

# Knowledge, Attitudes, and Practices Related to Heat Stress in the Climate of Koper and Ljubljana (Slovenia)

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►

#### ABSTRACT

This study examines the knowledge, attitudes, and practices related to heat stress among residents of two distinct urban neighbourhoods in Slovenia with different climate types: Olmo, Koper, and Zupančičeva jama, Ljubljana. The study explored the interplay of socio-economic indicators, demographic characteristics, and health status with heat stress KAP. While both locations demonstrated comparable levels of knowledge regarding heat stress, residents of Olmo exhibited significantly more positive attitudes towards adopting preventive measures and reported engaging in such behaviours more frequently. The findings suggest that targeted interventions must consider not only knowledge dissemination but also the unique characteristics of each community, including their specific climate, socio-economic profile, and cultural norms, to effectively enhance community resilience to the adverse impacts of heat stress.

## Introduction

Climate change is a complex issue with socio-economic impacts that extend beyond environmental concerns. Adapting to increased heat waves and heat stress is crucial for public health. Heat waves should be recognized as a critical component of heat stress, as they exert detrimental effects on ecosystems, human activities, infrastructure, and well-being.

The cities of Koper and Ljubljana, where our sample neighbourhoods are located, exhibit distinct climatic conditions. Koper has a moderate Mediterranean climate (Cfa), characterised by hot, dry summers and mild, wet winters. In contrast, Ljubljana has a moderate continental climate of central Slovenia (Cfb) with warm summers—the warmest month is July, with a mean temperature of 21.8 °C —and cold winters, with January (1.0 °C) as the coldest month (Ogrin et al., 2023).

Besides climatic, our sample neighbourhoods also have notable topological and socio-economic differences. Zupančičeva jama (ZJ) is a densely populated urban area in Ljubljana, predominantly comprising residential buildings with commercial spaces on the ground floor. In contrast, Olmo has developed in a more dispersed and less systematically planned manner, lacking a defined urban centre. These differences could contribute to varying heat stress experiences and responses among the residents of the two cities.

Heat stress is not exclusively a consequence of extreme heat waves but can also emerge from moderately elevated temperatures that trigger physiological responses. This phenomenon is increasingly recognised as a socio-ecological challenge that benefits from applying the Knowledge, Attitude, and Practice (KAP) framework. Empirical studies among healthcare workers in Jian, China (Li et al., 2016;

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Figure 1. Orthophotography of the sample neighbourhoods Zupančičeva Jama, Ljubljana (left) and Olmo, Koper (right)

Xu et al., 2018), and Victoria, Australia (Ibrahim et al., 2011) indicate that while a basic level of heat-related knowledge is present, translating awareness into sustained behavioral practices remains a significant hurdle. In parallel, investigations into public awareness and risk perception (Franck et al., 2013; Bittner & Stößel, 2012; Nitschke et al., 2013; Zhou et al., 2014; Khare et al., 2015; Kunz-Plapp et al., 2016; Lam et al., 2018; Grothmann et al., 2017; Krüger et al., 2017; Nitschke et al., 2017; Cornes & Cook, 2018; Herrmann & Sauerborn, 2018) have documented considerable variability in risk perception and adaptive behaviors across different socio-demographic groups. Our research extends this literature by examining how socio-economic status, cultural context, age, and gender modulate these responses. In this study, we analyse the interplays between selected socio-economic and health variables and KAP related to heat stress in selected neighbourhoods with different climate in Olmo, Koper, and Zupančičeva jama (ZJ), Ljubljana. Residents of the sample are presumed to have similar formal knowledge but may exhibit divergent attitudes and behaviours related to heat stress, exposure, and sensitivity.

# **Data and Methods**

## **KAP framework**

This study's conceptual framework is based on the knowledge, attitudes, and practices approach (KAP), a quantitative approach used in public health and social sciences to analyse human behaviour in response to specific issues. KAP examines the interrelations between knowledge (awareness and understanding), attitudes (perceptions and beliefs), and practices (actual behaviours), providing insights into behavioural patterns and potential intervention strategies (Vandamme, 2009).

KAP was developed in the 1950s for demographic studies and has been extensively applied in health research, including disease prevention and environmental health. Its structured methodology enables the identification of knowledge gaps, the design of targeted interventions, and the assessment of behavioural responses. However, its limitations include a lack of standardized methodology, challenges in cross-study comparisons, and an oversimplification of behavioural determinants, as external sociocultural and environmental factors often influence individual actions beyond knowledge and attitudes alone (Vandamme, 2009; Chandler, 2018).

Knowledge refers to information people possess about an issue, such as causes, symptoms, and preventive measures. Attitudes encompass beliefs, perceptions, and feelings that shape willingness to act. Practices denote actual behaviours and actions in response to knowledge and attitudes. Examining the relationships between KAP can identify gaps between KAP components and develop targeted interventions (WHO & Stop TB Partnership, 2008). Knowledge arises from formal/informal learning personal experiences and is shaped by memory, cognition, and motivation. Knowledge, experiences, and interconnected factors like social environment, culture, media, and psychology form attitudes. The more knowledge someone has, the more likely they are to develop specific attitudes. Attitudes can guide how and what new knowledge is acquired and can affect behaviour, while behaviour could impact attitudes and knowledge. However, behavioural factors are complex, as behaviour is the most visible KAP component influenced by various factors beyond this study's scope.

This study integrates the KAP framework with a socio-ecological geographical approach to assess heat stress-related behaviours in Koper and Ljubljana. Examining the interplay between KAP components and socio-economic variables, facilitates a deeper understanding of public responses to heat stress and the development of targeted public health interventions to enhance urban climate resilience.

# **Study Design and Data**

The questionnaire was designed based on the KAP framework and included socio-economic variables. Participants' responses were scored for each KAP segment. The knowledge segment had 42 possible points, with correct answers receiving one point and incorrect answers zero. The attitude category was scored using a 5-point Likert scale for four statements. Two theory-based questions were asked for practice, and participants evaluated their summer patterns on a 5-point scale. The KAP scores were used as variables in the statistical analysis.

For our research, we employed a KAP approach to investigate the influence of select socio-economic characteristics on urban heat stress in Koper and Ljubljana. The study was implemented in the autumn of 2020, focusing on the Olmo and Zupančičeva jama neighbourhoods. Data collection occurred immediately after summer to minimize direct heat influences on participants' perceptions. Residents in these neighbourhoods are presumed to have greater heat exposure. The questionnaire was administered in physical and digital formats, aligned with the KAP framework.

The researchers collaborated with local building administrators before the research, which occurred between the first and second COVID-19 waves. This partnership was most fruitful in Ljubljana, where administrators assisted in distributing questionnaires in Zupančičeva jama. In September 2020, physical questionnaires and flyers were disseminated, with posters and mailbox drops in Zupančičeva jama. Due to less support in Koper, the researchers used paid social media ads. In total, 750 physical questionnaires were distributed. Altogether, 168 responses were received by mid-October 2020, slightly higher in Olmo at 51.2%.

## Results

#### **KAP Descriptive Statistics**

In our study, most participants were female (68.6%), as women predominated in both neighborhoods. The differences are higher in Olmo, where 27.4% of participants were male and 72.6% were female. According to the official data, the gender composition of the sample was more balanced compared to our sample (Olmo 52.0% and Zupančičeva jama 52.4% female).

**Table 1.** Selected socio-economic characteristics of theneighborhoods

	Olmo	Zupančičeva jama			
Average household income	1.771.29€	2.364.18€			
Average number of the household members	2.31	2.2			
Income per household member	854.28€	1,197.80€			
Health self-assessed	3.48	3.89			
Sex					
Men	27.4 %	72.6 %			
Women	36.0 %	64.0 %			

The age composition of the participants showed that the largest group was aged 30-44 years, while the smallest group, at 7.6%, was young people aged 15-29 years, excluding one minor participant. Most respondents over 75 years old were from the retirement home in Olmo, which explains the higher proportion of this age group. In contrast, respondents from the Zupančičeva jama tended to be younger on average. The official age distribution data corroborate this. In Zupančečeva jama, 13.4% of residents were in the 0-14 age group, 69.9% were 15-64 years old, and 16.65% were over 65 (Zupančičeva jama, 2021). The Olmo had an older population, with 11.9% in the 0-14 age group, 62.3% aged 15-64, and 25.8% over 65 (Olmo, 2021).

Understanding these demographic differences is critical to our research. Age is a key factor in determining vulnerability to heat stress—older adults typically face more significant physiological risks due to age-related declines and a higher prevalence of chronic conditions. At the same time, younger individuals may respond differently to heat exposure. Additionally, the variations in age distribution across the study sites can influence the KAP outcomes; differing life experiences and risk perceptions are likely to shape adaptive behaviours in each age group. These insights enable us to tailor public health interventions and communication strategies more effectively, ensuring that strategies are sensitive to the distinct needs of younger and older populations.

The study participants exhibited relatively high educational attainment, with more than half holding post-secondary, higher education, or university degrees, including master's degrees. In contrast, just over 8% had incomplete or completed primary education, and these individuals tended to be in the oldest age group. Examining the key differences in educational attainment between the two neighbourhoods is crucial to verify our assumptions about the knowledge levels between the sample neighbourhoods.



Figure 2. The overview of education levels (%, up) and age groups (below) by neighbourhood

Residents of the Zupančičeva jama demonstrated significantly higher educational achievement, with more significant proportions holding the highest levels of education. Conversely, the Olmo had a higher proportion of participants with secondary school and primary education backgrounds. This differentiation is important for our study because educational attainment may determine how individuals acquire, interpret, and act upon information regarding heat stress.

The educational attainment of the respondents was reflected in their employment characteristics. Only a small minority, just under one-fifth, engaged in predominantly physical labour. Conversely, most participants reported working in sedentary roles. However, about two-thirds of respondents had relatively diverse work responsibilities. Additionally, one-third were employed in workplaces with formal dress codes.

While 30.2% of participants indicated they could work from home, this finding should be interpreted cautiously. The study was conducted in 2020 at the outset of the COV-ID-19 wave in Slovenia when remote work had already become an established practice. Thus, many respondents likely selected the "work from home" option based on the pandemic context, despite the questionnaire's clarification that this did not refer to the COVID-19 period. Approximately half of employed respondents perceived their workplace as stressful.

The health self-assessment average was 3.68, indicating a status between moderately good and good. Notably, differences emerged between the neighbourhoods: participants from Olmo reported an average health self-assessment 0.41 points lower than those from Zupančičeva jama. As Nitschke et al. (2013) noted, participants who rated their health as fair to poor were at significantly higher risk for heat-related morbidity. Similarly, Grothmann et al. (2017) stated that high levels of occupational stress may reduce the capacity for effective adaptive behaviour during heat events. These insights underscore that poorer self-rated health and stressful, sedentary work environments can amplify heat stress vulnerability, highlighting the need for targeted interventions that account for these socio-economic and occupational factors.

#### Knowledge

As described, the knowledge segment of the questionnaire initially included statements that were either true or false, and participants responded with "yes," "no," or "don't know" based on their familiarity with the topic. Subse-





quently, participants selected from the provided options in questions with multiple possible answers. The knowledge segment had 42 possible points; correct answers were scored with one point and incorrect with none. In this segment, participants achieved an average score of 30.2 points (out of 42 possible points), or 72.1% correct responses (Olmo 29.7 points; ZJ 30.9 points). Analysis of the knowledge segment revealed significant differences in the level of knowledge between the neighbourhoods.

The introductory questions revealed gaps in participants' understanding of heat waves and climate change trends. Only 21.0% accurately acknowledged that heatwave definitions lack uniformity, varying according to local climatic conditions. Similarly, knowledge about the rate of temperature increase in Slovenia compared to other regions was limited. As many as 40% of respondents could not assess the statement's validity regarding Slovenia's temperature trends, and an additional 20% believed the increase had been slower than elsewhere. However, most participants correctly identified that medication use can heighten the risk of heatstroke during hot weather and recognised common symptoms.

Participants' limited knowledge of climate change, heat waves, and associated health impacts may hinder the development of appropriate attitudes and practices, ultimately undermining the effectiveness of public health interventions. On average, respondents provided only 1.77 correct answers, indicating an overall lack of understanding that could impede adaptive behaviours during heat events.

Participants achieved better results in the second question related to more practical aspects of protection and health-friendly behaviour during the summer heat. Among the 15 suggestions, participants selected those they believed could effectively protect against the negative consequences of heat waves. Multiple answers were possible, including incorrect or unfavourable suggestions for prevention. Participants most frequently selected the correct answers, such as "drinking larger amounts of fluids," "ventilating living spaces in the morning hours," "wearing lighter and lighter-coloured clothing," "avoiding sun exposure between 11 a.m. and 4 p.m.," and "using head coverings and sunglasses. On the other hand, some misconceptions were also identified, with participants often selecting inadequate or even potentially harmful measures, such as "consuming alcoholic beverages."

**Table 2.** Participants' most common responses on effectivemeasures to protect against heatwave impacts (multipleanswers possible)

Activity	Frequency (%)	
Drinking larger quantities of fluids (non-alcoholic)	164 (14,2 %)	
Ventilating living spaces in the morning hours	160 (13,9 %)	
Wearing light and loose-fitting clothing	159 (13,8 %)	
Avoiding outdoor activities between 11 a.m. and 4 p.m.	159 (13,8 %)	
Using hats and sunglasses	147 (12,7 %)	
Ventilating living spaces in the evening hours	117 (10,1 %)	
Using sunscreen	87 (7,5 %)	
Drinking warm beverages	70 (6,1 %)	
Drinking cold beverages	64 (5,6 %)	
Ventilating spaces, regardless of time	10 (0,9 %)	
Drinking caffeinated beverages	6 (0,5 %)	
Wearing tight-fitting clothing	3 (0,3 %)	
Other	7 (0,6 %)	

Participants more frequently chose to ventilate living spaces in the morning than evening ventilation. This trend is expected since the effects of the UHI—where residents of the neighbourhoods live—persist in the evening hours, and temperatures remain relatively high. Nevertheless, evening ventilation is more appropriate for prevention than midday, regardless of the time. Participants rarely selected incorrect answers, such as drinking caffeinated and alcoholic beverages and consuming fatty foods. Answers categorised as "other" included drinking alcoholic beverages, consuming fatty foods, and using synthetic clothing. The differences in proportions between correct and incorrect answers, according to the theory of preventive behaviour during heat, are evident in the sample.

Participants demonstrated relatively satisfactory knowledge in recognising key health indicators or examples of health problems associated with heat stress. The most frequently selected health consequences were "dehydration" and "heatstroke or heat exhaustion," followed by fatigue and dizziness. The list of health indicators included some options not directly related to heat waves. Among the incorrect options, respondents best recognised the causes of pneumonia, followed by the common cold, chosen by 10.7% of participants. Additionally, 22% of participants selected "itchiness," which is not primarily associated with hot weather. One of the most frequently chosen incorrect answers was "sunburn," which is related to UV-B solar radiation rather than air temperature. The frequent selection of this option may suggest that participants assumed heat waves are associated with clearer or sunnier weather.

<b>Table 3.</b> Health issues that respondents believe may be
associated with heat waves (multiple answers possible)

Health outcome	Frequency (%)
Dehydration	157 (14,8 %)
Heat stroke	154 (14,5 %)
Fatigue	147 (13,9 %)
Dizziness	144 (13,6 %)
Sunburn	115 (10,8 %)
Worsening of chronic diseases	100 (9,4 %)
Vomiting	93 (8,8 %)
Diarrhea	50 (4,7 %)
Itching	37 (3,5 %)
Aggression	27 (2,5 %)
Cold	18 (1,7 %)
Pneumonia	13 (1,2 %)
Other	4 (0,4 %)
I don't know.	1 (0,1 %)

The final question in the knowledge segment of the questionnaire addressed the recognition of population groups most vulnerable to the adverse impacts of heat waves. Based on extensive research (e.g., Nitschke et al., 2013; Harlan et al., 2006; Kovats & Hajat, 2007), not all population groups are equally susceptible to heatwave and heat stress exposure. Nevertheless, 9.5% of respond-

ents answered this question incorrectly by selecting that there are no differences in vulnerability among population groups; notably, most of these participants were from Olmo.

The study participants demonstrated adequate knowledge and correctly identified the elderly, individuals with chronic health conditions, outdoor workers, pregnant women, and young as the groups most vulnerable to the adverse effects of heat waves. These findings align with a broad body of research indicating that physiological factors, pre-existing health conditions, and social determinants amplify heat-related risks for specific populations (Heatwaves: A Guide for Health-based Actions, 2021). For instance, Kovats & Hajat (2008) underscore that older adults and those with chronic illnesses are disproportionately affected by extreme heat. Basu (2009) further reviews epidemiological evidence demonstrating heightened mortality risks for older individuals and those with comorbidities. O'Neill and Ebi (2009) emphasise how socio-economic variables-such as income and housing quality—compound these vulnerabilities. In a Slovenian context, Kajfež Bogataj et al. (2018) found that 79% of respondents recognised the elderly as a group susceptible to heat stress, alongside those on medication and young children. This study's observations thus reinforce existing evidence that targeted interventions for these high-risk groups—especially in urban areas—are essential to mitigate heatwave impacts.

However, the current study revealed that only 19% of respondents recognised the socio-economically disadvantaged as vulnerable. This is concerning, as socio-economic status significantly influences vulnerability and exposure to heat stress.

Population group	Frequency (%)	
Elderly (over 65 yrs)	150 (89,3 %)	
Patients with chronic diseases	145 (86,3 %)	
Outdoor workers	131 (78,0 %)	
Pregnant women	119 (70,8 %)	
Small children	104 (61,9 %)	
Socially and economically disadvantaged	32 (19,0 %)	
No differences between groups, we are all equally vulnerable	16 (9,5 %)	
Men (40–50 yrs)	9 (5,4 %)	
Women	5 (3,0,7 %)	
Young people (15–29 yrs)	3 (1,8 %)	
Others	1 (0,6 %)	

**Table 4.** Population groups perceived to be most negativelyaffected by heat waves (multiple answers)

The analysis of participants' knowledge across both neighbourhoods reveals that residents of Zupančičeva

jama exhibited a relatively stronger understanding of climate change, heat waves, and vulnerability. However, the data also suggests notable variations in knowledge levels within the individual survey questions. Furthermore, the study found no significant differences in the knowledge category between male and female participants.

#### Attitudes

The Attitudes section was based on participants' personal experiences, emotions, and past encounters. Unlike the Knowledge section, this part was not scored, as there were no right or wrong answers. Instead, participants expressed their attitudes using a Likert scale.

Most participants indicated concern about the potential consequences of climate change in Slovenia. According to their self-assessment, the majority followed preventive measures to protect against heatstroke during the summer of 2020. Conversely, participants did not feel particularly sensitive to heat and heat stress. Similar opinions were held regarding the dangers of heat waves to their health. aimed to assess the behaviours of participating residents during heat waves or weather conditions characterised by heightened heat stress. Through two questions in this segment, the study examined how participants changed their daily routines and behaviours in response to hot weather. Participants were presented with two statements and asked to respond "yes," "no," or "don't know."

Regarding the first statement, which focused on fluid intake, 79.5% of respondents reported drinking fluids during summer even when they did not feel thirsty. Just under 20% of participants disagreed with this statement. A similar proportion of responses was observed for the second statement, which pertained to increased attention and care for more vulnerable populations. While interpreting these responses, caution is warranted, as both statements may have elicited socially desirable answers. Additionally, the fluid intake question did not provide insight into the types of fluids the participants consumed, some of which may not have beneficial effects during heat stress. Interestingly, differences in participants' responses were observed when considering the neighbourhood. However,



**Figure 4.** Respondents' average agreement with statements related to the perception of heat stress and understanding of climate change

The study found notable differences between the neighborhoods, with participants Olmo reporting higher average attitudes than those from Ljubljana. The most significant divergence emerged in their self-reported adherence to preventive measures against heatstroke. In contrast, the slightest difference was observed in their concern about the potential consequences of climate change, where residents of Olmo showed slightly higher agreement on average (0.09 higher).

### Practice

This section evaluated participants' behaviours, actions, and preparedness for heatwave risks and stress. This final part of the KAP framework incorporated into the research



**Figure 5.** Proportion of respondents who are more attentive to hydration and care for the vulnerable during heat waves



Figure 6. Frequency of use of preventive measures among survey participants in both neighbourhoods

these differences were evident only in the second statement, which was related to increased attention to the elderly, children, or weaker family members.

An interesting comparison between the neighbourhoods regarding preventive practices during extreme heat and heat waves reveals that the differences for the five most practised preventive measures are relatively small. The most significant difference is observed in shading windows with blinds.

Residents of Olmo more frequently used air conditioning than participants from Zupančičeva jama. Additionally, participants from Olmo exhibited a stronger tendency to avoid caffeinated and/or alcoholic beverages. Similarly pronounced differences were observed in measures such as wearing head coverings and avoiding physical exertion. Furthermore, the data suggests that Olmo participants generally practised preventive behavioural measures more often than their counterparts from Zupančičeva jama, with the latter only outpacing Olmo in two of the measures.

## **KAP Differences Between the Neighbourhoods**

The study examined potential differences between Olmo and Zupančičeva jama based on the KAP framework. To analyse how heat stress interacts with socio-economic factors across the sample, the researchers used a non-parametric Mann-Whitney U statistical test to compare the average ranks of residents from Olmo and Zupančičeva jama for each KAP variable.

$$U_1 = R_1 - \frac{(n_1 \cdot (n_1 + 1))}{2}$$
$$U_2 = R_2 - \frac{(n_2 \cdot (n_2 + 1))}{2}$$

The Mann-Whitney U test of our sample revealed statistically significant differences between the neighbourhoods in the categories of attitudes and behaviour. The Olmo had higher average ranks in these categories. In contrast, the knowledge category did not show significant differences between the neighbourhoods. Although the Zupančičeva jama sample had a slightly higher average rank in knowledge, the difference was not statistically significant. This can be primarily attributed to the socio-demographic factors of age and education, as the participating residents of Zupančičeva jama were somewhat younger and better educated than the Olmo residents.

While the differences in knowledge between the neighbourhoods are not statistically significant, the differences in the categories of attitudes and behaviour are statistically significant (attitudes: p = 0.017; behaviour: p = 0.044), suggesting that Olmo demonstrated more positive attitudes and preventive behaviours related to heat stress in comparison to the Zupančičeva jama, despite the lack of significant differences in knowledge levels between the two samples.

The analysis reveals that knowledge levels did not differ significantly between the neighbourhoods. Olmo exhibited a statistically significantly higher average ranking in attitudes and behaviours related to heat stress than the Zupančičeva jama. This suggests that Olmo residents held more positive attitudes and engaged in more preventive practices to address heat-related impacts despite comparable knowledge levels across the two samples. According to the study, Olmo residents more frequently ventilated their living spaces in the morning and at night, shaded glass surfaces with blinds, wore lighter clothing, and consumed more significant amounts of fluids.

КАР		N	Average of ranks	Sum of ranks	Mann-Whitney U	p-Value
	Olmo	86	78.94	6789		
к	Z]	82	90.33	7407	3048	0,128
	All	168				
A	Olmo	86	92.59	7963		
	Z]	81	74.88	6065	2744	0,017
	All	167				
Ρ	Olmo	86	90.74	7803.5		
	Z]	80	75.72	6057.5	2817.5	0.044
	All	166				

Table 5. Comparison of between Olmo, Zupančičeva jama and KAP categories

## Discussion

The findings provide valuable insights into the KAP related to heat stress. The analysis reveals that while knowledge levels did not differ significantly, the Olmo exhibited statistically significant higher average ranks in attitudes and behaviour compared to the Zupančičeva jama. This suggests Olmo residents held more positive attitudes and engaged in more preventive practices despite comparable knowledge levels. Socio-ecological factors influenced these differences. Olmo participants were older, economically disadvantaged, less educated, and more sensitive to heat due to poorer health. Zupančičeva jama residents were more formally educated, but knowledge levels were relatively low across both samples. Respondents performed better on practical heat protection and health impact questions. They correctly identified key risks and vulnerable groups, though fewer included the socio-economically disadvantaged. Demographic differences were evident, with Olmo having more people who believed there were no differences in vulnerability. Gender did not impact knowledge. The results confirm that knowledge was comparable, but attitudes and practices differed significantly between neighbourhoods. This suggests that formal education is not the sole factor shaping the KAP related to heat stress. Other geographic, socio-economic, and cultural factors influenced perceptions and behaviours.

The analysis reveals statistically significant differences between the two neighborhoods in the attitudes and behaviors related to heat stress. Residents of Olmo generally held stronger perceptions regarding the impacts of climate change and heat waves on their health and well-being. They were more actively engaged in public health preventive measures during heat events. For instance, Olmo participants more frequently ventilated their living spaces, shaded glass surfaces, wore lighter clothing, and consumed more fluids. This heightened engagement in protective behaviours among Olmo residents can be attributed to their older age, poorer self-reported health, and higher heat stress sensitivity (Ye et al., 2018). These findings suggest that strong attitudes are influenced by formal education and informal knowledge and experiences accumulated over time, shaping their practices, particularly regarding economically feasible measures.

The results confirm that knowledge levels and prevention were relatively comparable across the neighbourhoods, but notable differences emerged in their attitudes and practices. Notably, the observed variations in formal education between the neighbourhoods do not appear to play a significant role. This aligns with the theoretical foundations, which suggest that knowledge as part of the KAP concept is shaped by formal and informal education about the natural and social environment and individual experiences. These factors vary according to the geographical characteristics of the neighbourhoods, ultimately influencing participants' attitudes and behaviours.

The level of formal education relates to the type of employment, which can influence individuals' exposure to heat stress and its impact on their health and well-being, adaptive capacities, and overall vulnerability. However, the study sample was diverse, including participants from various backgrounds, such as working residents, retirees, and young people, rather than a specific cohort disproportionately exposed to heat stress through their occupation. As a result, only a small proportion of the study participants engaged in physically demanding labour.

In addition to formal education, certain physical-geographic and socio-geographic factors can shape perceptions, experiences, and habits related to heat stress. The climatic differences between Koper's coastal region and Ljubljana's central area may influence residents' perceived need for preventive measures. The moderate Mediterranean climate in Koper could motivate Olmo residents to adopt more effective protective practices.

Furthermore, socio-geographic characteristics beyond socio-economic status can impact how residents respond to heat stress. For instance, the Mediterranean dietary patterns and cultural practices, such as afternoon breaks, common in the Slovenian coastal region, may contribute to the local population's heat wave coping strategies.

The findings indicate that despite high levels of concern and the adoption of some preventive measures, knowledge and awareness of specific heat wave risks and management strategies remain limited. Targeted educational and preventive programs and other measures are needed to address this gap. Additionally, it is important to devote special attention to understanding the impact of demographic and socio-economic factors on the vulnerability of specific groups.

This study has limitations that must be considered. The COVID-19 pandemic directly and indirectly impacted the research, though the influence of societal mindset and the epidemic on the outcomes is unclear. While randomised and diverse, the sample size may not fully represent the broader population. Environmental conditions during the study period, such as above-average precipitation in Olmo, average summer rainfall in Zupančičeva jama, and a relatively mild 2020 summer, may have shaped participants' perceptions.

This research provides insights for future studies. Expanding the sample size and geographic scope could enhance representativeness. Replicating the study during a non-pandemic period and under more intense heat wave conditions and testing the model in a third climate type would be reasonable. These findings are crucial for developing effective adaptation strategies, communication methods, and awareness-raising initiatives to mitigate the adverse impacts of extreme heat amidst socio-economic and health factors.

# Conclusion

In conclusion, findings suggest similar knowledge levels about heat stress were comparable across the neighbourhoods; Olmo exhibited more positive attitudes and preventive behaviors (e.g., more frequent ventilation, shading, etc.) compared to the Zupančičeva jama. The analysis revealed a complex interplay between various factors, including demographic characteristics, health status, and environmental conditions, that shape the KAP of urban residents regarding heat stress. These differences highlight the influence of local context, including environmental conditions and potentially cultural norms, on heat-related responses. While formal education plays a role,

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demographic factors and health status also affect preparedness. Our study uniquely highlights how subtle climatic variations, socio-economic characteristics, and health within a relatively small geographic area can significantly influence heat-related attitudes and practices.

Although the COVID-19 pandemic and the conditions of summer 2020 may have influenced our results, this study provides a valuable baseline for future, wider-scope research. Replicating these methods in more varied environments and during more intense heat waves would further validate and refine these context-sensitive strategies for enhancing urban heatwave resilience.

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