



盘点气候风险机遇, 展望健康繁荣未来

张诗卉^{1†}, 张弛^{2†}, 蔡闻佳^{1†}, 白玉琪¹, Max Callaghan³, 常楠⁴, 陈彬⁵, 陈慧琪⁶, 程亮亮⁶, 戴瀚程⁷, 代鑫⁸, 范维澄^{8,9}, 房小怡¹⁰, 高仝¹¹, 耿阳¹², 关大博¹, 胡艺馨¹³, 华峻翊¹⁴, 黄存瑞¹⁵, 黄弘^{8,9}, 黄建斌¹, 黄小猛¹, 纪思翰¹⁵, 蒋俏蕾¹⁶, 姜晓朋¹⁷, Gregor Kiesewetter¹⁸, 李湉湉¹⁹, 梁璐²⁰, 林波荣¹², 林华亮⁶, 刘欢²¹, 刘起勇²², 刘小波²², 刘钊²³, 刘竹¹, 刘昱甫¹, 陆波²⁴, 鲁晨曦^{1,25}, 罗震宇²¹, 马伟²⁶, 米志付²⁷, 任超²⁸, Marina Romanello²⁹, 沈鉴翔¹, 苏婧³⁰, 孙语泽¹, 孙昕璐²⁷, 汤绪^{31,32}, Maria Walawender²⁹, 王灿²¹, 王情¹⁹, 汪蕊¹, Laura Warnecke¹⁸, 魏汪宇¹⁶, 文三妹¹⁶, 谢杨³³, 熊辉³⁴, 徐冰¹, 颜钰²⁶, 杨秀³⁵, 姚芳虹³⁶, 俞乐¹, 袁嘉灿^{31,32}, 曾仪婷³⁷, 张镜¹⁶, 张璐²², 张锐³⁶, 张尚辰¹, 张少辉^{18,33}, 赵梦真², 郑大山⁶, 周浩³⁸, 周景博³⁹, 周子乔⁷, 罗勇¹, 宫鹏^{40*}

1. 清华大学地球系统科学系, 北京 100084;
2. 北京理工大学管理学院, 北京 100081;
3. Mercator Research Institute on Global Commons and Climate Change, Mercator Research Institute on Global Commons and Climate Change, Berlin 10829, Germany;
4. 南京医科大学公共卫生学院, 南京 211166;
5. 北京师范大学环境学院, 北京 100875;
6. 中山大学公共卫生学院, 广州 510080;
7. 北京大学环境科学与工程学院, 北京 100871;
8. 清华大学公共安全研究所, 北京 100084;
9. 清华大学工程物理系, 北京 100084;
10. 中国气象科学研究院气象影响与风险研究中心, 北京 100086;
11. 山东师范大学商学院, 济南 250013;
12. 清华大学建筑学院, 北京 100084;
13. 南方科技大学统计与数据科学系, 深圳 518055;
14. 中国海洋大学国际事务与公共管理学院, 青岛 266003;
15. 清华大学万科公共卫生学院, 北京 100084;
16. 清华大学新闻与传播学院, 北京 100084;
17. 世界卫生组织驻华代表处, 北京 100600;
18. Pollution Management Research Group, Energy, Climate, and Environment Program, International Institute for Applied Systems Analysis (IIASA), Laxenburg 1-A-2361, Austria;
19. 中国疾病预防控制中心环境与健康相关产品安全所, 环境健康风险评估室, 北京 102206;
20. Department of Landscape Architecture & Environmental Planning, University of California, Berkeley CA 94607, USA;
21. 清华大学环境学院, 北京 100084;
22. 中国疾病预防控制中心传染病预防控制所, 传染病预防控制国家重点实验室, 北京 102206;
23. 北京经济管理职业学院临空经济管理学院, 北京 100102;
24. 中国气象局国家气候中心, 北京 100081;
25. Geography, College of Life and Environmental Sciences, University of Exeter, Exeter EX1 2LU, UK;
26. 山东大学齐鲁医学院公共卫生学院流行病学系, 济南 250002;
27. The Bartlett School of Sustainable Construction, University College London, London WC1H 0AL, UK;
28. 香港大学建筑学院, 香港 999077;
29. Institute for Global Health, University College London, London WC1H 0AL, UK;
30. 清华大学人文学院, 北京 100084;
31. 复旦大学大气与海洋系/大气科学研究院, 上海 200438;

32. 复旦大学极端天气/气候事件与人体健康风险互联和治理国际卓越中心, 上海 200438;
33. 北京航空航天大学经济与管理学院, 北京 100083;
34. 香港科技大学计算机科学与工程系, 广州 511453;
35. 清华大学气候变化与可持续发展研究院, 北京 100084;
36. 北京大学体育教研部, 北京 100871;
37. 清华大学苏世民学院, 北京 100084;
38. 清华大学城市治理与可持续发展研究院, 北京 100084;
39. 百度研究院, 北京 100091;
40. 香港大学地球科学系和地理系, 香港 999077

† 同等贡献

* 联系人, E-mail: penggong@hku.hk

气候变化带来的健康风险与日俱增, 煤炭消费及相关碳排放量的反弹, 再度敲响了中国气候变化警钟。2022年, 中国面临了严峻的气候挑战。极端天气事件发生的频率和强度不断上升, 许多地区气温纪录屡创新高, 全国平均气温攀升至历史第二高位, 同时降水量自2012年以来创新低, 南方地区遭遇夏秋连旱, 而湖南和东北地区则出现了极端降雨和洪涝灾害。采取及时、充分的措施不仅能减轻气候变化对健康的影响, 还将保护基础设施不被极端天气破坏。

为了推动在应对气候变化行动中优先考虑健康问题, 在全球柳叶刀倒计时工作基础上^[1,2], 柳叶刀倒计时亚洲中心(清华大学领导创建)自2020年起开始对气候变化对中国人群健康的影响进行全面系统评估^[3-6]。

2023年底, 由柳叶刀倒计时亚洲中心领衔, 包括26个顶尖研究机构在内的76位国内外各领域专家共同撰写发布了第四部中国版年度报告《柳叶刀人群健康与气候变化倒计时中国报告(2023)》(下文简称《中国版柳叶刀倒计时报告(2023)》)。《中国版柳叶刀倒计时报告(2023)》追踪了中国在气候变化与人群健康方面的成果, 在2023年报告中采用多项指标评估了人类活动作为气候变化的关键因素对人群健康影响的贡献程度, 并提出针对改善个人健康的有效的气候解决方案。报告主题内容分为五大领域, 包括了28项指标: 气候变化的影响、暴露和脆弱性; 针对健康的适应措施、规划和气候韧性; 减缓气候变化及其健康协同效益; 气候健康的经济与投资分析; 公众和政府参与。

2023年是首轮全球气候行动盘点年, 也是联合国缔约方大会(Conference of the Parties, COP)首次设立气候变化与健康日的重要改革年。全球盘点将为气候干预措施提供一个系统的清单, 能够为识别和执行以健康为优先考虑的干预措施提供指导。《联合国气候变化框架公约》第二十八次缔约方大会(COP28)首次召开了全球气候变化与健康部长级会议, 截至2024年3月, 共有148个国家(包括中国在内)签署《气候与健康宣言》, 标志着健康议题在全球气候变化议程中正逐步主流化。然而, 尽管气候行动对人类健康大有裨益, 但大多数行动并未明确地将健康列为政策目标或指标。因此, 2023



宫鹏 香港大学全球可持续发展讲座教授, 副校长。研究兴趣包括全球环境变化监测与模拟、星球健康等。领导完成世界首份30和10 m分辨率全球地表覆盖图, 率先发展基于球面坐标的全球分析和图像处理技术, 建立时空一体化的疾病传播模型, 推动基于空间化信息的水资源和粮食政策研究。

年报告作了两方面的新尝试并新增加了相应指标: 识别人类活动对碳排放(指标4.2.4)和气候变化健康风险的贡献(专栏2), 以说明减缓气候变化的紧迫性; 追踪健康风险预警服务进展(指标2.3)和气象对城市人体舒适度的影响(专栏3), 以反映对日常生活的影响。

清华大学联合国内研究机构, 每年撰写中国政策简报^[7-11], 目的是帮助相关部门政策决策者和公众了解中国在气候变化和公众健康方面的最新进展。本报告通过省级数据结果, 更好地辅助各地区决策者制定具有差异化、针对性的地方策略。通过研究28项指标, 本报告得出了以下两个关键观点。

1 气候变化对中国人群健康负面影响日益突出, 人类活动影响加大

高温热浪、低温寒潮、干旱、暴雨等极端天气可以通过多种路径直接或间接影响人群健康, 如热浪和寒潮会诱发呼吸、循环等系统疾病, 严重会导致死亡; 暴雨、干旱等增加传染病风险。2022年, 中国破纪录的高温 and 干旱导致了相关健康损失的增加。与基准(1986~2005年)相比, 各省夏季高温暴露大幅增加(图1), 全国与热浪相关的死亡人数、劳动生产率损失、安全户外活动时间损失分别增加了342%、24%、67%, 野火暴露增加了约54%。基于中国气象局开发的可用于追踪城市人体舒适天数的计算方法, 2022年, 中国大

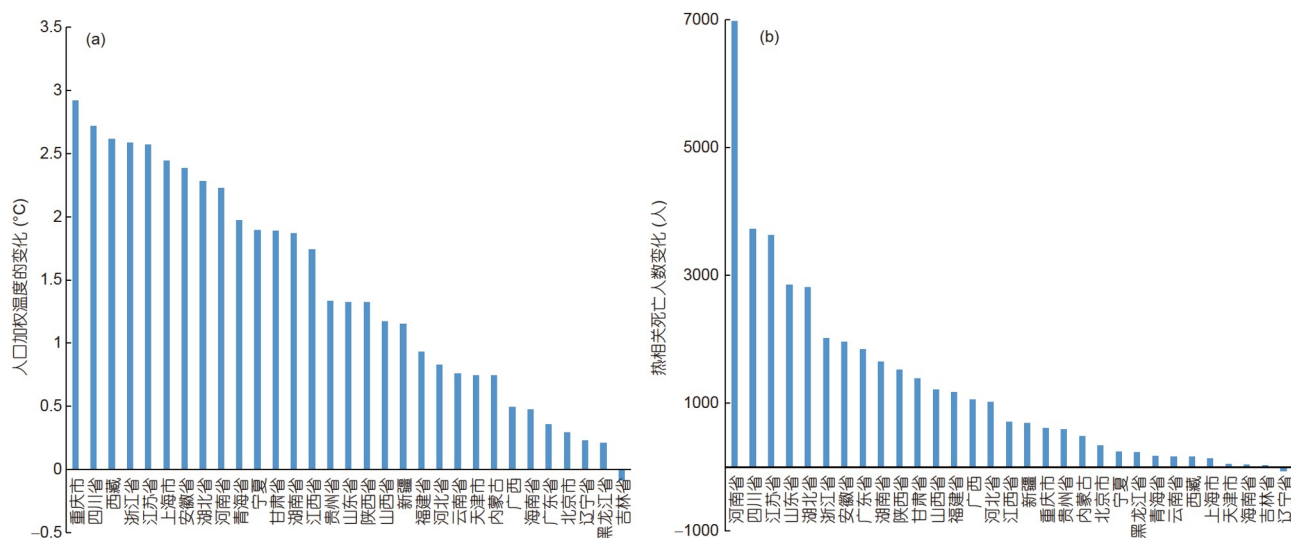


图1 与1986~2005年平均水平相比, 2022年各省夏季人口加权温度(a)和热相关死亡人数(b)的变化

Figure 1 The province-level rank of change in population-weighted summer temperature (a) and heat-related mortality (b) in 2022 relative to the 1986–2005 average

部分城市的舒适天数占全年天数的比例在20%~40%之间, 196个城市(约58%)舒适天数低于基准年平均水平。与此同时, 部分城市的舒适天数比例有所上升, 寒冷气候城市灵芝和昆明的舒适天数分别增加了15和35天。此外, 未来的气候风险也值得警惕。以海平面上升为例, 在高排放情景下, 预计2050年沿海省份受海平面上升影响人口占总人口的比例为7.7%, 2100年该比例将上升至12.9%。这些人群还将面临海岸侵蚀、洪水、水和土地盐碱化以及沿海基础设施损害等风险。

报告对气候变化的健康影响进行了归因分析, 发现几种主要气候相关风险比例始终高度归因于人为排放。能源生产、交通运输、工业生产、土地利用变化等人类活动排放的二氧化碳、甲烷等温室气体会造成全球温度的升高。在过去20年中, 49.4%与热浪相关的死亡率、30.9%与热浪相关的劳动生产率损失, 以及98.8%受干旱影响的人口都是由人为气候变化造成的。人为气候变化带来的风险在省级层面差异较大, 总体呈现出南部高于北部和西部地区的特点。与热浪相关的死亡可归因为人为气候变化比例最高的省份为广东(67.0%)、福建(60.3%)、海南(59.3%)、湖南(59.7%)和上海(60.2%)。

2 减缓和适应行动均有进展, 但与健康关联有限

中国在气候适应上持续取得稳步进展, 预防未来健康风险和应对已有风险的能力均有所提升(图2)。预警系统(主要包括高温、寒潮和空气污染预警)覆盖范围不断扩大, 发布气候变化健康风险预警的省市从2020年的2省2市增加到2021年的6省24市, 再增加到2022年的8省27市。然而, 高温和

寒潮预警覆盖人口远小于空气污染预警, 2022年两者预警人口覆盖范围分别为3185万、18333万。为应对气温升高, 居民增加了空调使用作为防暑降温的措施, 然而, 这也导致了能源的使用增加和温室气体排放的有害增长。城市绿地能够降低热岛效应, 改善居民身心健康。过去20年, 城市绿地避免了中国大约3.8万居民的过早死亡, 但2022年中国城市绿地覆盖率并没有大幅增加。

能源系统转型与空气污染末端控制相结合, 显著降低了温室气体和空气污染物的排放。煤炭替代和超低排放标准的实施使得与PM_{2.5}相关的过早死亡人数大幅减少, 家庭、电力和工业部门分别避免了约7.2万、3.7万、2.4万人过早死亡。但是, 由于水力发电和其他低碳能源发电受到极端天气事件的威胁, 煤电被用来填补空缺, 保障能源供应。因此, 煤炭消耗量增长速度达到了自2011年以来的第二高纪录, 为4.3%, 这也带来了持续的空气污染和相关健康风险。

随着气候变化对健康影响的日益凸显, 2021~2022年, 微博和个人用户对气候与健康议题的关注和报道分别增长了1和6倍多。然而, 在过去两年中, 报纸、学术期刊、政府网站等专业渠道对人群健康与气候变化议题的关注度几乎没有变化。健康议题在当前的气候变化减缓和适应行动中很少被提及或作为优先考虑的事项。例如, 目前的预警系统主要侧重于气象信号, 如极端高温, 对健康影响目前关注不足。虽然《国家适应气候变化战略2035》中包含了健康相关的独立章节, 但中国尚未公布单独的全国性健康适应行动方案。与此同时, 在过去20年中, 健康议题在气候议题中的公众参与(传统媒体、学术界和政府)占比增长较为缓慢, 反映了在气候变化的公共议程中, 健康问题的优先级相对较低。

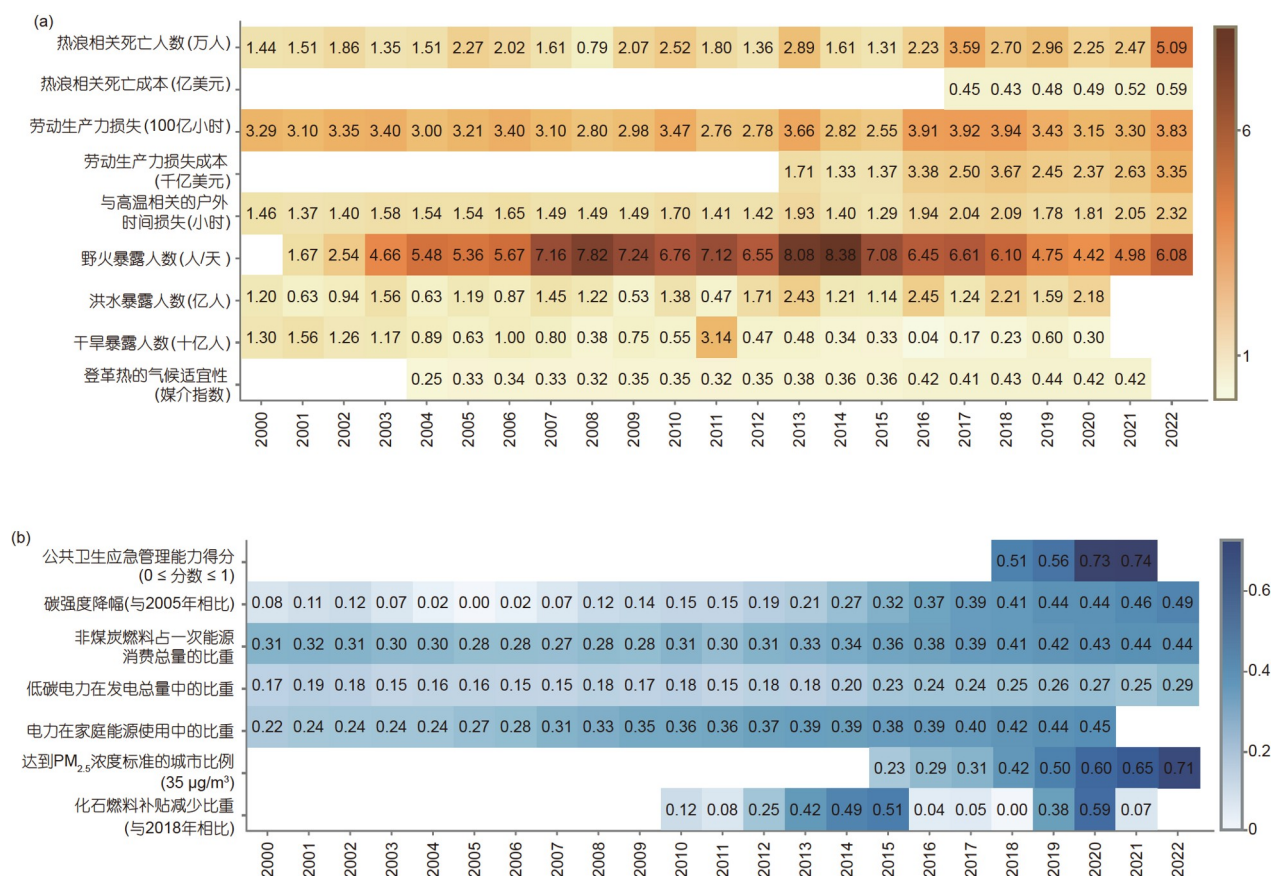


图2 《中国版柳叶刀倒计时报告(2023)》中追踪的影响(a)和应对措施概述(b)

Figure 2 An overview of impacts (a) and responses (b) tracked in The 2023 China Report of the Lancet Countdown on Health and Climate Change

3 政策建议

自2020年第一份报告发布以来,《中国版柳叶刀倒计时报告》在持续研究进展同时,致力于为相关领域提供指导信息,推动政策行动。回顾近年来的行动进展,人群健康与气候变化议题在国家、地区和部门层面的相关政策中日益突出,如健康中国2022和2023年度工作重点等健康政策中都出现了气候相关的内容。然而,气候健康相关的政策总体进展较为有限。在此,我们提出如下政策建议,以期充分利用当前的各种政策机遇,为中国居民创造一个更加安全、健康的未来。

(1) 加大对可再生能源行业的投资和研发力度,避免煤电的锁定效应。充分发挥中国可再生能源产业蓬勃发展的良好势头,使其成为中国实现高质量增长的新动能。加大可再生能源基础设施的投资力度有助于减少温室气体排放,提升能源种类多样性和能源系统韧性。加大可再生能源并网和储能技术的研发能够有效提升可再生能源技术的效率、可靠性和经济性,从而促进其大规模部署。优先投资这些领域,将有助于中国减少对煤电的长期依赖,为建成更清洁、更稳定、更可持续的能源系统奠定基础,从而进一步减缓气候变化,

为后代创造更健康的环境。

(2) 充分利用减污降碳的协同效应,加大减缓措施力度。中国是全球减污降碳的健康协同效益最显著的地区之一,应加大温室气体和空气污染物协同控制的力度,从而更好地保护人群健康、提高环境福祉,为子孙后代创造更具有韧性和抗灾能力的社区。具体措施包括能源系统清洁化转型、提高各行各业的能效、建设可持续交通系统、实施严格的工业排放标准、促进植树造林和森林保护行动、推广可持续农业等。

(3) 建立面向人民生命健康的气象灾害早期预警系统。为响应联合国的全民早期预警倡议,中国应发展面向人民生命健康的气象灾害早期预警系统,充分考虑气候变化对健康的影响。这个系统应在识别到与健康风险相关的气象灾害时,及时发布预警,指导相关部门采取具体预防措施。通过这种方式,我们能更全面地保护老人、儿童、孕妇和慢性病患者等脆弱群体,减轻气象灾害给中国造成的损失。

(4) 加强研究极端天气事件导致的级联影响及应对措施。厘清热浪、洪水和台风等极端天气事件通过社会经济、生态环境等链条对人群健康造成的复合级联式影响,识别并评

估保护脆弱性人群、关键基础设施和生态系统的措施,为保护人群健康提供有效信息。厘清水、能源、农业和健康等部门之间的协同合作机制,制定综合应对策略。开展典型应对措施的有效性评估,如加强预警系统、提高基础设施的抗灾能力、社区应急预案和基于自然的解决方案等。

(5) 制定面向不同主体的健康适应指南。针对地方政府、卫健系统、社区和个人等不同的主体制定有针对性的健康适应指南。地方政府的侧重点在于当地健康适应行动规划和脆弱性地区。卫健系统应制定相关技术指南和培训项目,提升气候变化健康风险的快速响应能力。社区应积极参加培训、教育宣传,学习典型示范社区的健康适应措施,并保护

脆弱人群。个人需要针对不同风险的实用指导,帮助他们调整生活方式,减少与气候变化相关的健康风险。加强各参与主体的适应能力,能够推动健康适应工作更为协调和全面地进行。

2023年是盘点过去、展望未来的一个关键时刻。通过回顾气候健康风险在中国的归因和影响,并盘点行动进展与政策机遇,更加凸显了加快减缓和适应气候变化的紧迫性和重要性。虽然减缓气候行动在健康和经济方面有潜在的收益,但由于极端天气、全球的不确定性和其他危机,减缓行动有所延缓。中国应进一步积极应对气候变化,以健康为引领,加大减缓措施的力度和速度,进一步改善人民健康与福祉。

致谢 我们衷心感谢英国惠康基金会(Wellcome Trust, 209734/Z/17/Z)、国家自然科学基金(72091514, 72140002, 72104029)、中国气象局气候变化专项、能源基金会和唐仲英基金会。感谢岳玉娟(中国疾病预防控制中心)、张百超(中国气象局)、赵亮(中国科学院)、杨军(广州医科大学)、李瑞奇(清华大学)、董文轩(清华大学)、杨丽丽(南方科技大学)、金虎(复旦大学)、Robert Kopp(罗格斯大学)、可奕博(清华大学)和杨雨人(清华大学)提供技术支持。

推荐阅读文献

- 1 Watts N, Adger W N, Agnolucci P, et al. Health and climate change: Policy responses to protect public health. *Lancet*, 2015, 386: 1861–1914
- 2 Watts N, Amann M, Arnell N, et al. The 2020 report of The Lancet Countdown on health and climate change: Responding to converging crises. *Lancet*, 2021, 397: 129–170
- 3 Cai W, Zhang C, Suen H P, et al. The 2020 China report of the Lancet Countdown on health and climate change. *Lancet Public Health*, 2021, 6: e64–e81
- 4 Cai W, Zhang C, Zhang S, et al. The 2021 China report of the Lancet Countdown on health and climate change: Seizing the window of opportunity. *Lancet Public Health*, 2021, 6: e932–e947
- 5 Cai W, Zhang C, Zhang S, et al. The 2022 China report of the Lancet Countdown on health and climate change: Leveraging climate actions for healthy ageing. *Lancet Public Health*, 2022, 7: e1073–e1090
- 6 Zhang S, Zhang C, Cai W, et al. The 2023 China report of the Lancet Countdown on health and climate change: Taking stock for a thriving future. *Lancet Public Health*, 2023, 8: e978–e995
- 7 Cai W J, Hui J X, Gong P, et al. China's challenges and policy recommendations for addressing climate change and improving public health (in Chinese). *Chin Sci Bull*, 2018, 63: 1205–1210 [蔡闻佳, 惠婧璇, 宫鹏, 等. 中国应对气候变化和改善公众健康的挑战与政策建议. 科学通报, 2018, 63: 1205–1210]
- 8 Cui X Q, Cai W J, Shi X M, et al. The nature and scale of the response to climate change will determine the human health for centuries to come in China (in Chinese). *Chin Sci Bull*, 2020, 65: 12–17 [崔学勤, 蔡闻佳, 施小明, 等. 当前应对气候变化的力度决定未来中国的公众健康水平. 科学通报, 2020, 65: 665–670]
- 9 Cai W J, Zhang C, Sun K P, et al. Location-specific health impacts of climate change require location-specific responses (in Chinese). *Chin Sci Bull*, 2021, 66: 3925–3931 [蔡闻佳, 张弛, 孙凯平, 等. 因地而异的气候变化健康影响需要因地而异的应对措施. 科学通报, 2021, 66: 3925–3931]
- 10 Cai W J, Zhang C, Zhang S H, et al. Seizing the window of opportunity to mitigate the impact of climate change on the health of Chinese residents (in Chinese). *Chin Sci Bull*, 2023, 68: 1899–1905 [蔡闻佳, 张弛, 张诗卉, 等. 把握机会窗口期减缓气候变化对中国居民健康影响. 科学通报, 2023, 68: 1899–1905]
- 11 Cai W J, Zhang C, Zhang S H, et al. Leveraging climate actions for healthy ageing (in Chinese). *Chin Sci Bull*, 2023, 68: 4472–4479 [蔡闻佳, 张弛, 张诗卉, 等. 以气候行动助力健康老龄化. 科学通报, 2023, 68: 4472–4479]

Summary for “盘点气候风险机遇, 展望健康繁荣未来”

Taking stock of climate action for a healthy and thriving future

Shihui Zhang^{1†}, Chi Zhang^{2†}, Wenjia Cai^{1†}, Yuqi Bai¹, Max Callaghan³, Nan Chang⁴, Bin Chen⁵, Huiqi Chen⁶, Liangliang Cheng⁶, Hancheng Dai⁷, Xin Dai⁸, Weicheng Fan^{8,9}, Xiaoyi Fang¹⁰, Tong Gao¹¹, Yang Geng¹², Dabo Guan¹, Yixin Hu¹³, Junyi Hua¹⁴, Cunrui Huang¹⁵, Hong Huang^{8,9}, Jianbin Huang¹, Xiaomeng Huang¹, John S. Ji¹⁵, Qiaolei Jiang¹⁶, Xiaopeng Jiang¹⁷, Gregor Kiesewetter¹⁸, Tiantian Li¹⁹, Lu Liang²⁰, Borong Lin¹², Hualiang Lin⁶, Huan Liu²¹, Qiyong Liu²², Xiaobo Liu²², Zhao Liu²³, Zhu Liu¹, Yufu Liu¹, Bo Lu²⁴, Chenxi Lu^{1,25}, Zhenyu Luo²¹, Wei Ma²⁶, Zhifu Mi²⁷, Chao Ren²⁸, Marina Romanello²⁹, Jianxiang Shen¹, Jing Su³⁰, Yuze Sun¹, Xinlu Sun²⁷, Xu Tang^{31,32}, Maria Walawender²⁹, Can Wang²¹, Qing Wang¹⁹, Rui Wang¹, Laura Warnecke¹⁸, Wangyu Wei¹⁶, Sanmei Wen¹⁶, Yang Xie³³, Hui Xiong³⁴, Bing Xu¹, Yu Yan²⁶, Xiu Yang³⁵, Fanghong Yao³⁶, Le Yu¹, Jiacan Yuan^{31,32}, Yiping Zeng³⁷, Jing Zhang¹⁶, Lu Zhang²², Rui Zhang³⁶, Shangchen Zhang¹, Shaohui Zhang^{18,33}, Mengzhen Zhao², Dashan Zheng⁶, Hao Zhou³⁸, Jingbo Zhou³⁹, Ziqiao Zhou⁷, Yong Luo¹ & Gong Peng^{40*}

¹ Department of Earth System Science, Tsinghua University, Beijing 100084, China;

² School of Management, Beijing Institute of Technology, Beijing 100081 China;

³ Mercator Research Institute on Global Commons and Climate Change, Mercator Research Institute on Global Commons and Climate Change, Berlin 10829, Germany;

⁴ School of Public Health, Nanjing Medical University, Nanjing 211166, China;

⁵ School of Environment, Beijing Normal University, Beijing 100875, China;

⁶ School of Public Health, Sun Yat-sen University, Guangzhou 510080, China;

⁷ College of Environmental Sciences and Engineering, Peking University, Beijing 100871, China;

⁸ Institute of Public Safety Research, Tsinghua University, Beijing 100084, China;

⁹ Department of Engineering Physics, Tsinghua University, Beijing 100084, China;

¹⁰ Meteorological Impact and Risk Research Center, Chinese Academy of Meteorological Sciences, Beijing 100086, China;

¹¹ School of Business, Shandong Normal University, Jinan 250013, China;

¹² School of Architecture, Tsinghua University, Beijing 100084, China;

¹³ Department of Statistics and Data Science, Southern University of Science and Technology, Shenzhen 518055, China;

¹⁴ School of International Affairs and Public Administration, Ocean University of China, Qingdao 266003, China

¹⁵ Vanke School of Public Health, Tsinghua University, Beijing 100084, China;

¹⁶ School of Journalism and Communication, Tsinghua University, Beijing 100084, China;

¹⁷ World Health Organization Representative Office in China, Beijing 100600, China;

¹⁸ Pollution Management Research Group, Energy, Climate, and Environment Program, International Institute for Applied Systems Analysis (IIASA), Laxenburg 1-A-2361, Austria;

¹⁹ Key Laboratory of Environment and Population Health, National Institute of Environmental Health, Chinese Center for Disease Control and Prevention, Beijing 102206, China;

²⁰ Department of Landscape Architecture & Environmental Planning, University of California, Berkeley CA 94607, USA;

²¹ School of Environment, Tsinghua University, Beijing 100084, China;

²² State Key Laboratory of Infectious Disease Prevention and Control, National Institute for Communicable Disease Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing 102206, China;

²³ School of Airport Economics and Management, Beijing Institute of Economics and Management, Beijing 100102, China;

²⁴ National Climate Center, China Meteorological Administration, Beijing 100081, China;

²⁵ Geography, College of Life and Environmental Sciences, University of Exeter, Exeter EX1 2LU, UK;

²⁶ Climate Change and Health Center, Shandong University, Jinan 250002, China;

²⁷ The Bartlett School of Sustainable Construction, University College London, London WC1H 0AL, UK;

²⁸ School of Architecture, the University of Hong Kong, Hong Kong 999077, China;

²⁹ Institute for Global Health, University College London, London WC1H 0AL, UK;

³⁰ School of Humanities, Tsinghua University, Beijing 100084, China;

³¹ Department of Atmospheric and Oceanic Sciences & Institute of Atmospheric Sciences, Fudan University, Shanghai 200438, China;

³² Integrated Research on Disaster Risk International Centre of Excellence on Risk Interconnectivity and Governance on Weather/Climate Extremes Impact and Public Health, Fudan University, Shanghai 200438, China;

³³ School of Economics and Management, Beihang University, Beijing 100083, China;

³⁴ Artificial Intelligence Thrust Area and the Department of Computer Science and Engineering, Hong Kong University of Science and Technology, Guangzhou 511453, China;

³⁵ Institute of Climate Change and Sustainable Development, Tsinghua University, Beijing 100084, China;

³⁶ Department of Physical Education, Peking University, Beijing 100871, China;

³⁷ Schwarzman Scholars at Tsinghua University, Beijing 100084, China;

³⁸ Institute for Urban Governance and Sustainable Development, Tsinghua University, Beijing 100084, China;

³⁹ Baidu Research, Beijing 100091, China;

⁴⁰ Department of Earth Sciences and Department of Geography, the University of Hong Kong, Hong Kong 999077, China

† Equally contributed to this work

* Corresponding author, E-mail: penggong@hku.hk

Human health is inextricably linked to climate change, as the increasing frequency and severity of extreme weather events, such as heatwaves, floods, and hurricanes pose direct and indirect threats to human life and well-being. The first round of the Global Stocktake (GST) in 2023 will provide a systematic inventory of actions to address climate change, and guidance for identifying and implementing interventions that prioritize health considerations. *The 2023 China Report of the Lancet Countdown*, led by Tsinghua University with contributions from 76 experts from 26 leading global institutions, continues to track progress on health and climate change in China through 28 indicators across five domains. These domains encompass a wide spectrum, from the climate change impacts, exposures, and vulnerability (Section 1), to different elements of actions including adaption (Section 2), mitigation and their health implications (Section 3), economics and finance (Section 4), and public and political engagement (Section 5).

We selected the most urgent and relevant indicators to compile a policy brief that provides a comprehensive understanding of recent progress on climate change and health in China. This report is the fourth China Lancet Countdown report, pays particular attention to the impacts on the health risks arising from human-induced climate change (Panel 2), and production- and consumption-based CO₂ and PM_{2.5} emissions (indicator 4.2.4), indicating the urgency for mitigation by identifying human contribution to carbon emissions and climate change. In addition, we found that the record-breaking heat and drought of 2022 were associated with increased adverse health outcomes. Wildfire exposure increased by 54% compared to the historical baseline, while heatwave-related mortality increased by 342%, heat-related work loss increased by 24%, safe outdoor physical activity loss increased by 67% and the resulting hours available for safe outdoor activities decreased by 9.6%. Human-caused climate change was responsible for 49.4% of heatwave-related mortality, 30.9% of heat-related labour productivity loss, 98.8% of population affected by drought, and 7.6% of population affected by flood in the previous 20 years. The national health emergency response score rose from 73 in 2020 to 73.5 in 2021, and health risk early warnings expanded to cover eight provinces and 27 cities, shielding 183.3 million people.

Based on the findings, the following recommendations are put forth to safeguard against the climate change-related health risks: (1) Increase investment, research and development of renewable energy to avoid lock-in effects of coal power. Investing in renewable energy infrastructures can reduce greenhouse gas emissions and promote energy diversity and resilience. (2) Harness the synergies in actions to reduce carbon and air pollutants. By capitalizing on the interconnections between carbon reduction and improved air quality, China can protect human health, enhance environmental well-being, and build resilient communities for generations to come. (3) Establish meteorology-informed early warning systems for health, and develop a population-health-oriented meteorological early warning system that accounts for climate health hazards. (4) Encourage research focused on the compound and cascading effects of extreme weather events, and on efficient response strategies. By promoting relevant research, China can deepen its understanding of the compound and cascading effects of extreme weather events, and develop effective strategies to mitigate their effects, safeguard lives, and foster societal resilience. (5) Develop health adaptation guidelines tailored to the specific needs and roles of different actors. These guidelines should offer targeted recommendations and strategies for a range of stakeholders, including local governments, healthcare systems, communities, and individuals.

climate change, public health, stock, extreme weather

doi: [10.1360/TB-2024-0439](https://doi.org/10.1360/TB-2024-0439)