Urban Forestry & Urban Greening 63 (2021) 127193

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.com/locate/ufug

Changes in recreation use in response to urban heat differ between migrant and non-migrant green space users in Vienna, Austria

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ARTICLE INFO

Handling Editor: Wendy Chen

Keywords:
Coping
Displacement
Green infrastructure
Recreation infrastructure
Risk factors
Urban heat
Visiting motives
Vulnerability

ABSTRACT

Previous research has found higher levels of heatwave mortality and morbidity among urban residents with a migration background because of their social, health and environmental conditions. The purpose of the study was to investigate and compare heat induced changes in the outdoor recreation behaviours of Turkish migrants with those of non-migrants on hot days in Vienna. Specifically, the study compared coping behaviours due to heat such as inter-area, intra-area, temporal and activity displacement between migrants and non-migrants. The study interviewed 400 migrants and non-migrants in four public green spaces of different area sizes and asked about their outdoor recreation motives and activities, as well as behavioural changes, due to summer heat. Results show that migrants have different motives for visiting urban green spaces on hot days, and that they visit these less frequently on hot days compared to non-migrants. While both groups shift their outdoor uses more to shady areas and the cooler times of the day, more migrants visit green spaces in the afternoon, perform more energetic recreational activities, and use sunnier sites more frequently than non-migrants on hot days. Few migrants and non-migrants stated that they would visit alternative green spaces when it is hot. The results indicate that migrants' behaviours result in higher heat exposure, while making less use of the opportunities larger green spaces such as forests can provide for heat relief. Recommendations on how green and city planners could reduce heat related health risks for both study groups are presented.

1. Introduction

1.1. Health impact of heat stress on urban population

Climate change is increasing the number, intensity and duration of heatwaves causing significant adverse health effects, especially on residents living in urban heat islands (Kovats and Hajat, 2008; IPCC, 2013; Klinenberg, 2002; Mayrhuber et al., 2018; Steul et al., 2018). Previous research has shown that vulnerability to heatwaves is distributed unequally across urban residents and has found higher levels of heat-associated morbidity and mortality among groups with a migration background (Hansen et al., 2013). The increased vulnerability of migrant groups is due to several overlapping risk factors such as the residential indoor environment, social status, and health condition, as well as cultural-behavioural specifics such as observing Ramadan (Leiper and Molla, 2003).

While some knowledge exists about factors influencing heat-related illness of migrants, more information on these groups is needed

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https://doi.org/10.1016/j.ufug.2021.127193
Received 25 September 2020; Received in revised form 3 May 2021; Accepted 17 May 2021
Available online 21 May 2021

(Hansen et al., 2013, 2014; Wiesböck et al., 2015) because the severity of health issues caused by heat is increasing with the rapid growth of the migrant population in many cities (Jay and Schraml, 2014). Despite European cities facing increasing heat risks, city administrations seem to have little awareness of the vulnerability of migrant groups (Hansen et al., 2014; Mayrhuber et al., 2018). One of the factors that has been rather neglected in heat risk research is outdoor recreation behaviour and the role green spaces play during heatwaves. Our study investigated whether – and how – heat changes the outdoor recreation behaviours of Turkish migrant, compared to non-migrant, green space users in Vienna, Austria. Vienna is a city which will be one of the most affected European cities by heat (Bastin et al., 2019).

1.2. Heat-coping behaviours in the context of urban green spaces

Possible strategies of urban residents for reducing heat stress impacts include the increased use of green spaces at cooler times of the day or refraining from specific outdoor activities during hot periods. However, not every green space might be a useful place on hot days and visitors may shift their uses to green spaces where, for example, more green, shade and water bodies result in cooler temperatures (Arnberger et al., 2017). Visitors may also change their recreational activities by moving from energetic to more passive activities, adjusting their use times and length of use, and visiting shadier areas of a green space. These heat-induced adaptations can be summarized under the concept of use displacement – a physical coping strategy to avoid undesired conditions (Arnberger et al., 2017; Arnberger and Eder, 2012; Baum and Paulus, 1991; Schuster et al., 2006; Schneider, 2007). So far, several types of use displacement have been recognized (Manning and Valliere, 2001); spatial displacement occurs when visitors shift their use to other locations within the same area (intra-area displacement) or move away from the area to other areas (inter-area displacement). Temporal displacement occurs when visitors change the time of their visits or length of stay. Research has identified the season, day, and the time of day as temporal substitutes (Arnberger and Eder, 2012; Hall and Shelby, 2000; Johnson and Dawson, 2004). Activity displacement is defined as visitors changing their primary recreational activity (Robertson and Regula, 1994; Hall and Shelby, 2000). Unfortunately, despite its potential effects on life and recreation quality (Arnberger and Eder, 2012), the concept of coping behaviours has rarely been explored in general (Hall and Shelby, 2000), and for the urban context in particular. It appears that no study has used this concept for comparing the recreational behaviours of migrants and non-migrants in the context of urban heat.

In addition, little research has been made into the behaviour of urban residents in, and their preferences for, green spaces during hot periods. Lafortezza et al. (2009) found that the users of green spaces in Italy and in the UK could alleviate the perception of thermal discomfort during hot periods. Wanka et al. (2014) and Klinenberg (2002) observed that older adults often stay at home during heatwaves. Arnberger et al. (2017) found green spaces that provide shade and a pond, and are easily accessible and cooler than the home, would encourage most older urban residents to visit a green space.

1.3. Green-space use by migrant and non-migrant urban residents

Different cultures use urban and rural landscapes differently for outdoor recreation (Gentin, 2011). Research on outdoor recreation behaviours in North America and Europe found differences between ethnic minority groups and native Europeans or European Americans. Passive and social activities, such as picnicking, barbequing, and socializing, as well as selected ball games, were often more important for migrants or ethnic minority groups than non-migrants, while hiking in forests, camping, jogging and dog walking were less popular among them (Floyd, 1999; Gobster, 2002; Schelhas, 2002). Studies also found that preferences for outdoor spaces differ between non-migrants and ethnic minorities with the latter group having a greater preference for more developed facilities and amenities that promote higher levels for social interaction within and among minority groups (Gobster, 2002; Payne et al., 2002). For example, in his study on urban park users in Chicago, Gobster (2002) showed that minority groups came from farther away, used the park less frequently, and were more likely to visit in large, family-oriented groups than park users from the majority population.

Overall, information on outdoor recreation of urban ethnic groups is limited (Floyd, 1999; Gobster, 2002); this is particularly the case in Europe (Jay and Schraml, 2014; Gentin, 2011). Growing in numbers, these ethnic groups are increasingly relevant for urban green space planning and management (Gentin, 2011; Gobster, 2002). Previous studies analysing differences in outdoor recreation behaviours have mainly focussed on African-Americans or other ethnic minority groups such as Asians in the USA, and the Caucasian majority, while little is known about differences in outdoor recreation behaviour between Turkish and non-migrants in Central European countries (Gentin, 2011). The few European studies comparing the outdoor recreation behaviours of Turkish immigrants with native western groups found that having a picnic and meeting friends and family in parks is more important for them, and that playing soccer was a prominent leisure-time activity for the men and boys (Peters et al., 2016; Jay and Schraml, 2009).

Heat can alter the recreation behaviour of urban residents (Arnberger et al., 2017; Hajat et al., 2002; Gabriel and Endlicher, 2011; Wanka et al., 2014). So far, little research has addressed and compared the motives for visiting urban green spaces on hot days, and the changes in the recreation behaviours of migrant and non-migrant green-space users, due to heat.

1.4. Research questions

Social, health and environmental factors define human susceptibility to heat and are interlinked with human behaviour (Arnberger et al., 2017; Schifano et al., 2009). Besides age, health condition, socioeconomic status, occupation, social isolation and social networks (Klinenberg, 2002; Kravchenko et al., 2013; The Lancet Editorial, 2015; WHO, 2011; Wilhelmi and Hayden, 2010; Wanka et al., 2014, 2019; Yardley et al., 2011), ethnicity seems to have strong links to heat-related health effects (Hansen et al., 2014; Kovats and Ebi, 2006). In Vienna, the capital of Austria, about 43 % of residents have a migration background (first- or second-generation migrants) with approximately one-fifth coming from Turkey (Statistik Austria, 2013). In Austria, poverty among migrants amounts to 16 % compared to only 5 % for those with Austrian citizenship; this affects Turkish migrants (27 %) in particular (Statistik Austria, 2013). In Vienna, migrant groups from Turkey and the Balkan states often live in small apartments in urban heat islands in densely populated areas, have a poorer health condition and may suffer from worse health outcomes due to heat (Anzenberger et al., 2015; Statistik Austria, 2013; Wiesböck et al., 2015; Wanka et al., 2019).

Although many heat-related factors may threaten urban residents with a migration background during heatwaves, there seems to be a knowledge gap about the vulnerability of this group. Because of their less privileged living conditions, public green spaces may play an important role in migrants' life as they often spend more time in such settings than urban non-migrants (Gentin, 2011; Peters et al., 2010). Turkish migrants were chosen to be studied because they are one of the largest groups of non-Western immigrants in Austria and Vienna. We explored whether the different, culturally driven, recreation patterns observed change in a similar way to the recreational patterns of non-migrants on hot days. The following questions guided this study:

- What are the motives for visiting public green spaces on hot days, and are there differences between migrants and non-migrants?
- What strategies do migrants and non-migrants employ to avoid heat stress, and what role do public urban green spaces play for heat coping strategies?

- Do migrants and non-migrants visit different public green spaces on warm compared to hot days? (Inter-area displacement)
- Do migrants and non-migrants use different areas of a green space on warm compared to hot days? (Intra-area displacement)
- Do migrants and non-migrants visit public green spaces at different times on warm compared to hot days, and do they change their length of stay? (Temporal displacement)
- Do migrants and non-migrants carry out different recreational activities in public green spaces on warm compared to hot days? (Activity displacement).

The following section presents the four green spaces used as study sites, the questionnaire and the data collection and data analysis process. The result chapter focusses on heat induced changes in outdoor recreation use of migrants and non-migrants, followed by the discussion and conclusions chapters.

2. Methodology

2.1. Study sites

This survey questioned visitors in four public green spaces in Vienna, varying in size and location: Donauinsel (Danube Island, 390 ha), Wienerberg Recreation Area (117 ha), Augarten (52 ha), and Kongresspark (9 ha) (Fig. 1). The criteria for the selection of the green spaces were: the size of the area should be at least several hectares to have a cooling effect due to the presence of several clumps of trees providing shade; the green space should provide opportunities for active and passive recreational activities; a high proportion of inhabitants with Turkish migration background should live in the vicinity. Parks of different sizes, with or without water bodies and forest patches, were chosen because of the assumption that visitors may avoid smaller parks and displace to larger ones with higher forest cover and blue spaces, including possibilities for swimming, that provided lower temperatures on hot days. The two smaller green spaces Augarten and Kongresspark are bordered by dense residential areas and have a more highly-developed recreational infrastructure (Fig. 2). The two larger green spaces Danube Island and Wienerberg provide a mix of meadows and woods and swimming opportunities. The Danube Island lies between the Danube River and the New Danube, while several ponds are part of the Wienerberg. All four green spaces are embedded in the urban fabric and surrounded by dense settlement areas, allotment gardens, office buildings and traffic infrastructures. Nearby larger public green spaces are missing except for the Danube Island. The Augarten is relatively close to public green spaces along the Danube River. All four green spaces are easily accessible via public transport and can be used without entrance

Fig. 1. Location of the four study areas Augarten, Donauinsel, Kongreßpark and Wienerberg in Vienna.

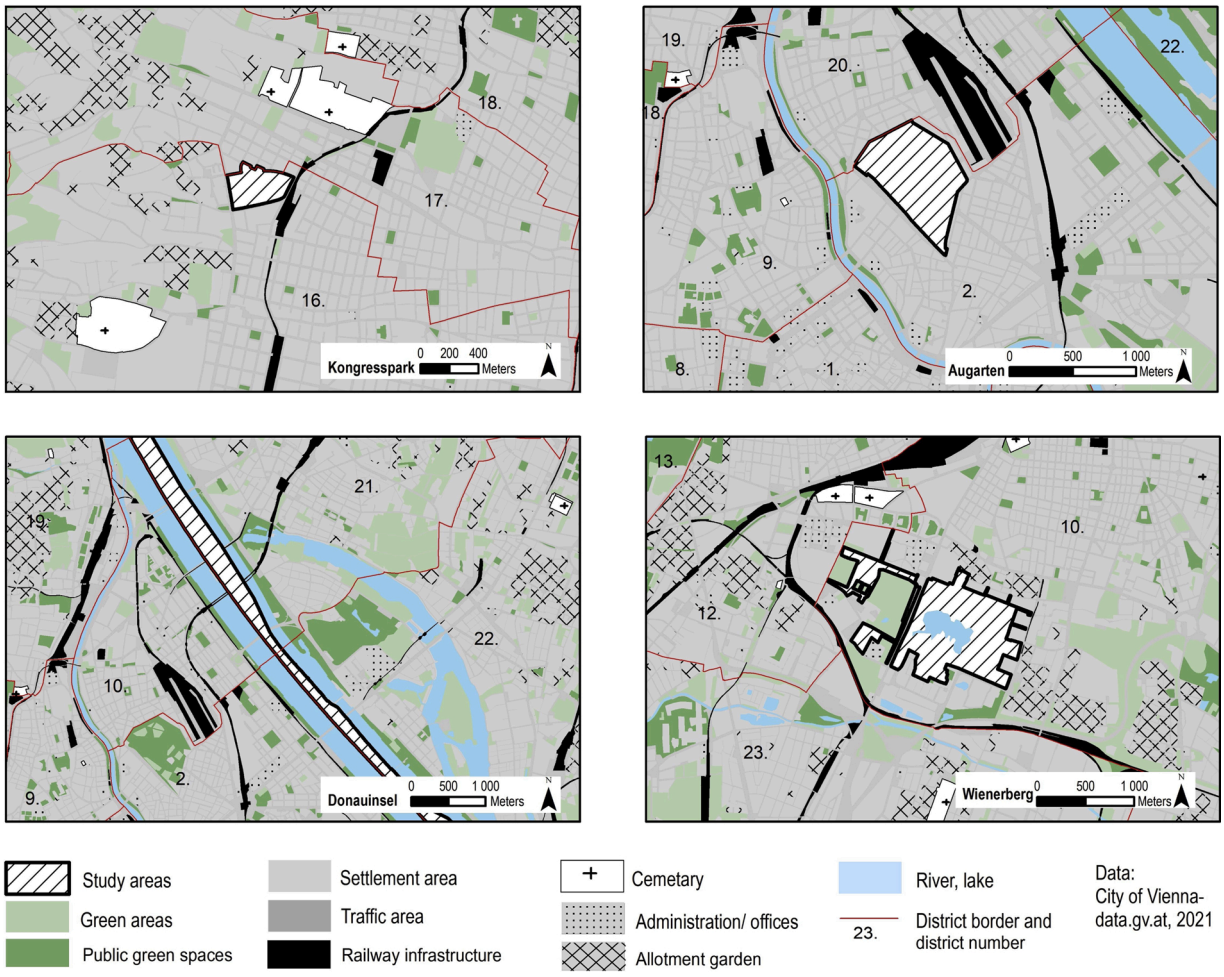

Fig. 2. Neighbourhoods of the four study areas Augarten, Donauinsel, Kongreßpark and Wienerberg in Vienna.

fees.

2.2. Questionnaire

A multi-disciplinary research team consisting of recreation planers, sociologists, anthropologists, and public health professionals developed the questionnaire in the German language. The questionnaire was translated into Turkish by native speakers from a professional survey research institute and then checked by an external native speaker. Further, Turkish native language research-assistants participated in the questionnaire development and analysis.

Information about socio-demographic characteristics, motives for visiting parks on hot days, and changes of recreation behaviours in response to heat were collected. Respondents were asked why they visit specific green spaces on hot days using twenty-three park facilities and park conditions on an answer scale from 1 = totally agree to 5 = totally disagree.

Respondents were also asked about their heat-coping behaviours by questioning them on whether they mainly stay at home on days with temperatures above 30 °C. Respondents who leave their home on hot days were then asked whether they go to urban parks, forests, churches, blue spaces, private gardens, outdoor baths etc. The respondents that went to public green spaces (parks, forests, rivers …) on hot days were asked to list the two they most frequently visited.

Several questions assessed shifts in recreation behaviours to compare use patterns between hot (outdoor temperatures > 30 °C) and warm days (outdoor temperatures between 20 and 25 °C): If the green space used on hot days was the one where the interview took place, respondents were questioned about time of visit, activities, length of stay, and use of shady and sunny areas. If the same green space was used on warm days, the respondents were also asked these questions about their recreational use patterns. If another park (not the park where the interview took place) was used on warm as well as hot days, the same questions were asked to allow for an intra-site comparison of use patterns between warm and hot days.

If respondents visited different green spaces on warm and hot days, inter-site displacement was taking place. Those respondents were asked about time of visit, activities, length of stay, and use of shady and sunny areas for each park in order to have a comparison regarding length of stay, time of visit, and activities between warm and hot days – but at different sites. There might be a recall bias in the perception of daily maximum temperatures, potentially resulting in an incorrect differentiation in warm and hot days by respondents.

2.3. Data collection

Data were collected between July and August 2015 after Ramadan, as this might have evoked different results in regard to the heat adaptation behaviours of migrants. The survey took place only on days with daily maximum temperatures of 25 °C and above throughout the day. A professional company provided interviewers with a Turkish migration background and the appropriate language skills.

The face-to-face survey was based on a quota sampling. Interviewers asked 200 Turkish migrants (first or second generation) and 200 persons without a migration background (the participants were born in Austria and their parents were born in Austria or another German-speaking

country respectively). Fifty migrants and 50 non-migrants were interviewed at each of the four study sites. Respondents had to live in Vienna and to have spent at least parts of the previous three summers in the city to be included in the survey. The sampling was also based on a quota system comprising gender (50 % men, 50 % women) and age (25 % each in the age groups 18–29 years, 30–49 years, 50–64 years, 65 years and above), to ensure oversampling of older migrants who might be more vulnerable to heat (Mees et al., 2015; Wanka et al., 2014; WHO, 2011; Wilhelmi and Hayden, 2010). Two persons were miscategorised by interviewers; thus, the sample includes 198 Turkish migrants and 202 non-migrants. Most interviews lasted between 20 and 30 min. The response rate was 39.1 %. Reasons for refusal included: no time (48 %), it is too hot (12 %), other reasons (no interest, want to relax, children); about 30 % of refusers did not provide any reason.

2.4. Analyses

Differences in socio-demographics, residential situation, visit-related variables, motives for the visit on hot days and changes in recreation behaviours (spatial, temporal and activity displacement) between migrants and non-migrants were analysed using t-tests, Chi-square tests or Median tests. Chi-square tests or Median tests were also used to test for differences in coping behaviours on hot days between the four green spaces. Differences in length of stay between migrants and non-migrants were analysed using *t*-tests. Changes within each group in recreation behaviours was tested either with dependent *t*-test or Wilcoxon signed rank test. Spearman correlation was used to test relationships between motives and coping behaviours. A significance level of $p < .05$ was chosen.

3. Results

3.1. Sociodemographic, residential, and visit-related factors of the samples

Non-migrants had higher levels of education than migrants ($p < .001$), while no differences in occupation were found (Table 1). The average household size of migrants was higher compared to non-migrants ($p < .001$), while their average apartment size was lower ($p < .05$). Significant differences between migrants and non-migrants were found in their access to private green/open space ($\chi^2 = 10.412$, $p = 0.015$). More non-migrants (83.2 %) have access to private green/open space than migrants (75.8 %). In addition, more non-migrants have access to a private balcony/terrace and private garden/green courtyard (57.4 %) compared to migrants (41.4 %). Non-migrants had lived longer in Vienna than migrants ($p < .001$). Migrants (mean = 25.7 min) reported longer travel times to the green space visited on hot days compared to non-migrants (mean =20.8 min). Migrants visited the green spaces in larger groups ($p < .001$) but fewer of them were accompanied by a dog ($p < .01$) compared to non-migrants.

3.2. Motives for visiting green spaces on hot days

For migrants and non-migrants alike, the most important motives for visiting the most commonly used green spaces on hot days were “I can regenerate very well”, “I can enjoy nature”, “It is easily accessible”, “There are many resting areas providing shade”, and “There are many seating opportunities” (Table 2). Migrants agreed stronger on the following statements compared to non-migrants: “My family/relatives are there” ($p < .05$), “There are water dispensers” ($p < .01$), “It is cooler than my home” ($p < .001$), “There are picnic areas” ($p < .001$), “There are barbecuing places” ($p < .05$), and “There are shaded children playgrounds” ($p < .001$), while non-migrants agreed more on “It is easily accessible” ($p < .05$), “It is near my home” ($p < .05$), “I feel safe” ($p < .01$), “It is very quiet” ($p < .01$), and “There is a place to swim” ($p < .05$).

Table 1
Profile of respondents (N = 400), residential situation, and visit-related differences between migrants (M) and non-migrants (N).

Socio-demographics		M (n = 198)	N (n = 202)	Differences p-value (*t* -test, Chi^2-test)
Age	Mean in years	46.6	50.3	n.s.
Gender	Women in %	48.5	51.5	n.s.
Education in %	No school exam	5.1	0.5	
	Compulsory school	42.4	11.9	<.001
	Apprenticeship, college	26.3	36.1	
	High school diploma	22.2	30.2	
	University	4.0	21.3	
Occupation in %	Employed	44.4	45.0	n.s.
	Retired	26.8	35.6	
	Jobless	10.6	7.4	
	Home maker	5.0	2.5	
	In education/training	7.6	5.9	
	Military/civil service	0.5	1.0	
Household members	Mean	3.4	2.2	<.001
Apartment size in m^2	Mean	65.2	70.0	<.05
Access to private green/open space in %	None	24.2	16.8	<.05
	Balcony/terrace	20.2	15.8	
	Private garden/green courtyard	14.1	9.9	
	Balcony/terrace & private garden/green courtyard	41.4	57.4	
Years of residency in Vienna	Mean	25.9	44.5	<.001
Travel time to green space on hot days in minutes	Mean	25.7	20.8	<.01
Group size in park[a]	mean	2.8	1.7	<.001
With dog in the park	Yes in %	3.0	10.9	<.01

[a] excl. respondent.

3.3. Recreation behaviour in response to heat

3.3.1. Heat-coping behaviours

On hot days, about 25 % of the respondents stay always and about 32 % of them stay frequently at home (Table 3). No difference in this behaviour in response to heat was observed between migrants and non-migrants. The access to a private open/green space had no effect on whether both groups are leaving their apartment on hot days. The more respondents agreed on the motive “The green space is cooler than my home”, the more they are leaving their apartment on hot days ($r = 0.153$, $p < .01$).

Respondents who leave their apartment on hot days most frequently visit urban green spaces, rivers and lakes, while others used their private balcony/terrace. Only six respondents (5 migrants, 1 non-migrant) never visit green environments on hot days. Migrants go to green spaces ($p < .001$), forests ($p < .001$), rivers and lakes ($p < .05$), and beer gardens/outdoor cafes ($p < .01$) less often than non-migrants. While 34 % of the migrants interviewed never visit forests on hot days, only 13 % of non-migrants do not visit such a site. No differences in the use of private outdoor spaces, open air baths, and cool buildings on hot days were found between migrants and non-migrants. When asked about the two most often visited green spaces during hot days, respondents (n = 394) listed larger areas that mostly provided woods and blue spaces.

3.3.2. Spatial displacement

3.3.2.1. Inter-area displacement. Two visitor groups were established

Table 2
Differences in visiting motives for the most frequently visited urban green spaces on hot days with temperatures >=30 °C between migrants (M) and non-migrants (N) in percent (N = 394).

Motives (in %)	(Totally) agree	Neutral	(Totally) disagree	
I visit the green space on hot days because…	M/N	M/N	M/N	Median-test
I can regenerate very well.	83.9/90.5	11.4/7.5	4.0/2.0	n.s.
I can enjoy nature.	81.3/86.1	13.0/11.4	5.7/2.5	n.s.
It is easy to access.	76.2/85.1	15.0/9.0	8.8/6.0	<.05
There are many resting areas among shadows.[x]	74.6/78.6	16.6/10.9	8.8/10.5	n.s.
There are many seating opportunities.	75.6/74.1	17.1/12.9	7.3/13.0	n.s.
I can engage in my favourite recreation activities.	68.4/77.6	18.7/14.3	13.0/7.5	n.s.
I feel safe.	64.8/80.1	22.8/15.9	12.4/4.0	<.01
It is nearby my home.	63.7/75.6	19.2/13.4	17.1/11.0	<.01
It is cooler than my home.	78.2/61.7	15.0/23.9	6.8/14.5	<.001
There are many trails in the shade.[x]	67.4/69.7	20.2/18.4	12.4/12.0	n.s.
There are water dispensers.[x]	71.4/56.9	17.5/24.6	11.1/18.5	<.001
It is very quiet.	56.0/70.1	30.6/17.9	13.4/12.0	<.01
Access to park is cool (tree shade, public transport with air condition…).	60.6/59.7	20.7/27.4	18.6/13.0	n.s.
There are many sunny areas.[x]	59.4/63.2	25.0/15.9	15.7/20.9	n.s.
My friends are there.	62.7/55.7	18.1/18.9	19.1/25.4	n.s.
I can be on my own.	54.4/54.7	25.9/20.4	19.7/24.9	n.s.
There are ponds, streams, or fountains.[x]	53.8/47.0	26.6/19.9	19.5/33.1	n.s
My family/relatives are there.	54.9/43.8	19.7/18.4	25.4/37.8	<.01
There is a restaurant/café,…[x]	42.6/51.1	28.4/15.9	29.0/32.9	n.s.
There are picnic areas.[x]	52.5/31.7	24.6/17.8	22.9/50.5	<.001
There are children playgrounds in the shade.[x]	54.5/33.7	19.0/15.5	26.4/50.7	<.001
There is a place to swim.[x]	39.3/55.2	6.6/6.0	54.1/38.8	<.01
There are barbecuing places.[x]	30.2/23.1	22.1/12.4	47.6/64.5	<.05

Answer scale: 1=totally agree, 5=totally disagree.
[x] if available in green space.

based on their spatial behaviour in response to heat. The larger group (88.6 %) uses the same park on warm as well as hot days ("non-displacers"), while the smaller group (11.4 %) uses other green spaces on hot compared to warm days ("inter-area displacers"). No differences in inter-area displacement behaviour due to heat were found between migrants and non-migrants.

The non-displacers and the inter-area displacers can be further divided into two subgroups. For 73.4 % of non-displacers (65.0 % of all participants) the park where the interview took place was also the park they visited independent of temperatures being warm or hot. For about 26.6 % (23.6 % of all participants), another park was used on both warm and hot days. About 75.6 % of inter-area displacers (8.6 % of all participants) use the survey site on hot days only and visit another site on warm days. About 24.4 % (2.8 % of all participants) went to other and different parks on warm and hot days because the survey site was not one of the green spaces they visited frequently. This study found no differences between migrants and non-migrants within these four

Table 3
Differences in heat-coping behaviours of migrants (M) and non-migrants (N) in percent (N = 400).

	M/N				Median-test
Where do you go on hot days (≥30 °C)?	always	frequently	infrequently	never	
I stay in my home	28.3/22.8	29.8/35.6	32.3/32.2	9.6/9.4	n.s.
Private balcony/terrace[x]	34.7/28.4	35.5/41.2	22.3/20.9	7.4/9.5	n.s.
Private garden/green courtyard[x]	18.9/22.8	32.4/36.8	28.8/16.2	19.8/24.3	n.s.
Urban park	36.4/31.2	34.8/54.0	23.7/11.9	5.1/3.0	<.001
Woods	12.6/23.8	25.8/36.1	27.3/26.7	34.3/13.4	<.001
Rivers, lakes	26.3/38.6	38.4/36.1	24.2/18.3	11.1/6.9	<.05
Open air bath	23.2/22.8	31.8/31.7	19.7/26.7	25.3/18.8	n.s.
Beer garden/outdoor café	17.7/23.8	29.8/43.1	31.3/24.8	21.2/8.4	<.01
Cool buildings	25.3/26.2	28.8/32.7	30.3/28.2	15.7/12.9	n.s.

[x] if available; multiple answers.

displacement groups. Inter-area displacers mainly mentioned areas along the Danube River (42.8 %) as places to go when it is hot, followed by large and easily accessible green spaces, such as Baroque gardens and the sites of former garden exhibitions. Overall, 33.5 % of all respondents uses the Danube Island on hot days, followed by the Augarten (23.1 % of all respondents), Wienerberg (19.0 %) and Kongresspark (18.8 %).

Differences in these four displacement groups were found between the four green spaces ($p < .05$). Only 56.0 % of the respondents in the Kongresspark spent time there on warm and hot days, while 73.5 % of Augarten visitors used the park on these days (Donauinsel: 64.0 %; Wienerberg: 66.7 %). In line with that, 28.0 % of the Kongresspark visitors went to another site on warm and hot days, while this was only the case with 17.3 % of the Augarten visitors (Donauinsel: 23.0 %; Wienerberg: 26.0 %).

3.3.2.2. Intra-area displacement. Both study groups frequently used shady and sunny areas in their most frequently visited green spaces on warm days (Table 4). Migrants were more likely to use sunny areas ($p < .01$). On hot days, both migrants and non-migrants applied intra-area displacement to avoid heat by visiting shady areas. Similar to warm days, more migrants visited sunny areas than non-migrants on hot days ($p < .05$).

Table 4
Differences in use of recreation sites between migrants (M) and non-migrants (N) on warm and hot days (intra-site displacement) (N = 394).

Use of park sites	Use on warm days (Yes in %)		Use change on hot compared to warm days (Yes in %)				Use only on hot days (Yes in %)
			More frequent	About the same	Less frequent/not		
	M/N	χ^2-test	M/N	M/N	M/N	χ^2-test	M/N
Sunny sites	75.1/63.0	<.01	37.9/23.0	34.5/44.4	27.6/32.5	<.05	3.5/3.5
Shady sites	91.2/90.0	n.s.	53.4/53.0	36.4/41.4	10.2/5.5	n.s.	2.5/4.0

3.3.3. Temporal displacement

Approximately half of the migrants questioned (51.0 %) visit green spaces in Vienna almost daily or several times a week between April and October, whereas nearly three quarters of non-migrants (74.8 %) visit these sites with the same regularity ($p < .001$; Table 5). Compared to warm days, both groups went to the most frequently visited parks less often on hot days ($p < .001$). The frequency of visits differs between migrants and non-migrants on hot days, with the number being higher for non-migrants ($p < .001$).

On warm (migrants 153 min on average; non-migrants: 136 min on average; $p < .05$) and hot days (migrants: 155 min on average; non-migrants: 138 min on average; $p < .05$) migrants stay longer in the most commonly used green spaces compared to non-migrants. No differences in the length of stay between warm and hot days were found for both migrants and non-migrants.

On warm days, migrants and non-migrants mainly visit green spaces in the afternoon (Table 6). Migrants visit green spaces more frequently at midday compared to non-migrants ($p < .05$), while non-migrants visit green spaces more often in the morning ($p < .05$), forenoon ($p < .05$), evening ($p < .001$) and at night ($p < .01$). Compared to warm days, migrants and non-migrants change their visiting times on hot days, with higher uses in the morning, evening and night hours, as well as during the afternoon. However, migrants increase their use in the afternoons of hot days more than non-migrants ($p < .001$). Compared with non-migrants, even higher numbers of migrants start to use the parks in the afternoons on hot days – a period they normally tend to avoid for a visit on warm days ($p < .01$).

3.3.4. Activity displacement

Both groups reported that their most frequent activities in green spaces on warm days were walking and using seating opportunities (Table 7). Migrants were more likely to walk ($p < .05$), use water dispensers ($p < .05$), have a picnic ($p < .01$), carry out activities with children ($p < .001$), and use playgrounds ($p < .001$), while non-migrants were more likely to take part in sporting activities ($p < .001$), visit cafes ($p < .05$), read ($p < .001$), or walk a dog ($p < .001$).

Many respondents adjusted their recreational activities to heat with more reported activity shifts among migrants (Table 7). Both groups use significantly more restaurants, water dispensers and seating areas on hot compared to warm days. Non-migrants additionally swim more. Differences in activity shifts on hot compared to warm days were found between migrants and non-migrants. On hot days, migrants walk ($p < .001$), read ($p < .05$), participate in activities with their children ($p < .05$), visit playgrounds ($p < .05$), use seating opportunities ($p < .001$), and go to restaurants/cafes ($p < .05$) more often than non-migrants, while non-migrants specifically reduced their sport activities ($p < .01$).

Several respondents performed specific activities on hot but not on warm days. Use of drinking fountains, swimming, and visiting restaurants/cafes were among the most mentioned activities taking place only on hot days with no differences in participation rates between migrants and non-migrants.

Table 5
Differences in frequency of green space visits between migrants (M) and non-migrants(N) on warm and hot days, as well as within the study groups (temporal displacement) (N = 394).

Frequency of visits	Green space use between April & October in Vienna M/N	χ^2-test <.001	Green space use between April & October on hot days M/N	χ^2-test <.001	Differences within M as well as N (RWSRT*) M<.001/ N<.001
Daily	16.7/43.6		11.4/27.4		
Several times per week	34.3/31.2		26.9/34.8		
Several times per month	33.3/19.3		45.6/30.3		
Once in a month	7.1/4.0		4.7/4.0		
Less than once in a month	7.1/2.0		10.4/3.5		
(Nearly) never	1.5/0.0		1.0/0.0		

* Related Wilcoxon signed rank test.

4. Discussion

This study analysed differences in motives for visiting green spaces on hot days and changes in green space use due to summer heat between migrants and non-migrants. Interviews took place in four urban green spaces varying in size and features on warm and hot days. The study found that heat alters the recreational behaviour of both target groups, but not always in the same way. Differences were reported between migrants and non-migrants in connection with intra-area, temporal and activity displacement – but not for inter-area displacement and length of stay in response to heat. Results indicate that the recreation behaviour of migrants seems to result in higher exposure to heat than non-migrants.

Previous research has found higher levels of heatwave mortality and morbidity among groups with a migration background. The higher vulnerability of migrants is due to several risk factors such as their residential environment, social status and health condition (Kovats and Ebi, 2006; Wanka et al., 2019). This study adds outdoor recreation behaviour as an additional potential component to the risk factors for migrants living in larger cities.

4.1. Differences in motives for visiting green spaces between migrants and non-migrants

Previous European studies on migrants have focussed on their outdoor recreation behaviours and preferences without investigating their motives for visiting green spaces on hot days, although these trigger outdoor activities and preferences for recreation infrastructures (Gentin, 2011). This study found differences in the motives migrants and non-migrants have for going to their most frequently visited parks on hot days. For migrants, opportunities for social-passive (picnicking, barbequing), specific active (ball playing), and child-related pastimes were more important than for non-migrants. Studies in Europe and in the USA (Floyd, 1999; Gobster, 2002; Schelhas, 2002) – and specifically studies comparing Turkish immigrants to non-migrants in Europe (Peters et al., 2016; Jay and Schraml, 2009) – reported similar findings. Thus, the motivations for visiting parks normally reported by migrants seem to be similar for hot days. Consequently, different recreation patterns with different demands for recreation facilities exist between the groups. Previous research on recreation provides several explanations for the differences in outdoor recreation behaviours between migrants and non-migrants. These are the degree of assimilation, the socio-economic status, and ethnic group membership (Tierney et al., 2001), which this study did not include.

Non-migrants scored higher on perceived accessibility to green spaces, closeness to home, and on swimming opportunities, while migrants focussed more on the presence of more developed park facilities and amenities such as barbeque and picnic areas (Gobster, 2002; Payne et al., 2002). As migrants depend more on facilities that are important for interaction among people, they may have scored lower on accessibility. The longer travel time of migrants for visiting green spaces on hot days seems to support this assumption. In contrast, good access was more important for non-migrants possibly because of their frequent dog walking activities and lower dependence on developed facilities such as barbeque areas.

Despite these differences, this study found similarities in motives for

Table 6
Differences in visiting times between migrants (M) and non-migrants (N) on warm and hot days (temporal displacement) (N = 394).

	Use times on warm days		On hot days compared to warm days in %				Use on hot days additionally	
Visiting times	Yes in % M/N	χ^2-test	More frequent M/N	Same M/N	Less frequent/ no use M/N	χ^2-test	Yes in % M/N	χ^2-test
Morning	16.7/26.7	<.05	51.5/25.9	33.3/50.0	15.2/24.1	n.s.	11.0/13.5	n.s.
Forenoon	26.3/37.6	<.05	26.9/22.4	48.1/47.4	25.0/30.3	n.s.	14.5/7.7	n.s.
Midday	46.5/36.1	<.05	32.6/21.9	38.0/52.1	29.3/26.0	n.s.	16.9/7.5	n.s.
Afternoon	64.6/69.3	n.s.	39.1/19.3	49.2/58.6	11.7/22.1	<.001	39.0/7.5	<.001
Evening	27.3/52.0	<.001	35.2/26.7	38.9/51.4	25.9/21.9	n.s.	17.4/13.3	n.s.
In the night	3.0/9.9	<.01	16.7/35.0	30.8/40.0	33.3/25.0	n.s.	9.8/8.8	n.s.

Table 7
Differences in recreational activities between migrants (M) and non-migrants (N) on warm and hot days (activity displacement) (N = 394).

	Activities on warm days in %		Activity change on hot days in %				Activity only on hot days Yes in %
Recreational activities	M/N	χ^2-test	More frequent M/N	About the same M/N	Less frequent/not M/N	χ^2-test	
Walking	91.2/84.6	<.05	48.3/21.8	25.0/47.1	26.7/31.2	<.001	2.0/1.0
Sport activities*	36.5/50.5		38.6/16.0	32.9/44.0	28.6/40.0	<.01	3.5/3.0
Dog walking	13.5/30.7	<.001	23.8/29.4	57.1/51.0	19.0/19.6	n.s.	1.5/2.5
Barbecuing	26.7/19.9	n.s.	32.1/28.6	39.3/50.0	28.6/21.4	n.s.	4.5/2.5
Use of drinking fountains	72.6/60.9	<.05	48.6/36.7	36.2/50.8	15.2/12.5	n.s.	9.1/6.4
Use of seating opportunities	88.6/83.6	n.s.	48.0/31.0	36.8/59.5	15.2/9.5	<.001	4.5/3.0
To have a picnic	54.7/40.3	<.01	26.5/21.9	45.9/52.1	27.6/26.0	n.s.	2.5/2.5
Lying on the lawn	64.6/57.7	n.s.	29.5/18.8	46.7/51.8	23.8/29.5	n.s.	5.1/4.0
Reading something	46.1/64.7	<.001	31.5/17.7	37.1/56.9	31.5/25.4	<.05	5.1/1.0
Doing something with my children	50.6/29.9	<.001	31.8/16.4	35.2/58.2	33.0/25.5	<.05	2.0/3.0
Use of children playgrounds	44.3/26.1	<.001	40.7/20.4	32.1/49.0	27.2/30.6	<.05	2.5/1.0
Visit of restaurants/cafés	47.6/58.2	<.05	37.5/29.0	44.3/62.6	18.2/8.4	<.05	5.1/5.9
Swimming	34.0/45.7	<.05	28.3/40.6	37.7/39.1	34.0/20.3	n.s.	7.1/4.5

* bicycling, jogging, playing soccer ….

visiting green spaces on hot days. For both groups, a park should be a good place to relax and allow for the enjoyment of nature, while the provision of shade was an important – but not the most important – motive. Both groups agreed that the access to green spaces should not be heat and sun exposed. Heat exposed streets, for example, may discourage respondents from a visit of even shady and attractive green spaces. A similar finding was reported by Arnberger et al. (2017) who found that the elderly preferred trees along streets leading to green spaces on hot days.

More migrants than non-migrants believed that the park they visited was cooler than their home. This seems to be plausible as they reported a higher number of household members and a smaller apartment size compared to non-migrants. Similarly, Wanka et al. (2019) showed that many migrants' residential environment is less privileged, and it can be assumed that their homes are hotter compared to those of non-migrants. Although one might presume that migrants are more in need of cool environments because of their probably hotter apartments and more limited access to private green/open space, no differences in the demand for shade were found between migrants and non-migrants.

4.2. Heat impacts on recreation behaviour

4.2.1. Coping behaviours and spatial displacement

Visiting other places is a frequently applied strategy for avoiding environmental and social stressors (Arnberger and Eder, 2012; Baum and Paulus, 1991). Similarly, Lafortezza et al. (2009) and Wanka et al. (2014) found that urban residents visit green spaces on hot days to avoid heat stress. This study found that the majority of both migrants and non-migrants leave their apartment and visit several types of green environments when it is hot. A study among older adults in Vienna (Arnberger et al., 2017) found that higher proportions of them stayed at home when it is hot because of their poor health condition. However, for about 30 % of older adults, woods and parks played an important role during heatwaves. The studies mentioned above underpin the important role of green spaces as a refuge for urban residents during hot periods. The current study additionally shows that larger blue-green spaces such as the Danube Island are important heat escape environments for many local residents.

Previous research has found that heat is a socio-economic issue: those who stay at home live in less privileged apartments and report poorer health status (Mees et al., 2015; Wanka et al., 2014). This study found no differences in stated home-leaving behaviours between migrant and non-migrant green space users, although migrants perceived their apartment as hotter. However, this study only asked respondents visiting these green spaces during warm and hot weather conditions, and not persons staying at home. Future research may ask migrants and non-migrants at their homes on hot days and measure indoor temperatures to better understand home-leaving behaviours due to indoor-heat.

The study revealed that migrants use urban green spaces less frequently than non-migrants on warm, as well as on hot, days contradicting previous research (Gentin, 2011; Peters et al., 2010), while confirming the results of Gobster (2002). In addition, migrants visited urban parks, woods and blue spaces less frequently on hot days although these sites can provide cooler temperatures through the shade provided by the vegetation and higher evaporation compared to densely built-up areas (Franck et al., 2013; Lin et al., 2010). As shown by previous studies (Floyd, 1999; Gobster, 2002), walking in forests is also less popular among minorities Thus, migrants take less opportunity for visiting cooler green spaces to reduce heat stress. It is possible that migrants feel constraints of security and discrimination when visiting public green spaces (Wanka et al., 2019). However, security was more an issue for non-migrants; a similar finding was reported by Gobster (2002). We did not consider marginality and discrimination hypotheses in this explorative study because its focus was on changes in recreation behaviours due to heat. These hypotheses might further explain differences in, and changes of, outdoor recreation patterns between migrants and non-migrants.

4.2.2. Spatial displacement

This study originally assumed that respondents interviewed in the smaller parks would shift their use to larger areas which provide more shade and swimming opportunities during periods of heat. However, the majority of both study groups used their most frequently visited parks on warm and on hot days. They did not apply inter-site displacement, indicating that all green spaces, even the smallest one (Kongresspark), were used on warm and hot days by most respondents. Social and passive activities were important for both groups on hot days and the Kongresspark also provided the needed recreational infrastructure for these, in addition to some shaded areas. However, the lowest proportion of visitors to a park on warm, as well as on hot, days was reported for this park. Obviously, several visitors to the Kongresspark found other parks more suitable for outdoor recreation.

Inter-site displacement is seen as a behaviour that takes a lot of effort (Manning and Valliere, 2001). The question arises of whether the travel costs for visiting other cooler sites are too high for the respondents as few larger recreational areas which could serve as a substitute exist in the immediate vicinity of the four public green spaces. This study only asked visitors to medium-sized and larger parks; because of their reduced cooling potential, it would be of interest to analyse the role of pocket parks (< 1 ha) in inter-area coping behaviour.

Intra-site displacement from sunny to shady areas on hot days was frequently reported by both study groups independent of study sites. Therefore, areas providing shade, even in small parks, are important for both groups on hot days. Arnberger et al. (2017) reported similar findings for older adults, who preferred green spaces providing shade on hot days. Although migrants already reported higher uses of sunny areas on warm days, these even increased on hot days, potentially resulting in higher heat exposure.

4.2.3. Temporal displacement

Temporal use displacement is a frequently applied coping behaviour – in particular, employed by local residents. Because of the nearby green spaces, they can more easily shift their activities to other times of the day (Arnberger and Eder, 2012; Arnberger and Brandenburg, 2007). A shift in use to cooler evening – or even night – times was observed for non-migrants on hot days, while migrants stated increased uses of green spaces in the afternoon, the hottest time of the day. In addition, migrants reported less use of the cooler times of a day, specifically the evening hours, and more of them started to use the afternoons only on hot days, potentially leading to higher exposure to heat. Both groups did not change their length of stay on hot compared to warm days; however, migrants stay longer in parks than non-migrants. This behaviour may additionally result in higher exposure to heat compared to non-migrants.

4.2.4. Activity displacement

This study found that migrants and non-migrants have partly different motives for visiting green spaces on hot days and, consequently, participate in different outdoor activities (Gentin, 2011; Gobster, 2002; Payne et al., 2002). Both migrants and non-migrants adjusted their recreation behaviours to heat; shifts in recreational activities were reported by more than half of them. Overall, respondents performed passive more than active activities on hot compared to warm days. However, migrants increased specific physically active behaviours such as walking and sport on hot days, while non-migrants reduced these. Furthermore, non-migrants did less with their children on hot days, while migrants increased such activities. Some respondents in both study groups were even attracted to become more active by the heat. This pattern was found for most activities, and more migrants than non-migrants took part in activities on hot days compared to warm days. Similar to temporal displacement, activity displacement in response to heat indicates a higher exposure to heat of migrant families because of the more active recreational activities they participated in. Unfortunately, this study did not consider interactions between the time of the day and activities such as energetic pastimes carried out in the early morning or late evening hours only, resulting in a lower heat impact. This is left to future research.

5. Conclusions

Heat related vulnerability is distributed unequally across urban residents and may lead to different coping strategies. As many cities have a large and increasing migrant population, with many members living in poor housing conditions, the heat impact will increasingly become an issue of high priority for city administrations (IPCC, 2013; The Lancet Editorial, 2015; Mees et al., 2015; WHO, 2011; Wiesböck et al., 2015). Thus, reducing the vulnerability of the urban population – and specifically, migrant groups – should be a priority for city administrations. Sensitizing stakeholders for this topic is of key importance. This study is, to our knowledge, the first attempt to establish evidence on adaptive behaviours in response to heat among persons with a migration background compared to non-migrants living in Vienna with a specific focus on recreation behaviour in green spaces. We found differences and similarities in motives for visiting green spaces on hot days and heat-induced recreation behaviour changes between migrants and non-migrants. Both groups reported more changes in use times and activities than changes in green space sites. Motivations for green space visits shaped and triggered recreation activities which result in higher heat exposure and potentially more health risk for migrants on hot days. However, high indoor temperatures of migrants' homes may have forced them to leave their home and tolerate the heat exposure in green spaces in the afternoons of hot days.

Based on the results, recommendations can be derived for urban and green space planning to make cities more liveable for non-migrants and migrants during the summer months. Public green spaces should provide water bodies and shade (Arnberger et al., 2017; Bowler et al., 2010; Ebenberger and Arnberger, 2019); in particular, the shade provided by trees is important for playgrounds, resting and picnic areas. In addition, public green spaces should be made easily accessible by providing environmentally friendly, cooled public transportation, and park access streets with trees are recommended (Arnberger et al., 2017).

Cities can increasingly develop measures to protect their vulnerable citizens against heat stress by implementing heat-health action plans (Mayrhuber et al., 2018; Mees et al., 2015). Provision of information on heat exposure and risk reducing behaviours in the respective language of target groups would be an important part of the heat-health action plan. Presumably, conventional channels for heat warning. such as TV, radio, social media, and newspapers, as well as medical consultation, will not be adequate to reach elderly migrants in particular. The focus for this group should therefore be placed on enhancing intergenerational communication. In Vienna, other possible channels are provided by the Turkish newspapers, which are usually distributed free of charge in Turkish supermarkets, clubs and other organizations. Turkish migrants get their health information primarily from physicians and nursing personnel. Physicians should advise them consciously about correct behaviour when confronted with heat. Migrant organizations (i.e., cultural/religious clubs, social institutions) could place a stronger focus on raising awareness about heat and providing information on adequate indoor and outdoor heat behaviour. Practices, such as fasting during Ramadan, must also be addressed in heat warning systems.

Vienna offers large forests across its territory. In order to increase the motivation to visit these areas on hot days, the research team has developed a "Heat Toolbox" which, among other things, promotes planned excursions to large green areas in Vienna and illustrates easy accessibility via public transportation or bicycle. In addition, it displays cool areas in several districts of Vienna (Allex et al., 2018).

We acknowledge that migrants are not a homogeneous group, and their behaviour is not simply influenced by their 'migration background' but by intersectionalities between migration, age, socio-economic status, gender, and spatial dis/advantage (Wanka et al., 2019). As this

project focused on a comparison *between* Turkish migrants and non-migrants, follow-up-research projects to investigate differences *within* migrant groups, as well as projects to investigate the heat vulnerability of migrants from other countries, would be of interest. Future research should also include analyses of heat vulnerability and adaptive behaviour of different migrant generations (first generation, 1.5 generation, 2nd generation, etc.) as the sample size in this study was rather small. In summary, more research of (possible) differences in heat-susceptibility among minority ethnic groups is needed to develop tailored adaptation measures for specifically affected and vulnerable groups.

CRediT authorship contribution statement

Arne Arnberger: Conceptualization, Methodology, Writing - original draft, Data curation, Project administration, Investigation. **Brigitte Allex:** Conceptualization, Methodology, Project administration, Investigation, Writing - review & editing. **Renate Eder:** Conceptualization, Methodology, Investigation, Writing - review & editing. **Anna Wanka:** Conceptualization, Methodology, Investigation, Writing - review & editing. **Franz Kolland:** Conceptualization, Methodology, Project administration, Writing - review & editing. **Laura Wiesböck:** Methodology, Writing - review & editing. **Elisabeth Anne-Sophie Mayrhuber:** Methodology, Writing - review & editing. **Ruth Kutalek:** Conceptualization, Methodology, Writing - review & editing. **Peter Wallner:** Methodology, Writing - review & editing. **Hans-Peter Hutter:** Conceptualization, Methodology, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The study was supported by the ACRP Program of the Austrian Climate and Energy Fund (Grant no. KR13AC6K11022). The authors want to thank research assistants Hemma Preisel, Dilan Sengül, Martin Heckenblaichner, Narin Yilmaz, and Derya Erdemgil, as well as the city of Vienna (Municipal Departments MA42 Parks and Gardens, MA45 Water Management, MA49 Forestry Office and Urban Agriculture), and the Austrian Federal Gardens for allowing access to the study sites to conduct interviews.

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