlying diseases in the emergency room is often unfeasible owing to the patient's level of consciousness or cooperation. Therefore, caution must be exercised when

interpreting results based solely on the response of patients who do not represent the entire population.

The highest number of patients was observed between 6:00 and 9:00 a.m., with more cases reported in the morning than in the afternoon. Notably, this time period corresponds with lower temperatures. Furthermore, the occurrence time does not necessarily indicate exposure to cold during that specific period. Therefore, some patients exposed to the cold for extended periods overnight may have been found in the morning. When classified by the location of occurrence, heat-related illnesses were more frequently reported outdoors than indoors; however, cases occurring at home also accounted for a significant proportion, at 15.7%. According to an analysis of mobility big data (compiled using smartphone applications of individuals aged 20–60 years) from April to June, 2023, as reported by the Korea Research Institute for Human Settlements, individuals reported spending 10.3 hours out of 24 hours outside their homes [9]. This finding is consistent with the observation that the time spent at home is considerably longer than that spent outdoors.

Despite the heightened perception of warming and comparatively smaller scale of cold-related illnesses relative to cold-related illnesses resulting in less attention being paid to the former, the severity associated with cold-related illnesses necessitates the consideration of measures for their prevention and management. Despite the global rise in average temperatures and increase in the number of extreme heat days, extreme cold snaps still occur, and a notable decrease in cold-related illnesses has not been confirmed. Consequently, sustained vigilance is essential regarding the health hazards associated with cold weather. Heat-related illnesses occur most frequently during the hottest hours of the day, when people are most active. Community centers can be operated as shared cooling shelters with support for cooling costs. However, the prevalence of cold-related illnesses is particularly pronounced during periods of patient convalescence at home. This poses challenges in terms of effective treatment and management through shared facilities, emphasizing that this aspect must be considered. This issue is particularly salient in Gyeongbuk, where a significant number of patients are observed to be at home, in contrast to the national level. Thus, adequate indoor heating must be promoted, and effective support measures must be reviewed for households struggling with heating costs.

Declarations

Ethics Statement: Not applicable.

Funding Source: None.

Acknowledgments: None.

Conflict of Interest: The authors have no conflicts of interest to declare.

Author Contributions: Data curation: SHK. Formal analysis: SHK. Writing – original draft: YMS. Writing – review & editing: YMS, SHK.

Supplementary Materials

Supplementary data are available online.

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