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ORIGINAL ARTICLE

"Cool" governance of a "hot" climate issue: public and private responsibilities for the protection of vulnerable citizens against extreme heat

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Abstract In cities in temperate climate zones, the elderly, disabled and socially deprived are most vulnerable to extreme heat, as witnessed by increased mortality rates during heat waves in Europe and North America. Many cities, however, lag behind in the protection of vulnerable citizens against heat stress, an issue gaining importance in the face of climate change, ongoing urbanization and an ageing population. This raises questions as to who bears responsibility for the protection of these vulnerable citizens. Should they protect themselves, or is this a collective responsibility? Which public and private organizations could take on this collective responsibility? This study explores potential governance arrangements between public and private actors by analysing the perceived responsibilities and their underlying considerations of public and private actors through two multi-stakeholder workshops and one focus group held in two Dutch cities. Furthermore, the study looks into what can be learned from ten foreign cities where a heat stress policy has been implemented, with respect to the concrete shaping of responsibilities and how trade-offs in considerations are dealt with. The research reveals that because of conflicting considerations there is disagreement as to who bears responsibility for the implementation of health care measures, and it shows how this might be resolved through differentiated approaches for an active outreach to vulnerable citizens. We conclude that "cool" governance suggests extensive public responsibilities throughout the policy process, but that policy implementation needs public–private networks tailored to these differentiated approaches.

Keywords Adaptation · Climate change · Heat waves · Vulnerability · Divisions of responsibilities · Local governance

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Introduction

The rise in global mean temperature is expected to enhance the frequency, intensity and duration of hot days and heat waves (Coumou et al. 2013; IPCC 2012). Of all natural disasters, heat waves are claimed to have most impact on human health in Europe; they are estimated to have caused between 22,000 and 70,000 excess deaths in 2003 in West and Eastern Europe (EEA 2012; Robine et al. 2008; Kovats and Ebi 2006; IFRC 2004), and another 55,000 in 2010 in Eastern Europe (Barriopedro et al. 2011). It is claimed that urban populations are more vulnerable to the health effects of climate change than their rural counterparts because of the urban heat island effect, but there are also considerable differences in vulnerability among urban citizens to climate impacts (Costello et al. 2009; Friel et al. 2011). Vulnerability is the propensity or predisposition to be adversely affected (IPCC 2012, p. 3). In line with scholars, who describe vulnerability as a function of sensitivity, exposure and adaptive capacity (e.g. Wilhelmi and Hayden 2010; Adger 2006), citizens who are vulnerable to heat stress are (1) less able to regulate and adapt their body temperature (high sensitivity, in particular the elderly cf. Verbeke et al. 2001); (2) living in older, poorly insulated houses in

densely built neighbourhoods lacking green space (high exposure; Friel et al. 2011); and (3) less mobile and often live in social isolation (low adaptive capacity; Sampson et al. 2013; Luber and McGeehin 2008). In temperate climate zones, it is the elderly, chronically ill and socially deprived citizens who are shown to be most vulnerable to extreme heat (Kovats and Ebi 2006; Ebi et al. 2004). The heat waves of Philadelphia (1993), Chicago (1995), Paris (2003) and Moscow (2010) are cases in point, which have led to increased rates of morbidity and mortality in particular among the elderly (Fouillet et al. 2006, Luber and McGeehin 2008; Robine et al. 2008; Schär and Jendritzky 2004). With an ageing population and an ongoing urbanization, these rates might significantly increase in the coming decades.

Heat stress may be preventable through early warning systems and response plans, meant to trigger the short-term adaptive behaviour of citizens, such as shading windows, drinking water and seeking cooler places (Friel et al. 2011; Lowe et al. 2011; Luber and McGeehin 2008; WHO 2007). For many cities, however, such plans are lacking for this poorly recognized climate adaptation issue (e.g. Bernard and McGeehin 2004; Runhaar et al. 2012). Moreover, these plans pay insufficient attention to vulnerable citizens and often fail to address them effectively (Sampson et al. 2013; Poutiainen et al. 2013; Allex et al. 2013; Sheridan 2007, Kovats and Ebi 2006). This raises the issue of who could bear responsibility for taking measures to protect vulnerable citizens who have trouble in protecting themselves. Is this primarily a personal, individual responsibility, or is this a collective, social responsibility? The issue of personal versus social responsibility, which has gained importance with the emergence of the neo-liberal agenda and the decline of the welfare state, is heavily debated in the health care literature (e.g. Tinghőg et al. 2010; Buyx 2008; Cappelen and Norheim 2005; Wikler 2002; Galvin 2002; Minkler 1999). And even if society views it as a collective responsibility to care for the weakest, the issue arises as to which actors or organizations carry this responsibility. Is it primarily a public responsibility of city governments or their public health officers, or is it a private responsibility of health practitioners, caretakers, community workers or family and friends?

To address the issue of who, or which organizations, bear responsibility for the protection of vulnerable citizens against extreme heat, we need to understand the underlying rationales for allocating responsibilities to certain public or private actors (Mees et al. 2012). For instance, a primary consideration for individual responsibility is the empowerment of citizens so that they can control their own health and avoid patronage, or efficiency aimed at the reduction of costs of the health care system (Galvin 2002). An important consideration for public responsibility is fairness, since local authorities can redistribute the benefits of adaptation measures that combat extreme heat to those most in need (e.g. Osberghaus et al. 2010; Paavola 2008; Eakin and Lemos 2006). An important consideration for allocating private responsibility to, for instance, home care workers is efficiency, since they can relatively simply integrate heat stress treatment in their routine visits to the elderly and chronically ill. The above examples show that different rationales can compete with each other for the same responsibility division issue. Tensions exist between the different considerations underlying responsibility divisions, and this might lead to inevitable trade-offs (Mees et al. 2012).

Research on the issue of responsibility divisions for the emerging policy field of climate adaptation is still sparse and dominated by conceptual explorations (e.g. Mees et al. 2012; Aakre and Rübbelke 2010; Osberghaus et al. 2010; Mendelsohn 2006), even though a lack of clarity of responsibilities is considered a key barrier to the governance of adaptation (e.g. Biesbroek et al. 2010; Dovers and Hezri 2010). This research aims to contribute to the literature by exploring the range of governance arrangements between public and private actors/organizations that enable adaptation. We focus on an adaptation issue that so far has received little attention, i.e. heat stress and its governance in terms of "cooling" cities, despite the declared high morbidity and mortality rates of vulnerable citizens. A recent study showed that heat-related mortality is both the most certain and the most relevant health effect for Dutch adaptation policy according to experts (Wardekker et al. 2012). In the Netherlands, the governance of adaptation to heat stress has been limited to the development of a national heat response plan, while governance at the local level is virtually absent (Runhaar et al. 2012). The Netherlands has a universal health care system based on solidarity and available to everyone. Recently, more and more health care tasks are being devolved from the Dutch national government to the municipalities. Although Dutch municipalities have a broadly defined duty of care for the health of their citizens as described by law (WPG 2008), this law is purposefully vague in terms of responsibilities to allow flexibility and it therefore remains unclear how responsibilities are arranged at the local level to protect vulnerable citizens during a heat wave. We therefore also hope to inform (Dutch) policy makers about potential local governance arrangements.

We address the following research questions: (1) what are public and private responsibilities and their underlying considerations for the protection of vulnerable citizens from extreme heat, as perceived by Dutch local stakeholders? and (2) what can be learned from cities where a heat stress policy has been implemented, with respect to the concrete shaping of responsibilities and to how

potential trade-offs are resolved? We provide answers to these questions through two research projects. The first project consisted of two multi-stakeholder workshops, and one focus group discussion of elderly people as the largest affected citizen group, held in the cities of Arnhem and Rotterdam, the Netherlands. During the workshops and focus group, representatives of various public and private organizations that have a stake in this issue discussed and deliberated on the considerations supporting certain allocations of responsibilities to specific public and private stakeholders. The second project consisted of a desk research that analysed the actual responsibilities and measures taken in ten foreign cities in temperate climates that are frontrunners in the implementation of adaptation to extreme heat. Of these cities, seven are located in countries with some form of a universal public health care system, and three in a country (USA) with individual health care. By comparing the results of the workshops with the results found in other cities, we provide an analysis of potential local governance arrangements for the protection of vulnerable citizens against extreme heat. First, we present the analytical framework used for the exploration of responsibilities and considerations, as derived from a literature review. Next, we describe the research method. Consequently, the results are discussed of the Dutch workshops and focus group, and of the ten foreign cities contained in the desk research. We end with conclusions and reflections.

Analytical framework

Responsibilities

In order to make sense of the concept of responsibility, we distinguish four stages in the policy process relevant for the protection of vulnerable citizens. The first is problem analysis in terms of the assessment and mapping of vulnerable citizen(group)s in light of the diversity in vulnerabilities depending on their living environment, physical and mental health, and socio-economic well-being. Identifying vulnerable citizens has proven to be difficult (Bulkeley et al. 2013). This identification is often limited to a geographic analysis that identifies hotspots, but fails to identify differential vulnerabilities among population groups within these hotspots (Wilhelmi and Hayden 2010; Luber and McGeehin 2008). There is insufficient data at household level, and more specifically, data are missing on households' adaptive capacity, such as access to air conditioning and extent of social isolation (Wilhelmi and Hayden 2010). The second stage concerns policymaking: the development of a (heat response) plan for the protection of vulnerable citizens. The third stage entails policy implementation: the realization of adaptation measures. These measures are divided into two categories: health care measures and adaptive measures to the built environment. The first is meant to reduce heat stress during a heat wave through adjustment of behaviour, such as drinking extra water, shutting windows, and heat information lines. The latter is meant to prevent heat stress by moderating temperatures indoors and outdoors through adaptive measures to buildings and the urban fabric, such as installations of green roofs, air conditioning, insulation of buildings, and tree planting. The fourth stage is about policy maintenance after implementation. For heat prevention, it concerns (ongoing) risk communication: to have a media campaign ready for the issue of a heat alert and for the provision of heat prevention tips to the public. Each of these stages can be the responsibility of public actors (public responsibility), of private actors (private responsibility), of the vulnerable citizen him/herself (individual responsibility) or a joint responsibility between public and private actors as witnessed in policy networks and partnerships (public–private responsibility).

Considerations

We contend that each allocation of a certain responsibility to a public or private actor is driven, either implicitly or explicitly, by one or more considerations. Based on the work of Mees et al. 2012, we distinguish six considerations which might play a role in responsibility divisions for the protection of vulnerable citizens against extreme heat.

Rule of law concerns conforming to the regulations to which the adaptation issue is subject (Driessen and Van Rijswick 2011). National regulations and constitutions often assign certain duties of care to local public authorities. For instance, municipalities may have a duty of care for the health of their citizens, or for the liveability of their city, which includes the creation of a comfortable climate.

Fairness is about a reasonable distribution of costs, benefits, risks and responsibilities (Aakre and Rübbelke 2010). Fairness is a subjective concept, and several principles serve to structure the debate on fairness. Those principles can be applied to achieve a fair distribution of burdens and benefits in society. Fairness often leads to public responsibilities, to safeguard an equitable distribution of burdens and benefits (e.g. Paavola 2008; Eakin and Lemos 2006; Osberghaus et al. 2010). Local governments can, for instance, re-distribute benefits, i.e. scarce municipal resources to reduce the heat load of senior citizens' houses through better insulation, by applying Rawl's maximin principle of "putting the most vulnerable first" (e.g. Paavola 2008; Grasso 2007; Paavola and Adger 2006). On the other hand, a fair distribution can also be guided, for instance, by the "beneficiary pays principle", in which case the burdens fall on those who benefit from

taking adaptation action (e.g. Driessen and Van Rijswick 2011; Atkinson et al. 2000).

Securing adaptation action concerns the attainment of predefined adaptation goals to secure the supply of sufficient levels of an adaptation good, in our case the effective protection of vulnerable citizens against extreme heat. In case of market failure, governments can step in by providing the adaptation good themselves or by stimulating private adaptation action, for instance, by offering subsidies for better insulation of houses (e.g. Berkhout 2005; Mendelsohn 2006; Aakre and Rübbelke 2010).

Efficiency relates to the optimum allocation of scarce resources by supplying an adaptation good at the lowest cost. Economists claim that markets are generally more efficient in allocating scarce resources and in spurring innovations (e.g. Agrawala and Fankhauser 2008; Baarsma et al. 2010), and therefore, the consideration of efficiency is often linked to private responsibilities.

Legitimacy relates to the acceptance by stakeholders and society of certain adaptation goals and measures, and of the way in which decisions about these goals and measures are made. Acceptance is generally enhanced through the involvement of all relevant public and private stakeholders (Edelenbos and Klijn 2005). It often requires public–private arrangements through deliberative processes in which a wide range of stakeholders can participate, and particularly, those most affected by extreme heat (e.g. Hulme et al. 2007; Adger et al. 2009).

Accountability refers to clarity of responsibilities and transparency of information on the content and process of policymaking, so that public and private actors can be held accountable. It requires transparency in decision-making processes, and open access to and sharing of information among actors. Literature suggests that networks in which responsibilities are shared are able to foster communication, information and knowledge dissemination (e.g. Bogason and Musso 2006; Bodin and Crona 2009).

The above shows that each consideration could place responsibilities on different actors. The question then is: which consideration(s) is/are considered to be more important than others and which important but contradicting considerations might pose trade-offs in the division of responsibilities among the various public and private actors involved?

Methods

Three research steps were conducted. Since there are currently no local arrangements for heat stress prevention in the Netherlands, the first step explored the perceptions of public and private responsibilities for the care of vulnerable citizens among representatives of key public and private organizations with a potential stake in adaptation to extreme heat, as well as the underlying considerations for assuming these responsibilities. It consisted of two interactive multi-stakeholder workshops organized in 2013 in Arnhem and Rotterdam, the Netherlands, and one focus group of elderly people in Rotterdam. The workshops were co-organized with the local authorities of these cities: they were interested in hearing the views of relevant public and private stakeholders, as input for the development of a local heat adaptation policy and of a local governance arrangement. Workshop participants were representatives of key public and private stakeholders in social and health care, special interest groups such as for the elderly and chronically ill, and various stakeholders involved in the built environment, such as housing corporations, urban planners, architects, construction companies and certifying bodies for sustainable building. A list of organisations represented in the two workshops can be found in the online supplementary material. In total, 63 participants were divided into subgroups involved either in health care or in the built environment. Each subgroup consisted of 10–14 people who deliberated on the division of responsibilities for adaptation to extreme heat and the breadth of tasks of the local authorities, and the rationales for assuming such divisions. These discussions were recorded, transcribed and summarized in reports. To complement the results of the workshops, we organized a discussion of around 1 h with 14 senior citizens active as peers in community work for the elderly, as the largest affected citizen group. During this discussion, we particularly explored the issue of individual versus collective responsibility. This discussion was also recorded and transcribed.

The second step answered the question of what can be learned from cities where a heat stress policy has been implemented, with respect to how responsibilities are shaped and to how trade-offs are resolved in practice. The existing governance arrangements of these cities were analysed by a content analysis of relevant literature, reports (mostly from the World Health Organization and European research projects such as CIRCLE-2 and GRABS), local policy documents and internet sites. Ten foreign cities were selected for their experience with the four policy stages in adaptation to extreme heat so that actual responsibilities can be mapped: Chicago, Kassel, London, New York, Paris, Philadelphia, Rome, Stuttgart, Tatabanya and Toronto. Moreover, they represent cities in temperate climates that may show a range of arrangements under a range of different more publicly or more privately oriented health care systems. The cities in Europe and Canada, like the Netherlands, have some form of a universal public health care system based on the principle of solidarity. By contrast, the three cities in the USA provide examples of arrangements that have emerged under an individual health

care system based on the beneficiary pays principle. Finally, the selection was constrained by practical reasons: information had to be easily traceable, transparent and available in the English, Dutch or German language (as restricted by the language skills of the first author). An overview of the main adaptation activities and measures of these cities can be found in the online supplementary material. The desk research resulted in an overview of existing public and private responsibilities for adaptation to heat stress and an analysis of how these cities deal with vulnerable citizen groups.

In a final analytical step, the results of perceived responsibilities (from the workshops/focus group) and of the actual responsibilities (from the desk research of ten cities) were combined and compared. In doing so, the ten cities provided on the ground experience against which the perceived responsibilities could be checked. Furthermore, these cities provided valuable examples of how the trade-offs in terms of considerations found in the workshops could be dealt with in practice, in particular with respect to the different ways in which active outreach to vulnerable citizens is organized to balance the trade-off between personal empowerment and legitimacy, on the one hand, and securing sufficient adaptation action to protect vulnerable citizens, on the other hand.

Perceived responsibilities and considerations

The first project gained insight into the perceived responsibilities and their underlying considerations, an overview of which is provided in Table 1. This section summarizes the key points raised in the discussions held during the multi-stakeholder workshops and the elderly focus group. The results are structured in line with the four policy stages. As stated in the introduction, two questions are pertinent in the debate on responsibilities for the protection of vulnerable citizens against extreme heat: individual versus collective responsibility, and in case of collective responsibility, public versus private responsibility. Stages one, two and four concern a debate between public versus private or public–private responsibilities; the third stage contains the additional dimension of individual versus collective responsibility; a contentious issue, as is further discussed below.

Problem analysis

Participants perceive the assessment of vulnerabilities to be quite critical, since this type of knowledge underpins an efficient and effective policy targeted at different vulnerable citizen groups. The discussions focussed on the socially isolated elderly who live independently, since they are judged as most vulnerable, but also the most difficult group to identify. They literally slip through the safety net because they do not fall into some kind of health care system (such as home care or elderly care homes), but they are perceived to be unfit to bear individual responsibility for their heat health.

In all subgroups, the local authorities are perceived to be the appropriate actor to acquire and assemble knowledge regarding vulnerabilities. The considerations for allocating this responsibility with the local authorities are twofold. First, they are regarded as the most efficient actor to oversee the whole city; to collect the necessary information from different sources/actors, such as health practitioners, social workers and community groups; and to ensure that the mapping of vulnerable groups happens in a uniform way. Second, it was assumed that they take on this responsibility because of the consideration of rule of law: from their duty of care for the general health of the population as prescribed by law in the Dutch Public Health Act (WPG 2008). In the health care subgroups, it was suggested that the public health service agency should develop "a social neighbourhood map" (translated from Dutch "sociale wijkkaart") based on the collective knowledge of different organizations. As expressed by a representative of a private home care organization: "My employees are an important source of information, since they are able to observe people behind the front door" (Arnhem 2013). This neighbourhood map should not be limited to the prevention of heat stress, but can be used to address all kinds of social issues.

There was no difference of opinion between public or private representatives: all believe the public authority to be primarily responsible. Some difference was observed between the health care and built environment subgroups. Discussions in the first group were more people-oriented and focussed on the personal characteristics of vulnerable people. In the latter group, discussions were more place-oriented: the geographic identification of "hot spots", of places with more heat load due to the density of buildings and lack of green space. The challenge is how to bring these social-human and physical-environment assessments together, a challenge that was more directly addressed in the health care subgroups where the need for cooperation between health care and the built environment was explicitly mentioned as an important step forward.

Policymaking

The discussions illustrate a pragmatic approach to policymaking: the protection of vulnerable citizens should not be treated separately, but should be integrated as an attention point within existing health care and sustainable urban planning policies. For instance, the heat health of vulnerable citizens can be addressed by incorporating heat

Table 1 Summarized overview of perceived responsibilities and considerations

Role	Consensus or dissensus	Responsibility	Considerations	Explanation
Problem analysis: assessment of vulnerabilities of different citizen(group)s	Consensus	Public responsibility of the local authority	Efficiency	Local authority (public health service) oversees the city as a whole and can gather data from relevant public and private organizations
			Rule of law	Local authority has a duty of care for the health of its citizens as prescribed by Dutch law (but it is sufficiently broad and vague to allow flexibility)
Policy making: development of a plan for vulnerable citizens	Consensus	Public responsibility of the local authority	Rule of law	Local authority has a duty of care for the health of its citizens as prescribed by Dutch law
			Fairness	Only public authorities can fairly weigh different interests and guard the interests of the weakest
Policy implementation: realization of health care measures	Dissensus	Individual responsibility of the vulnerable person him/herself	Legitimacy	Interventions by third parties, in particular active interventions, are regarded as paternalism and invasion of one's privacy
			Personal empowerment	Everybody has the right to decide for themselves in matters of their health
			Accountability	Many measures, such as drinking more water, are simply hard to control and non-enforceable
		Collective: joint responsibility of all public and private stakeholders	Securing adaptation action	Use the collective resources in society in an effort to safeguard the protection of vulnerable citizens that are unable to bear that responsibility themselves
Policy implementation: realization of adaptive measures to individual buildings	Consensus	Individual responsibility of the inhabitant or owner of the building	Fairness	Beneficiary Pays Principle: it is fair that the person benefiting from the measure pays for that measure
			Efficiency	The inhabitant/owner can adjust according to his/her own needs and budget
Policy implementation: realization of adaptive measures in neighbourhoods	Consensus	Collective: joint responsibility of all public and private stakeholders	Efficiency	Implementation of measures that serve multiple purposes, such as green no-regrets measures, thus accessing multiple budgets to finance these measures
Policy implementation: realization of adaptive measures at city-wide scale	Consensus	Public responsibility of the local authority	Rule of Law	Local authority has a duty to care for the maintenance of the public space and the liveability of the city in general
Policy maintenance: risk communication	Consensus	Public responsibility of the local authority	Rule of Law	Local authority has a duty of care for the health of its citizens as prescribed by Dutch law

prevention in social neighbourhood teams ("sociale wijkteams") or by incorporating insulation standards in the procurement of buildings for elderly care homes, hospitals and other places with large concentrations of vulnerable citizens.

There was broad agreement among the participants that policymaking should be undertaken by the local authorities. They are responsible for the initiation and coordination of policymaking, and in doing so, they should seek cooperation with other organizations. Duty of care for the health of citizens is an important consideration for this public responsibility. Furthermore, the consideration of fairness is also important, since public authorities are able to fairly weigh societal interests and guard the interests of those most vulnerable. The latter is a representation of the fairness principle of "putting the most vulnerable first".

The debate regarding policymaking did not centre so much on *who* should be responsible, but rather on *how* public authorities should exercise their responsibility, in particular with respect to policies to ensure that buildings become "heatproof" over time through the introduction of norms in building codes or the requirement for certain adaptation measures such as green roofs. This was a viable option among most representatives in the health care groups, given the duty of care of the government for the liveability of the built environment. There was, however, some debate in the built environment groups regarding the usefulness and necessity of such a regulation. Arguments against regulation ranged from lack of urgency, lack of knowledge regarding which type of norms would be feasible, lack of political support for any new regulation, to lack of verifiability and enforceability. On the other hand, some participants, from public and from private organizations, think it is the only option for the effective protection of vulnerable citizens, after a preparatory period of awareness-raising and stimulation via, for instance, subsidies for insulation or green roofs. One participant commented: "In the long run, you cannot avoid addressing healthy living issues such as heat stress prevention in the building code" (Rotterdam 2013a).

Policy implementation

It is this policy stage that was fiercely debated, and over which certain dilemmas emerged regarding the allocation of responsibilities. We first address the debates on health care measures, where the dilemma of individual versus collective responsibility was most dominant. Secondly, we address the debates on measures in the built environment. Thirdly, we address another dilemma that came to the surface, i.e. that of the divisions of responsibility between health care and the built environment.

Health care measures

All participants agree that the responsibility for the protection of vulnerable citizens, who are hospitalized or living in health care institutions, is borne by that particular health care institution. The debate focused on the isolated elderly/disabled people living alone as the most difficult vulnerable group to reach out to. Interestingly, views diverged randomly and not necessarily between public and private representatives, suggesting that there is a general societal dilemma regarding individual versus collective responsibility for one's health.

Participants in favour of individual responsibility use three different considerations. The first is the right to decide over one's own health ("Why can't I decide for myself how and when I want to die?", Arnhem 2013). Another consideration is accountability; there is no way of actually controlling or forcing someone to change their behaviour ("Old people are very stubborn", Rotterdam 2013b). By far, the most important consideration is legitimacy: interventions that directly approach vulnerable individuals are viewed as patronizing and as invasion of one's privacy. This corresponds with the work of Wolf et al. (2010) who found in a UK study that such interventions are perceived as impingement on one's independence. The word "patronizing" was mentioned very often during the workshops and in the elderly focus group. In the elderly focus group, some nuances were sensed regarding the limits of patronage from different forms of active interventions. A house visit ("getting behind the front door", Rotterdam 2013b) was not acceptable, in any case by strangers, but an SMS alert or phone call was still considered legitimate.

Other participants inclined towards collective responsibility, basing this on the consideration that it is the only effective way to protect vulnerable people. These participants assume a collective responsibility, in the sense that all public and private actors who can potentially play a role should bear a joint responsibility. Effectiveness is a key consideration for this joint responsibility, since a collective effort provides the best guarantee that vulnerable citizens are actually reached. It is suggested that public health authorities should seek cooperation with existing private health care networks and community networks such as neighbourhood watch groups, volunteer networks such as the Red Cross, and interest groups for the elderly. The specific role of the public health authorities would then be to initiate, facilitate and coordinate these networks. Furthermore, it is suggested to piggyback by integrating heat prevention into existing public–private networks such as the earlier mentioned social neighbourhood teams.

Measures in the built environment

All agreed that measures to individual buildings are an individual responsibility of the inhabitant(s) of that building or the building owner. There are two considerations for this responsibility. First and foremost, it is regarded as fair that the person(s) who benefit from taking the measure should also bear the responsibility for realizing and financing that measure, an expression of the fairness principle of "the beneficiary pays". However, concerns were expressed as how to use this principle in practice, since the building owner and the building inhabitant are often not the same person. This would require smart financial constructions. The second consideration for individual responsibility is that it is seen as most efficient that the inhabitant him/herself selects the most appropriate solution for his/her own purposes. With particular regard to vulnerable individuals, it is suggested to adopt new technologies such as home automation, so that these individuals and their living environment (e.g. indoor temperature) can be monitored from a distance. With respect to measures at the neighbourhood level, participants are quite reluctant to implement measures purely for the sake of heat stress prevention. Even for the areas more vulnerable to heat stress such as specific hotspots and deprived neighbourhoods, it is suggested not to address heat prevention as an isolated issue, but to link up with other interests and benefits so that various public and private stakeholders can bear responsibility for improving those neighbourhoods. The most important argument used for this joint responsibility is efficiency; it is cheaper to implement measures that serve multiple purposes and their fringe benefits help disclose different public and private budgets. Another consideration is legitimacy; in the eyes of the participants, there is no societal support for tackling heat prevention separately. City-wide measures are regarded as the sole responsibility of the public authority, being the manager of the public space. Not much emphasis was placed on these measures, because it was agreed that it would be much more efficient to target specific vulnerable hotspots/neighbourhoods.

Health care versus the built environment

From the comparison of the discussions in the health care and built environment groups, a slight tendency to shift responsibilities from one side to the other surfaced. Health care representatives contend that a gradual, proactive adaptation of the built environment of vulnerable citizens over the next 30 years will make a reactive quick fix of the health effects of extreme heat superfluous in the long term. On the other hand, representatives of the built environment argue that it is far more efficient to react to extreme heat events as and when they come ("How often do heat events occur?" and "They affect only a limited number of vulnerable citizens", Rotterdam 2013a), than to take expensive adaptive measures. Furthermore, they argue that any attempt at adapting a building is worthless, if the vulnerable individual fails to ventilate properly or drink sufficiently. This dilemma indicates that there is a need for the two types of stakeholder groups to cooperate with each other.

Policy maintenance

There was general agreement that the role of risk communication is a public responsibility. According to participants, the absolute minimum that can be done is a passive intervention, i.e. ensure that vulnerable people and their social network are aware of the risks and well informed about the things one can do oneself to adapt to extreme heat. According to the participants, the national government and local authorities bear the responsibility for issuing a media campaign when a heat wave is anticipated. Again, rule of law is the key consideration: the duty of care of the municipality/government for the health of its citizens.

Actual responsibilities

The second project entailed an analysis of actual responsibilities as observed in the governance arrangements of ten foreign cities, the insights of which enable a reflection on the perceived responsibilities discussed in the previous section. In this section, the responsibilities for the four policy stages and the extent to which attention is paid to the protection of vulnerable citizens are discussed (a detailed overview of activities can be found in the online supplementary material). The desk research revealed an increased focus on adaptation to extreme heat in Europe, where the heat waves of 2003 and 2010 triggered planning activities at various governance levels (Lowe et al. 2011; Matthies and Menne 2009). Table 2 summarizes the observed responsibilities. Many cities spend considerable efforts on the protection of vulnerable citizens, but these are mainly confined to health care measures.

Problem analysis

Most cities have data available (aided by satellite imagery) to identify hotspots within the city, and these are often combined with data on concentrations of elderly citizens. This identification is typically a public responsibility of the local authorities, which corresponds with the perceptions of the Dutch stakeholders. Several cities have a refined method for detecting specific vulnerable groups or

Table 2 Summarized overview of actual responsibilities in the foreign cities

Policy stage	Responsibility	Explanation
Policy preparation: assessment of vulnerabilities of different citizen(group)s	Public responsibility of the local authority	Most cities extend their assessment beyond purely geographic indicators, to include socio-economic factors that may lead to increased sensitivity, exposure or reduced adaptive capacity
Policymaking: development of a plan for vulnerable citizens	Public responsibility of the local authority	All cities have an early warning system and response plan, but relatively few plans focus to a large extent on vulnerable citizens. Two cities were found to have a dedicated plan for the protection of vulnerable citizens
Policy implementation: realization of health care measures	Individual responsibility of the vulnerable person	
	Public responsibility of the local authority	Active intervention of the public health or social service towards vulnerable citizens (witnessed in one city)
	Collective: joint responsibility of all public and private stakeholders	In many cities, public authorities collaborate with health practitioners and civil society groups to actively engage with vulnerable citizens
Policy implementation: realization of adaptive measures to individual buildings	Individual responsibility of the inhabitant or owner	
	Public responsibility of the local authority	Public authorities install or subsidize air conditioners for low income vulnerable elderly people (witnessed in one city)
Policy implementation: realization of adaptive measures at district or city-wide level	Public responsibility of the local authority	Several cities turn public buildings into cooling centres during a heat wave in districts with high concentrations of vulnerable citizens
Policy maintenance: risk communication	Public responsibility of the local authority/government	All cities (or their national governments) activate a media campaign for the general public during a heat wave

individuals, based on socio-economic indicators of vulnerability. In Paris, France, a so-called CHALEX database exists of vulnerable citizens who have registered themselves voluntarily following an invitation letter from the Mayor (Cadot et al. 2007). Voluntary registration also happens in Kassel, Germany (Müller et al. nd). A registration system of vulnerable citizens in Rome was informed by records of hospital admissions and by general practitioners (WHO 2007). One of the most advanced assessments is witnessed in Toronto, Canada. The Toronto public health authority uses an advanced modelling tool, which assesses vulnerable population groups based on an extensive list of indicators for exposure, sensitivity and adaptive capacity (TPH 2011a). It contains both general and target group-specific indicators (e.g. 12 specific indicators for sensitivity in the elderly), which enables a very refined mapping of vulnerable citizen groups (see Fig. 1 for an example).

Policymaking

In the ten cities, heat health early warning systems and response plans are in place and their development is a public responsibility borne by the local authorities, which again corresponds with the perceptions of the stakeholders of the workshops. In a recent large empirical study on adaptation in cities, Bulkeley et al. (2013) found that only in four out of 76 cases there was an explicit focus on the protection of vulnerable citizens in the formal adaptation planning processes of the city. As far as documents of the cities were retrievable, we found that most make mention of vulnerable citizens in formal planning documents. Only three cities, however, have elaborate descriptions about activities for the protection of vulnerable citizens. The heat emergency plan of Philadelphia pays extensive attention to the allocation of responsibilities for the protection of vulnerable citizens (POEM 2010); Toronto and Paris have separate policy documents for the protection of vulnerable people.

Policy implementation

Health care measures

Most cities have different arrangements in place resulting from different approaches to reaching out to vulnerable individuals (see Table 3 for an overview of different approaches). In Paris, a public arrangement exists; the local authorities are in charge of the earlier mentioned CHALEX database, and during a heat wave, the registered citizens in this database are called every other day by the public social services. The analysis also revealed several interactive arrangements, where public (health) authorities collaborate with health practitioners and social/community workers. The most prominent example appears in Philadelphia, USA. The public authorities cooperate with the

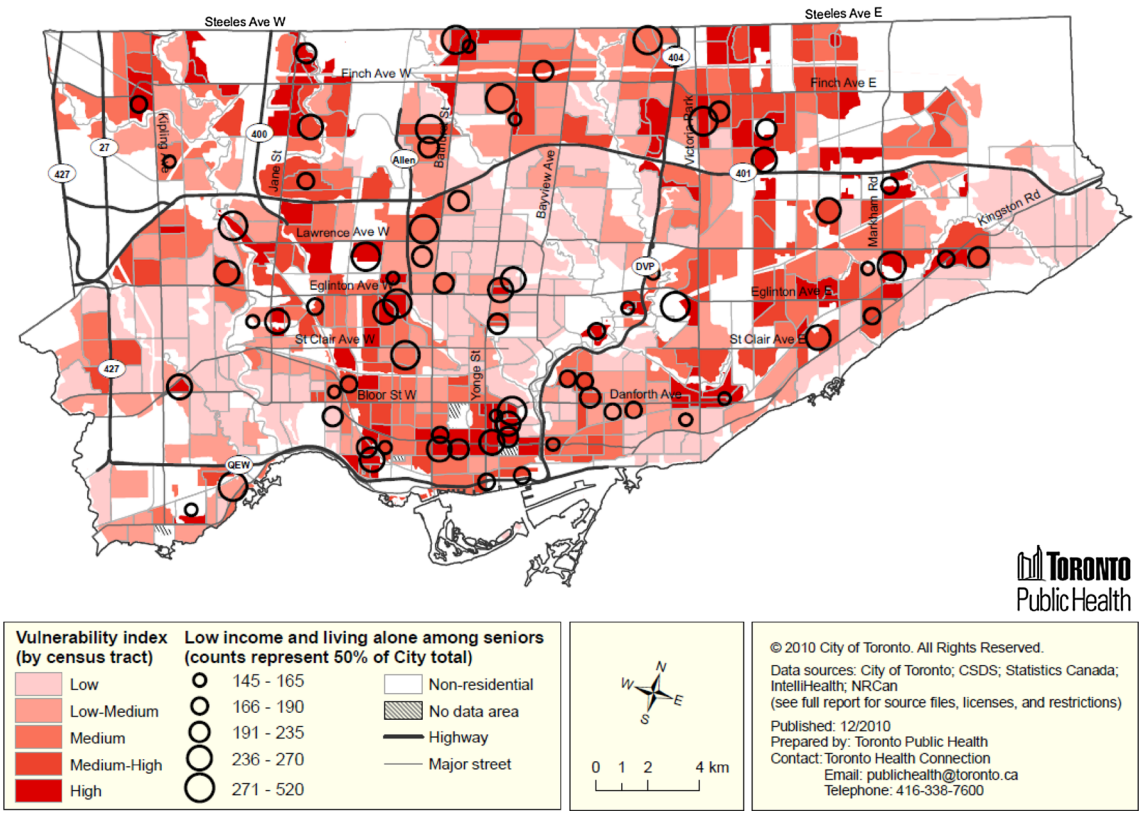

Fig. 1 Low income seniors living alone and seniors' heat vulnerability index in Toronto (TPH 2011a). Reprinted with the permission of Toronto Public Health

Table 3 Approaches of active outreach to vulnerable citizens

Approaches to vulnerable citizens living independently	Examples from the ten foreign cities
How vulnerable citizens are identified	Assessment and geographic mapping (most cities)
	Voluntary self-registration (Paris, Kassel)
	Records of hospitals and general practitioners (Rome)
How vulnerable citizens are addressed	Passive heat line (most cities)
	Active phone calls (Paris, Kassel, London, Toronto)
	Home visits (Philadelphia, Rome)
	Cooling centres for vulnerable citizens (most cities)
Who approaches vulnerable citizens	Social service (Paris)
	Public–private networks (Kassel, Philadelphia, Rome)

Philadelphia Corporation for Aging by implementing a heat line during heat waves. A nursing team is available to pay home visits following the calls from the heat line. Furthermore, the city works with a buddy system, consisting of community volunteers who actively keep an eye on and pay visits to vulnerable citizens (EPA 2008; Kalkstein et al. 2009; Ebi et al. 2004). In Kassel, Germany, a network ("Netzwerk Hitzeprävention") has been created of public health officials, health practitioners and community workers who actively approach vulnerable citizens through home visits and telephone assistance (WHO 2007). In Toronto, in addition to setting up a heat line, active outreach is organized via public agencies and community groups (TPH 2011b). In Rome, registered citizens are actively contacted during a heat wave, using existing networks of social services, general practitioners and volunteers (Matthies and Menne 2009; WHO 2004).

Measures in the built environment

Measures at the level of buildings, such as the installation of air conditioning, are the individual responsibility of the building owners. In some cities, public authorities promote more sustainable adaptive measures such as green roofs. These cities have hierarchical arrangements where the public authorities take on responsibility for initiating some

kind of policy to change the behaviour of building owners, either through a building code that requires building owners to install an albedo or green roof or through economic incentives (e.g. subsidies for green roofs). Measures on a larger spatial scale that apply to parts or the whole of a city are generally the responsibility of public authorities, such as the designing of ventilation corridors, the planting of street trees, the installation of permeable paving and the provision of drinking fountains. Many city governments, for instance, have tree planting programmes in place, some of which direct planting efforts to specific hotspot areas (e.g. Toronto). Based on the desk research, we could find only one common measure directly targeted at vulnerable citizens: in several cities (New York, Chicago, Philadelphia, Toronto and Paris), the local authorities assign certain public places (such as swimming pools, libraries, senior centres, hotels) as cooling centres in specific neighbourhoods.

Policy maintenance

In the foreign cities, the public authorities are responsible for informing and advising the general public about an upcoming heat wave. This passive public intervention relies on the self-governance of citizens; citizens bear an individual responsibility for adapting their behaviour to extreme heat. This public responsibility is in line with the perceptions of the Dutch stakeholders.

Perceived versus actual responsibilities

The perceptions of the 63 stakeholders and 14 elderly in the two Dutch cities regarding responsibilities for the protection of vulnerable citizens are broadly in line with the actual responsibilities in the ten foreign cities. The duty of care of Dutch municipalities for the citizens' health drives the expectation in Rotterdam and Arnhem that the local authorities are responsible for the collection of information regarding physical, geographic and socio-economic determinants of vulnerabilities of different citizen groups, and this is mirrored in the actual responsibilities for problem analysis as observed in the foreign cities. Likewise, there is a perceived public responsibility for policy making (initiating and developing a policy plan for the protection of vulnerable citizens), for the implementation of city-wide measures in the built environment and for policy maintenance (risk communication), which again is consistent with the public responsibilities observed in the foreign cities. The observed public responsibilities are omnipresent in the ten foreign cities; they also apply to the three US cities subject to individual health care. The expected private responsibilities for adaptation to private buildings also coincide with the observed private responsibilities in the foreign cities.

The workshops brought an important dilemma to the fore regarding individual versus collective responsibility for the protection of vulnerable citizens. The different customized approaches that were observed in the foreign cities (see Table 3) suggest this is a common dilemma: each city has found a way to actively reach out to vulnerable citizens in an effort to strike a balance between the consideration of legitimacy (avoidance of paternalism) and securing sufficient action to protect the most vulnerable. In some cases, vulnerable individuals are spontaneously contacted; in other cases, vulnerable people register themselves on a voluntary basis. In several cases, house visits are conducted; in other cases, telephone calls are made, as this is less intrusive. In one city (Paris), public officials approach the vulnerable; in most other cities, this activity is done by private actors such as community workers, elderly peers or health practitioners. In the majority of the studied foreign cities, this has led to a collective, public–private responsibility for the implementation of health care measures through the employment of networks that contain public health officials, community workers, health practitioners and/or elderly peers.

Conclusions and reflections

While most of us can readily adapt to heat, vulnerable citizens such as the elderly, disabled and socially deprived are faced with high risks of morbidity and mortality if they are not properly supported. Research has so far paid limited attention to the governance of the protection of vulnerable citizens against extreme heat. In the governance practice of cities, the protection of vulnerable citizens is not (yet) extensively addressed either, even if heat events are described as the most deadly natural disasters in temperate climates. This research aimed to explore potential local governance arrangements for adaptation to heat stress. It analysed stakeholder perceptions of public and private responsibilities for the protection of vulnerable citizens, as well as their underlying considerations and the trade-offs among these considerations in two Dutch cities. These results were compared against the actual responsibilities as observed in ten foreign cities. These foreign cities also provided valuable input as to how the trade-offs could be resolved by showing a variety of approaches as to how vulnerable citizens can be actively approached. From the results of this twin-research method, we derive the following conclusions.

First, the common patterns of perceived and actual responsibilities show that, although the need for both public and private responsibilities is apparent, an extensive public responsibility borne by local authorities is regarded as pivotal to safeguarding the protection of vulnerable

citizens. The fulfilment of three out of four policy stages is viewed and fulfilled as a public responsibility. This is not to say that the contribution of private actors, such as health practitioners, community volunteers, families and friends is not viewed as necessary, but they mainly play a role in the policy implementation stage by actively reaching out to the different vulnerable citizen groups in the implementation of health care measures, often in network arrangements with the local authorities.

Second, this research highlights that the issue of individual versus collective responsibility generates debate and embodies a serious trade-off in terms of considerations. The workshop results show that (at least for the Netherlands), individual responsibility for one's own (heat) health and consequently for taking adequate health measures is a sensitive topic. Interventions by others, meant to safeguard the protection of those citizens who have difficulty bearing this individual responsibility, are easily viewed as interference or even paternalism. Hence, the considerations of securing sufficient adaptation action and fairness, in terms of protection of the weakest in society, face competition from considerations such as legitimacy (avoidance of paternalism) and personal empowerment. This trade-off appears to have played in the ten foreign cities too, as can be deduced from the different approaches they have taken to deal with this sensitivity issue. At least for this climate adaptation issue, this trade-off provides a challenge. How does one put into practice the dominant stance in the adaptation literature of "putting the most vulnerable first" to achieve a fair adaptation to climate change (e.g. Paavola 2008; Grasso 2007; Paavola and Adger 2006)? Building on the works of Sampson et al. (2013) and Wolf et al. (2010), we argue that this extra dimension needs careful attention in governance arrangements that aim to protect vulnerable citizens against extreme heat.

Third, the results indicate that a customized and differentiated approach is needed for the implementation of health care measures in light of the trade-off mentioned above. This differentiated and context-dependent approach becomes apparent in the different ways in which the ten foreign cities implement health care measures for the protection of vulnerable citizens. It suggests that the implementation of health care measures should be targeted at different types of vulnerable groups, taking into account sensitivities as to which type of active interventions (e.g. SMS alert, telephone call, house visit) by which type of actors (e.g. family, friends, peers, health care professionals, community volunteers) are still perceived as legitimate.

Fourth, joint public–private responsibilities are viewed to be important for employing this customized and diversified approach in the implementation of health care measures. Here, forces are joined, since it is rather difficult to reach vulnerable citizens and activate them to change their behaviour (e.g. Sampson et al. 2013; Allex et al. 2013; Sheridan 2007). Several arrangements have been created in the cities of Kassel, Rome, Philadelphia and Toronto by using networks of local public, private and civil society groups. These networks and the types of active interventions can vary per city, depending on the availability of these public and private groups and the resources they have at their disposal, leading to localized network arrangements.

Finally, Dutch stakeholders think that heat prevention should be integrated into existing policies, health and community networks, and urban design measures. This so-called "mainstreaming of climate adaptation" (cf. e.g. Uittenbroek et al. 2012; Berrang-Ford et al. 2011; Adger et al. 2005) delivers efficiency gains by utilizing existing societal resources rather than requiring new resources to be spent on a climate issue of incidental character such as a heat wave. Mainstreaming applies to both health care and built environment responses; for the latter, it also entails the implementation of no-regrets measures, in which heat prevention of the built environment is combined with other interests such as the energy efficiency of buildings or the improvement of the liveability of a city district.

In sum, this research suggests that there is likely to be a co-existence of several governance arrangements in correspondence with the different policy stages and the different contexts of a city. The stages of problem analysis, policymaking and policy maintenance are likely to be fulfilled through more public arrangements, while policy implementation is likely to be fulfilled by one or more network arrangements tuned to different vulnerable groups and to different deployable public and community networks. These network arrangements can be dormant and activated only when a heat wave occurs.

We end with some reflections regarding our research. Our starting point was that a certain sense of urgency is present for dealing with heat stress. For many cities, the reality is that this urgency is still absent or weakly developed (e.g. Runhaar et al. 2012; Luber and McGeehin 2008). In such cases, the creation of awareness and sense of urgency require attention first before discussions can start regarding who does what to protect vulnerable citizens during a heat wave. Another reflection is that, even if we selected Western democratic cities as comparative cases for the two Dutch cities, this does not imply that the governance arrangements of these cities can be blindly transplanted, since this would also depend on the resemblance of institutional contexts of these cities (e.g. de Jong 2004). Furthermore, it became apparent that for this adaptation issue, the dichotomy of public versus private should be nuanced, because of (1) the additional dimension of individual versus collective responsibility, (2) the apparent necessity of joint public–private responsibilities

for health care measures, and (3) the thin line between what is actually public and what is private, as demonstrated by, for instance, private voluntary organizations such as the Red Cross that serve public interests.

While our research focussed on the local level, an avenue for further research would be to study multi-level dimensions of governance arrangements, and the (supportive) roles of national governments and supranational organizations such as the WHO. Another future avenue for research would be to evaluate emerging governance arrangements in terms of how effective they are in reducing the health effects of heat waves with vulnerable citizens, as and when heat wave occurrences increase and urban governance arrangements in this area become mainstream. As cities become hotter and the number of vulnerable citizens increases, the awareness and need for instigating local heat policy for the protection of vulnerable citizens will likely increase. Local governments are the most likely actors to take on the responsibility for the initiation and facilitation of "cool" governance networks in which the diverse public and private stakeholders are employed for a targeted outreach to vulnerable citizens.

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References

Aakre S, Rübbelke DTG (2010) Objectives of public economic policy and the adaptation to climate change. J Environ Plan Manag 53(6):767–791. doi:10.1080/09640568.2010.488116

Adger WN (2006) Vulnerability. Glob Environ Change 16:268–281. doi:10.1016/j.gloenvcha.2006.02.006

Adger WN, Arnell NW, Tompkins EL (2005) Successful adaptation to climate change across scales. Glob Environ Change 15:77–86. doi:10.1016/j.gloenvcha.2004.12.005

Adger WN, Dessai S, Goulden M, Hulme M, Lorenzoni I, Nelson DR, Naess LO, Wolf J, Wreford A (2009) Are there social limits to adaptation to climate change? Clim Change 93:335–354. doi:10.1007/s10584-008-9520-z

Agrawala S, Fankhauser S (eds) (2008) Economic aspects of adaptation to climate change: costs, benefits, and policy instruments. Executive summary, OECD Paris

Allex B, Arnberger A, Wanka A, Eder R, Hutter H-P, Kundi M, Wallner P, Kolland F, Blättner B, Grewe HA (2013) The elderly under urban heat pressure—strategies and behaviours of elderly residents against urban heat. In: Proceedings REAL CORP Tagungsband 20–23 May 2013, Rome, Italy. http://www.corp.at

Arnhem (2013) Workshop heat stress in Arnhem, held on Sept 12 2013

Atkinson G, Machado F, Mourato S (2000) Balancing competing principles of environmental equity. Environ Plan A 32:1791–1806. doi:10.1068/a32106

Baarsma B, Koopmans C, Theeuwes J (2010) Beleidseconomie. Een rationele onderbouwing van overheidsingrijpen. Amsterdam University Press, Amsterdam

Barriopedro D, Fischer EM, Luterbacher J, Trigo RM, Garcia-Herrera R (2011) The hot summer of 2010: redrawing the temperature record map of Europe. Science 332(6026):220–224. doi:10.1126/science.1201224

Berkhout F (2005) Rationales for adaptation in EU climate change policies. Clim Policy 5(3):377–391. doi:10.3763/cpol.2005.0521

Bernard SM, McGeehin MA (2004) Municipal heat wave response plans. Am J Public Health 94(9):1520–1522. doi:10.2105/AJPH.94.9.1520

Berrang-Ford L, Ford JD, Paterson J (2011) Are we adapting to climate change? Glob Environ Change 21(1):25–33. doi:10.1016/j.gloenvcha.2010.09.012

Biesbroek GR, Swart RJ, Carter TR, Cowan C, Henrichs T, Mela H, Morecroft MD, Rey D (2010) Europe adapts to climate change: comparing national adaptation strategies. Glob Environ Change 20:440–450. doi:10.1016/j.gloenvcha.2010.03.005

Bodin O, Crona BI (2009) The role of social networks in natural resource governance: what relational patterns make a difference? Glob Environ Change 19:366–374. doi:10.1016/j.gloenvcha.2009.05.002

Bogason P, Musso JA (2006) The democratic prospects of network governance. Am Rev Public Adm 36:3–18. doi:10.1177/0275074005282581

Bulkeley H, Carmin J, Castán Broto V, Edwards GAS (2013) Climate justice and global cities: mapping the emerging discourses. Glob Environ Change 23:914–925. doi:10.1016/j.gloenvcha.2013.05.010

Buyx AM (2008) Personal responsibility for health as a rationing criterion: why we don't like it and why maybe we should. J Med Ethics 34(12):871–874

Cadot E, Rodwin VG, Spira A (2007) In the heat of the summer: lessons from the heat waves in Paris. J Urban Health 84(4):466–468. doi:10.1007/s11524-007-9161-y

Cappelen AW, Norheim OF (2005) Responsibility in health care: a liberal egalitarian approach. J Med Ethics 31:476–480. doi:10.1136/jme.2004.010421

CCAP (2010) Chicago Climate Action Plan. Strategy 5 Adaptation, pp 39–43

CIRCLE (2013) Circle-2 adaptation inspiration book

Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N, Johnson A, Kett M, Lee M, Levy C, Maslin M, McCoy D, McGuire B, Montgomery H, Napier D, Pagel C, Patel J, Puppim de Oliveira J, Redclift N, Rees H, Rogger D, Scott J, Stephenson J, Twigg J, Wolff J, Patterson C et al (2009) Managing the health effects of climate change. The Lancet 373:1693–1733. doi:10.1016/S0140-6736(09)60935-1

Coumou D, Robinson A, Rahmstorf S (2013) Global increase in record-breaking monthly-mean temperatures. Clim Change 118(3–4):771–782. doi:10.1007/s10584-012-0668-1

De Jong M (2004) The pitfalls of family resemblance: why transferring planning institutions between 'similar countries' is delicate business. Eur Plan Stud 12(7):1055–1068. doi:10.1080/0965431042000267902

Dovers SR, Hezri AA (2010) Institutions and policy processes: the means to the end of adaptation. Wiley Interdiscip Rev Clim Change 1:212–231. doi:10.1002/wcc.29

Driessen PPJ, Van Rijswick HFMW (2011) Normative aspects of climate adaptation policies. Clim Law 2:559–581

Eakin H, Lemos MC (2006) Adaptation and the state: Latin America and the challenge of capacity-building under globalization. Glob Environ Change 16:7–18. doi:10.1016/j.gloenvcha.2005.10.004

Ebi KL, Teisberg TJ, Kalkstein LS, Robinson L, Weiher RF (2004) Heat watch/warning systems save lives. Estimated costs and benefits for Philadelphia 1995–98. Bull Am Meteorol Soc 85:1067–1073

Edelenbos J, Klijn EH (2005) Managing stakeholder involvement in decision-making: a comparative analysis of six interactive processes in the Netherlands. J Public Adm Res Theory 16(3):417–446. doi:10.1093/jopart/mui049

EEA (2012) Urban adaptation to climate change in Europe. Challenges and opportunities for cities together with supportive national and European policies. European Environment Agency Report No 2/2012

EPA (2008) Excessive heat events guidebook. United States Environmental Protection Agency report 430-B-06-005, June 2008

ETC (2010) Urban Regions: vulnerabilities, vulnerability assessments by indicators and adaptation options for climate change impacts. Scoping Study. The European Topic Centre on Air and Climate Change, ETC/ACC Technical Paper 2010/12

EWHOP (2006) Extreme heat weather operations plan. Chicago Police Department. http://directives.chicagopolice.org/directives/data/a7a57be2-12a76ce1-24512-a776-fa99e0b0a9221e57.html?ownapi=1

Fouillet A, Rey G, Laurent F, Pavillon G, Bellec S, Guihenneuc-Jouyaux C, Clavel J, Jougla E, Hémon D (2006) Excess mortality related to the August 2003 heat wave in France. Int Arch Occup Environ Health 80(1):16–24. doi:10.1007/s00420-006-0089-4

Friel S, Hancock T, Kjellstrom T (2011) urban health inequities and the added pressure of climate change: an action-oriented research agenda. J Urban Health 88(5):886–895. doi:10.1007/s11524-011-9607-0

Galvin R (2002) Disturbing notions of Chronic illness and individual responsibility: towards a genealogy of morals. Health 6(2): 107–137. doi:10.1177/136345930200600201

Grasso M (2007) A normative ethical framework in climate change. Clim Change 81:223–246. doi:10.1007/s10584-006-9158-7

Hulme M, Adger WN, Dessai S, Goulden M, Lorenzoni I, Nelson D, Naes L, Wolf J, Wreford A (2007) Limits and barriers to adaptation: four propositions. Tyndall Briefing Note 20. Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, UK

IFRC (2004) World disasters report 2004. Focus on community resilience. Chapter 2: Heatwaves; the developed world's hidden disaster. International Federation of Red Cross and Red Crescent Societies

IPCC (2012) Summary for Policymakers. In: Managing the risks of extreme events and disasters to advance climate change adaptation, Field CB, Barros V, Stocker TF, Qin D, Dokken DK, Ebi KL, Mastrandrea MD, Mach KJ, Plattner G-K, Allen SK, Tignor M, Midgley PM (eds) A special report of working groups I and II of the intergovernmental panel on climate change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp 1–19

IPCC (2013) Summary for policymakers. In: Stocker TF, Qin D, Plattner G-K, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V, Midgley PM (eds) Climate change 2013: the physical science basis. Contribution of working group I to the fifth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge

Kalkstein LS, Sheridan SC, Kalkstein AJ (2009) Heat/health warning systems: development, implementation, and intervention activities. In: Ebi KL et al (eds) Biometeorology for adaptation to climate variability and change. Springer, New York, pp 33–48

Kazmierczak A, Carter J (2010) Adaptation to climate change using green and blue infrastructure. A database of case studies. http://www.grabs-eu.org/membersArea/files/Database_Final_no_hyperlinks.pdf

Klimzug (2011) Prävention hitzebedingter Gesundheitsgefahren – das Hitzetelefon Sonnenschirm. Klimzug-Nordhessen. http://klimzug-nordhessen.de/fileadmin/Dokumente/Umsetzung/Hitzepraevention_Factsheet_Umsetzung_2-seitig_final.pdf

Kovats RS, Ebi KL (2006) Heatwaves and public health in Europe. Eur J Public Health 16(6):592–599. doi:10.1093/eurpub/ckl049

Lowe D, Ebi K, Forsberg B (2011) Heatwave early warning systems and adaptation advice to reduce human health consequences of heatwaves. Int J Environ Res Public Health 8:4623–4648. doi:10.3390/ijerph8124623

LRHP (2011) London Resilience Heatwave Plan. Preparing for emergencies. Greater London Authority. Sept 2011. https://www.london.gov.uk/sites/default/files/archives/London-Resilience-Heatwave-Plan-version-1.pdf

Luber G, McGeehin M (2008) The health impacts of climate change. Climate change and extreme heat events. Am J Prev Med 35(5):429–435. doi:10.1016/j.amepre.2008.08.021

Matthies F, Menne B (2009) Prevention and management of health hazards related to heat waves. Int J Circumpolar Health 68:8–22

Mees HLP, Driessen PPJ, Runhaar HAC (2012) Exploring the scope of public and private responsibilities for climate adaptation. J Environ Plan Policy Manag 14(3):305–330. doi:10.1080/1523908X.2012.707407

Mendelsohn R (2006) The role of markets and governments in helping society adapt to a changing climate. Clim Change 78:203–215. doi:10.1007/s10584-006-9088-4

Minkler M (1999) Personal responsibility for health? A review of the arguments and the evidence at century's end. Health Educ Behav 26(1):121–140. doi:10.1177/109019819902600110

Müller K, Heckenhahn M, Schimmelpfennig M (nd) Gezielte Prävention hitzebedingter Gesundheitsrisiken alter Menschen in der Kommune (PräKom). Gesundheitsamt Region Kassel

NYC (2011) Climate change adaptation: addressing heat-related morbidity and mortality among seniors in New York City. EPA webinar series: Public health effects of climate change. Presentation by Nathan Graber, department of Health and Mental Hygiene, held on Oct 18 2011. http://epa.gov/region2/climate/pdf/heat_related_mortality.pdf

Osberghaus D, Dannenberg A, Mennel T, Sturm B (2010) The role of the government in adaptation to climate change. Environ Plan C Gov Policy 28:834–850. doi:10.1068/c09179j

Paavola J (2008) Science and social justice in the governance of adaptation to climate change. Environ Polit 17(4):644–659. doi:10.1080/09644010802193609

Paavola J, Adger WN (2006) Fair adaptation to climate change. Ecol Econ 56:594–609. doi:10.1016/j.ecolecon.2005.03.015

POEM (2010) Heat emergency plan. City of Philadelphia Managing Director's Office of Emergency Management, May 2010

Poutiainen C, Berrang-Ford L, Ford J, Heymann J (2013) Civil society organizations and adaptation to the health effects of climate change in Canada. Public Health 127(5):403–409. doi:10.1016/j.puhe.2013.02.004

Robine J-M, Cheung SLK, Le Roy S, Van Oyen H, Griffiths C, Michel J-P, Herrmann FR (2008) Death toll exceeded 70,000 in Europe during the summer of 2003. C R Biol 331:171–178. doi:10.1016/j.crvi.2007.12.001

Rotterdam (2013a) Workshop heat stress, held on September 30th, 2013

Rotterdam (2013b) Discussion during meeting of Pluspunt, elderly focus group, held on Oct 14 2013

Runhaar H, Mees H, Wardekker A, Van der Sluijs J, Driessen P (2012) Adaptation to climate change related risks in Dutch urban areas: stimuli and barriers. Reg Environ Change 12:777–790. doi:10.1007/s10113-012-0292-7

Sampson NR, Gronlund CJ, Buxton MA, Catalano L, White-Newsome JL, Conlon KC, O'Neill MS, McCormick S, Parker EA (2013) Staying cool in a changing climate: reaching

vulnerable populations during heat events. Glob Environ Change 23(2):475–484. doi:10.1016/j.gloenvcha.2012.12.011

Schär C, Jendritzky G (2004) Hot news from summer 2003. Nature 432:559–560. doi:10.1038/432559a

Sheridan SC (2007) A survey of public perception and response to heat warnings across four North American cities: an evaluation of municipal effectiveness. Int J Biometeorol 52(1):3–15. doi:10.1007/s00484-006-0052-9

Tatabanya (nd) The launching of a local heat-and-UV-alert plan in Tatabánya, Hungary to set an example for other cities to follow. http://old.env-health.org/IMG/pdf/Andras_Olah_Tatabanya_Hungary_Launch__of_a_local_Heat_and_UV_alert_Plan.pdf

Tinghőg G, Carlsson P, Lyttkens CH (2010) Individual responsibility for what?–a conceptual framework for exploring the suitability of private financing in a publicly funded health-care system. Health Econ, Policy and Law 5(02):201–223

TPH (2011a) Implementation of a map-based heat vulnerability assessment and decision support system. Final project report and map series. Toronto Public Health, March 2011. http://www.climateontario.ca/doc/ORAC_Products/TPH/Mapping%20Tool%20-%20User%20Manual%20for%20Heat%20Vulnerability%20Mapping%20Tool.pdf

TPH (2011b) Protecting vulnerable people from health impacts of extreme heat. Toronto Public Health, July 2011. http://www.toronto.ca/health/hphe/air_quality/pdf/protecting_ppl_in_extreme_heat.pdf

Uittenbroek C, Janssen-Jansen L, Runhaar H (2012) Mainstreaming climate adaptation into urban planning: overcoming barriers, seizing opportunities and evaluating the results in two Dutch case studies. Reg Environ Change 13(2):399–411. doi:10.1007/s10113-012-0348-8

Verbeke P, Fonager J, Clark BFC, Rattan SIS (2001) Heat shock response and ageing: mechanisms and applications. Cell Biol Int 25(9):845–857. doi:10.1006/cbir.2001.0789

Wardekker JA, De Jong A, Van Bree L, Turkenburg W, Van der Sluijs JP (2012) Health risks of climate change: an assessment of uncertainties and its implications for adaptation policies. Environ Health 11(67):1–16. doi:10.1186/1476-069X-11-67

WHO (2004) Health and global environmental change series, no. 2. Heat-waves: risks and responses. World Health Organization

WHO (2007) Improving public health responses to extreme weather events. IV Preventing heat-related health effects. The prevention framework. World Health Organization

WHO (2010) WHO Collaboration Center for Housing and Health Newsletter No. 7. http://www.gesundheitsamt-bw.de/SiteCollectionDocuments/10_Kompz_WHOCC/Newsletter7.pdf

Wikler D (2002) Personal and Social responsibility for health. Ethics Int Aff 16(2):47–55. doi:10.1111/j.1747-7093.2002.tb00396.x

Wilhelmi OV, Hayden MH (2010) Connecting people and place: a new framework for reducing urban vulnerability to extreme heat. Environ Res Lett 5:014021. doi:10.1088/1748-9326/5/1/014021

Wolf J, Adger WN, Lorenzoni I, Abrahamson V, Raine R (2010) Social capital, individual responses to heat waves and climate change adaptation: an empirical study of two UK cities. Glob Environ Change 20:44–52. doi:10.1016/j.gloenvcha.2009.09.004

WPG (2008) Wet Publieke Gezondheid. http://wetten.overheid.nl/BWBR0024705/geldigheidsdatum_31-01-2014