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# A Manual for Reducing Heat in Jeddah's Urban Parks to Enhance Elderly's Experience

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**Abstract**
This thesis focuses on improving urban parks to enhance elderly experience and offer a better quality of life. It analyzes both their physical and emotional needs and delves into ways to enhance their experience when visiting parks in Jeddah. The target users of this study were both the elderly, aged 65 and above, and their companions. Using both qualitative and quantitative methods, needed information was gathered from both groups. Statistics were analyzed and showed that heat was a common factor affecting the quality of experience for park visitors. To further investigate the issue and acquire better solutions, precedent studies were analyzed. The aim of this research is to fill an existing gap locally by researching the effects of high temperatures on park visitors, specifically the elderly, and ways to implement solutions through redesigning urban parks in the city of Jeddah. This research will provide stakeholders with a manual that serves the aforementioned aims. According to the case study and literature review, implementing better shading systems, misting system, increasing vegetation and adding a refreshment source are key to enhancing the user experience. The changes proposed, following the 2030 vision will aid in enhancing the quality of life for citizens and encourage healthy living.
**Keywords:** Elderly, exhaustion; urban, parks, heat, vegetation; improvement, health; manual.

## 1. Introduction

Urban parks have long been a necessity to sustain a healthy and happy community for individuals and the environment alike (Amen, 2021, Aziz Amen, 2022) . In recent years, Saudi arabia has focused on both the environment and citizens. The 2030 vision, drawn by HRH Mohammad Bin Salman, highlights it's many goals, one being offering a healthy and fulfilling life to citizens, with building a sustainable country being the heart of the vision. Projects ranging from using renewable energy to the launch of The Saudi Green Initiative and The Green Riyadh project were immediately commenced. In its vision, Saudi vows to reach the net zero goal by the year 2060. Another great goal is to establish a good quality of life.

Since the elderly are part of the community, making up 4.2% of society, and are a demographic that showcase more health risks and have special needs, focusing on creating spaces that encompass activities catered to them and is accessible for them is an integral part of enhancing their quality of life.

The current state of parks in Jeddah has sparked some interest. Why are people not visiting parks? What is missing? Who's responsible and how can we fix it? The municipal services sector is heading the beautification and diversification of urban landscapes to establish that goal. Part of this will be focusing on parks and enhancing them. But, with every great vision comes great responsibilities and numerous changes. Our parks still need modification in many areas to accommodate the elderly and their needs. This paper focuses on the city of Jeddah and proposes ways to combat one of the biggest causes of risk for the elderly which is heat. Acting as a guide for stakeholders to use in future considerations for park improvements and urban planning. With Saudi having a desert climate. This climate is only exacerbated during summer in cities like Jeddah. Park goers, especially the elderly, turn away from outdoor activities (Pratiwi, et all., 2022; SHAFIK, 2019). This research focuses on filling the existing gap nationally, which is looking into and documenting factors that could decrease heat levels in our parks and it studies the needs of elderly to create a safe and inviting space for them and their companions. The objectives of this paper are as follows:

1. Study the elderly in Jeddah and the level of comfort in Jeddah's urban parks.
2. Promoting healthy living on the physical, emotional and mental aspects of the elderly and their companions.
3. Implementing heat regulating changes to enhance the quality of our parks and positively impact the user experience.

By the completion of this research, the following questions will be answered:

1. What impact will decreasing the temperature in our parks have on the user experience?
2. How can urban parks satisfy the needs of the elderly?
3. Will implementing heat regulating changes enhance the quality of our parks?

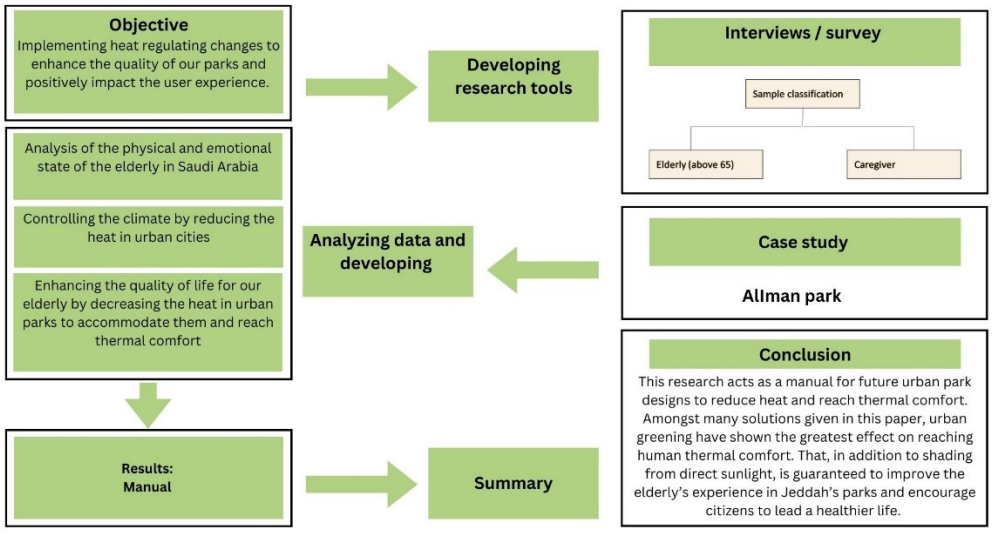


**Figure 1.** Methodology diagram (Developed by Author).

## 3. Material and Methods

The target group for this paper were:

1. Elderly: According to (UNHCR, n.d), the elderly are defined by the united nations as any individual above the age of 60 years old.

2.Their companions: The term companions in this paper refers to any and every person accompanying an elderly. Whether that person is a caregiver, a friend or a relative.

Both qualitative and quantitative methods, in the form of a survey and interviews were used to further understand and analyse the target group. As for the interviews, this method was used to collect answers from a group of randomly selected individuals aged 65 and older, in addition to their companions or caregivers, in the form of interviews. These interviews helped direct the project and provided in-depth understanding of elderly's needs. The elderly and their caregivers supply the research with relative target audience context. The full questions and answers are recorded in the appendix attached. On the other hand, surveys were used to collect answers from a random sample of 50 people from both groups. It gave insight into many relevant topics that justified the research and aided in narrowing the scope.

## 4. Results

From the answers recorded in table 1, the following can be deduced:

- Both the elderly and their companions refrain from outdoor activities in Jeddah.
- Both groups do not go to parks often
- Both groups proved the safe assumption that heat is one of the main factors keeping individuals from visiting parks.

**Table 1.** Interviews analysis.

| Questions / Interviewees | **Do you prefer indoor or outdoor activities?** | **Do you go to parks often?** | **Does heat affect how many times you go to parks?** |
|---|---|---|---|
| **E1** | **1** | **0** | **1** |
| **E2** | **1** | **0** | **1** |
| **C1** | **1** | **0** | **1** |
| **C2** | **1** | **0** | **1** |
| **Results** | **Indoor= 100%** | **No= 100%** | **Yes= 100%** |

Legend: E= elderly, C= companion, 1= yes, 0= no, Indoor= 1, Outdoor= 0

**Table 2.** Survey analysis.

| questions / group | **How would you describe your fitness level? (poor=0) (bad=1) (fair=2) (good=3) (great=4)** | **How often do you workout? (never=0) (not often=1) (more than once/week=2) (daily=3)** | **How many times do you go to parks now? (never=1) (once/week=2) (more than once/week=3)** | **Does heat impact your health negatively? (yes=1) (no=0)** | **During which time of the year do you go to parks more often, in Jeddah, if you don't go which one would you prefer? (summer= 0 ) (spring 1) (fall= 2) (winter= 3)** | **During which time of the day do you go to parks in Jeddah? If you don't go which one would you prefer? (morning=1) (noon=2) (afternoon=3) (evening= 4)** | **If you chose (discomfort) please specify the cause of said feeling: (heat=1) (humidity=2) (boredom=3) (all of the above=4) (lack of accessibility=5)** |
|---|---|---|---|---|---|---|---|
| **Elderly (over 65)** | 0= 22.2%<br>1= 55.6<br>2= 22.2%<br>3= 0%<br>4= 0% | 0= 44.4%<br>1= 44.4%<br>2= 5.6%<br>3=5.6% | 1 = 83.3%<br>2= 16.7% | 1= 77.8%<br>0= 16.7% | 0=0%<br>1= 44.4%<br>2= 27.7%<br>3= 22.2% | 1= 16.7%<br>2= 5.6%<br>3= 0 %<br>4= 77.8% | 1= 88.9%<br>2= 11.1% |
| **Average** | 1 | 0.72 | 1.17 | 0.82 | 1.76 | 3.39 | 1.11 |
| **Companions** | 0= 3.1%<br>1= 28.1%<br>2= 50%<br>3= 12.5%<br>4= 6.3% | 0= 3.1%<br>1= 40.6%<br>2= 43.8%<br>3= 12.5% | 1= 81.3%<br>2= 18.8% | 0= 56.3%<br>1=43.6% | 0=0%<br>1=28.1%<br>2= 25%<br>3=46.9% | 1= 31.3%<br>2= 0%<br>3=3.1%<br>4=65.7% | 1=68.8%<br>2= 18.8%<br>3= 9.4%<br>4= 3.1% |
| **Average** | 1.91 | 1.66 | 0.19 | 0.44 | 2.19 | 3.03 | 1.47 |

According to table 2, the following can be inferred about the respondents:

1. The average fitness level of the elderly can be described as bad, with more than half of the respondents recording that as their answer. More than 80% do not workout, with only 16.7% working out once per week. On the other hand, the average fitness level of their companions falls around the fair category. With over 40% working out once per week, and only 12.5% recording that work out more than once per week.
2. An overwhelming number of both elderly and companions don't visit parks currently, with 82% of both groups combined not going to parks.
3. The majority of elderly, comprising almost 78% of elderly respondents recorded that heat has negative impacts on their health. More than half of their companions have also recorded the same. This goes to show that enhancing the level of thermal comfort is a decision that will benefit all groups.
4. Almost half of the elderly agreed that spring would be their favorite time of year to visit parks in Jeddah, while 46.9% of the companions chose winter. As for the specific time of day, to no surprise, 0% of elderly chose afternoon.

The majority preferred the evening comprising 70% of respondents from both groups. The second highest time was morning with 26% of all respondents preferring the 5-10am timing.

5. Heat was the number one cause of discomfort for both groups, with almost 90% of elderly choosing heat and 11.1% of them choosing humidity as causes of discomfort in urban parks. The companions' answers were not far off as more than half agreed on heat being the biggest cause, choosing humidity and boredom next respectively. Noting that a small percentage chose all of the above.

Case study (Al-Iman park):

This park was selected to be the center and guide for this research. It is located in the targeted city of Jeddah, in the northern region. More specifically in Almohamadiyah neighborhood. It is 2842m2 with most of its ground covered in grass. Day and night visits to the park were necessary to ensure correct analysis of the current state of the park. Below are images taken at those visits. Provided in figure 2 is the site analysis and the sun path in figure 3. In the appendix attached is an explanation on how to read figure 3. Figure 4 shows the wind direction and strength across all months in Jeddah. Perhaps, the most noticeable thing in the following park images would be the lack of presence from any age group. Noting that the visits were done in the month of October, which would be autumn in Saudi Arabia. The weather ranged from above 40 degrees Celsius at noon to the lowest degree marked at 37 at night.

***Figure*.2** *Site analysis, 2022*

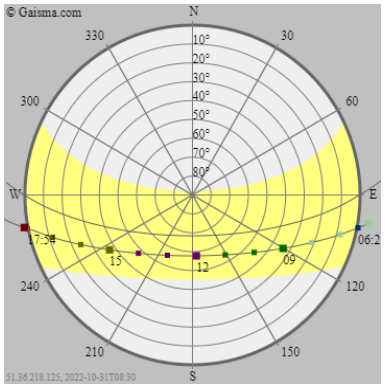


***Figure*.3** *Jeddah Sun Path, retrieved from Gaisma.com, 2022.*

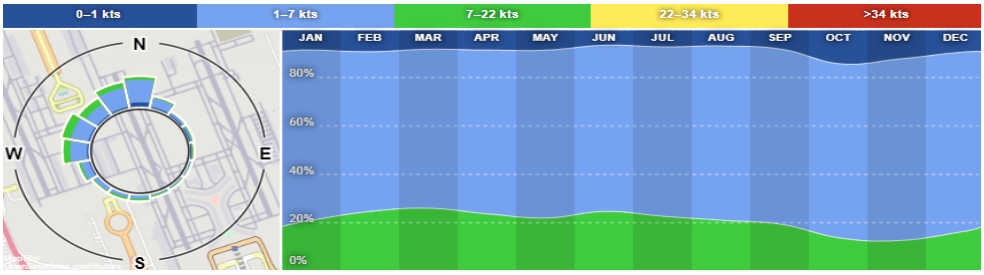


***Figure*.4** *Jeddah Monthly wind direction and strength distribution, retrieved from www.windfinder.com, 2022*

***Figure*.5** *Al-Iman park, 2022*

The most prominent features missing are shading systems. Proposed solutions would be to start with installing a good shading system and ensuring maintenance. Secondly, misting cooling systems should be added wherever seating is placed. Furthermore, more seats should be placed as elderly tend to get tired easily, this could prevent injuries or exhaustion. Drinking water fountains can be added to urban parks as per the tips included in this paper. Vegetation is an integral part of any park, but special focus should be placed on what type of vegetation will be used, as there are types that provide good shading and allow for better air circulation.

**4. Discussion**

***Figure*.6** *Edit by author, 2022*

A. Role of spatial attachment in understanding elderly needs in parks:

Designers and urban planners try to achieve many objectives through their designs. But perhaps the most important is to not only create a space that caters to its users but one users connect to. “Fostering positive emotional connections between elderly people and their environment has been emphasized as one of the most significant environmental design objectives.” (Meganathan & Azizul bin Azizui, 2021, Amen et al., 2023, Amen & Nia, 2020). According to Meghanthan and Azizui, parks are key to preventing elderly from falling into social isolation. The authors then go on to further solidify the importance of parks for elderly by showcasing the positive cognitive impact nature has on elderly, as it reduces stress and levels of cortisol which in return aid in enhancing their cognitive abilities. They explain space attachment and its role in encouraging individuals to visit a space more often. Understanding the role a space, its design and functions play in the type of attachment users have to it is essential.

B. Impact of decreasing temperature in urban parks on thermal comfort:

Urban heat island, commonly referred to as UHI, is described as the increase in air temperature in heavily populated urban centers. (Aram et al., 2020). The authors go on to examine temperatures at different distances from parks. Their investigation was carried by measuring microclimate data during summer. Temperature was evidently lower near parks and people surveyed recalled their experience at the park as more thermally comforting than in other areas. This literature review proves and validates the significant role parks play in decreasing temperatures and increasing thermal comfort.

C. Benefits of increasing vegetation:

A series of recent studies have shown that increased vegetation offers shade and aids in the cooling of the surrounding areas, thus reaching thermal comfort. “Based on our analyses, effective arrangements of vegetation in urban areas can mitigate the surface UHI effect through enhanced heat transport efficiency.’ (UEYAMA & ANDO, 2020). In this study it was emphasized that increasing vegetation and parks helped mitigate heat waves during summer and contributed heavily in increasing thermal comfort throughout the year.

1. Analysis of the physical and emotional state of the elderly in Saudi Arabia.

The elderly are a complex group. They have many needs and require attention but are also still functioning adults and want to be treated as such. To better understand their needs and how to accommodate them, all aspects of their lives must be looked into. Physical health, mental and emotional health should all be considered. In addition to their societal role and habits. According to statistics provided by the general authority for statistics in Saudi Arabia, the percentage of elderly, 65 and over, in Saudi is 4.2%, where women comprise the largest portion with 24.5% of aforementioned elderly being in Makkah region. There are 27% of them widowed, 70% married, 1% single and 2% divorced. Only 1.7% of elderly workout, 150+ mins per week. It is rather important to note that 52.7% of elderly are special needs.

1.1 Health Worldwide

In addition to heat causing a multitude of issues, like general discomfort and exhaustion, it also is a contributing factor in more serious illnesses. A study, done in New York city, showed the association between extreme temperatures and emergency room visits related to mental disorders.

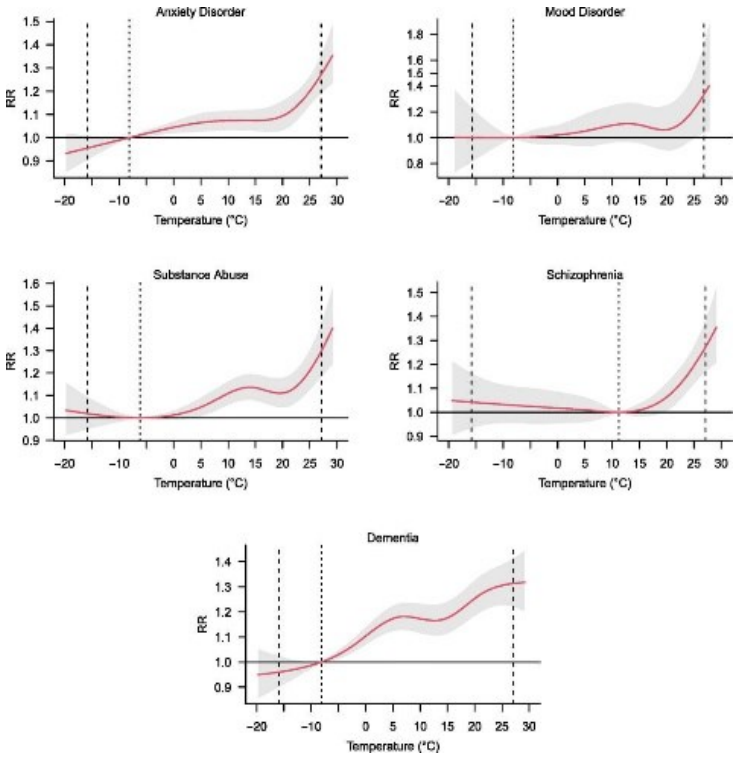


***Figure 7.*** *by Eun-hyeYoo, retrieved 2022.*

As evident by figure 1, disorders ranging from mood disorders to anxiety, depression and schizophrenia have all shown a clear and alarming increase in number of visits. Even substance abuse rose with the rising temperatures.

1.2 Health locally

There are multiple illnesses, such as hypertension, diabetes, multiple sclerosis and various heart conditions, that have been medically proven to increase heat sensitivity. 11.1% of elderly suffer from heart conditions, and as it has

been reported by the ministry of health in Saudi arabia heart conditions are responsible for 42% of deaths in the country. 49.2% are diabetic and a staggering 51.7% suffer from hypertension, otherwise known as high blood pressure.

2. Controlling the climate by reducing the heat in urban cities.

2.1 Climate worldwide

It is no secret that global warming is rising and temperatures are bound to get higher with each passing year. The world health organization predicted that between the years 2030 and 2050, climate change will cause approximately 250 thousand additional deaths per year, from many causes such as malnutrition, malaria, and most notably heat stress. In figure 8, a graph clearly shows the number of mortalities caused by heat in the US between the years 2004 and 2018. It is noticeable that the highest age group affected are individuals aged 55-64, then 45-54 and then 65-74.

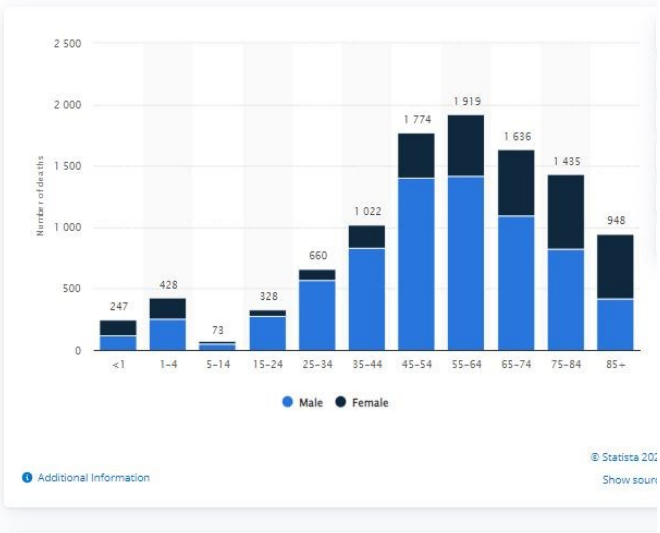


***Figure* 8.** *by John Elflein, retrieved 2022.*

2.2 Climate locally

In order to carry out this research and suggest the needed changes, a thorough examination of the weather in the city of Jeddah was deemed necessary. In figure 9, a meteorology analysis is shown. It includes the insolation levels, clearness levels, surface temperature, wind speed, precipitation and wet days across all months of the year. Insolation is defined as “the rate of delivery of direct solar radiation per unit of horizontal surface.” (Webster, 2022). It is important to note that surface temperature differs from air temperature in that air temperature is measured at a height of 1.2 m, and surface temperature measures the general given temperature of a surface at ground level. Although the referenced figure analyzes Jeddah during 2002, one can safely assume that temperatures have only risen since then. Also presented, in figures 10 and 11, are images provided by The National Center of Meteorology visualizing temperatures in Saudi arabia. The month of August was chosen because it is almost the peak of summer in Saudi arabia, in contrast, January was chosen because it is almost the peak of winter in Saudi arabia. By viewing both figures it can be said that thermal discomfort is generally present in Jeddah. “Thermal discomfort is exposure to either excess cold or excess heat, that is the exposure for a period of time to temperatures below 18C or above 24C.” ( Ezratty & Ormandy, 2015).

| Variable | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Insolation, kWh/m²/day | 4.37 | 5.24 | 6.14 | 7.08 | 7.35 | 7.51 | 7.48 | 7.19 | 6.61 | 5.87 | 4.61 | 4.07 |
| Clearness, 0 - 1 | 0.62 | 0.64 | 0.65 | 0.68 | 0.67 | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 | 0.62 | 0.60 |
| Temperature, °C | 19.71 | 20.49 | 22.77 | 26.29 | 30.31 | 32.05 | 32.07 | 32.12 | 32.18 | 28.99 | 24.66 | 21.27 |
| Wind speed, m/s | 5.23 | 5.21 | 5.12 | 4.78 | 4.19 | 4.34 | 4.90 | 4.67 | 4.31 | 4.01 | 4.26 | 4.84 |
| Precipitation, mm | 15 | 4 | 4 | 4 | 2 | 0 | 0 | 0 | 0 | 2 | 20 | 15 |
| Wet days, d | 1.6 | 0.3 | 0.7 | 0.8 | 0.5 | 0.0 | 0.2 | 0.1 | 0.1 | 0.3 | 1.5 | 1.2 |

These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center; New et al. 2002

*Figure.***9** *Meteorology analysis, retrieved from Gaisma.com, 2022*

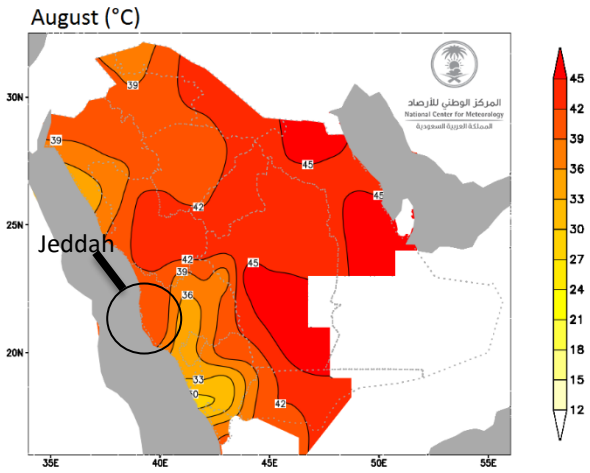


***Figure*.10** *Meteorology analysis, retrieved from ncm.gov.sa, 2022*

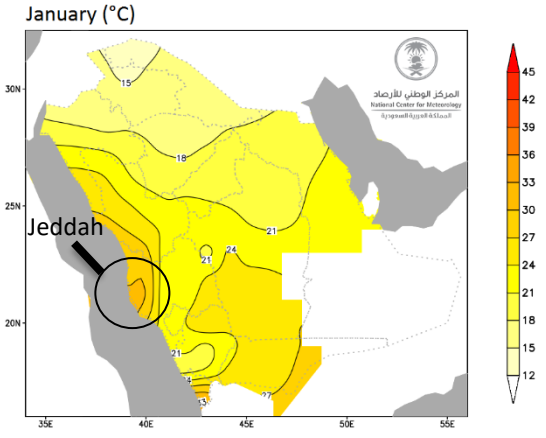


***Figure*.11** *Meteorology analysis, retrieved from ncm.gov.sa, 2022*

3. Enhancing the quality of life for our elderly by decreasing the heat in urban parks to accommodate them and reach thermal comfort.

Thermal comfort is described globally as a state of mind that expresses satisfaction with the thermal environment. PET stands for physiologically equivalent temperature. It has been found that " PET values between 18 and 23 °C are regarded as being comfortable, while values of 29 °C, 35 °C and 41 °C define the respective thresholds between mild, moderate, severe and extreme heat stress." (Höppe 1999; Matzarakis et al. 2009). The formal representative of Saudi's meteorology committee has declared that Jeddah, for the last 10 years, has held the lead in having the highest temperature averaging around 52 degrees Celsius at 1 pm under shade. (almanatiq, 2019). There exists many methods to reach thermal comfort. The most cost effective and easily applicable solutions will be reviewed, such as increasing vegetation, installing shading systems and misting cooling systems and more importantly ensure continued maintenance of the systems applied in the parks. Another solution which is changing the materials used in constructing parks is also listed as it has a tremendous effect on reducing urban heat.

3.1 Increase vegetation

Evapotranspiration, is explained as the process by which water is transferred to the atmosphere by evaporation from soil and transpiration from plants. "The cooling effect of vegetation is also enhanced by the process of evapotranspiration. A single tree absorbs as much as 600,000 Btu of solar radiation every day and evaporates water into the air." (Louisiana.gov, n.d). According to the United States Environmental Protection Agency "Evapotranspiration, alone or in combination with shading, can help reduce peak summer temperatures by 2–9°F (1–5°C)." (EPA, 2022). In the same article it is mentioned that researchers advise to plant deciduous trees as they are the best in mitigating heat. In a compendium published by the same organization, the benefits of vegetation in reducing heat is proven with the authors stating that "Air temperatures over irrigated agricultural fields that are (3ºC) cooler than air over bare ground." A number of trees can be used in parks but perhaps the most beneficial would be shade trees. To increase vegetation, one must carefully study the type of plants to be used, their required maintenance, soil and even study foliage loss of each type. Shade trees, such as shrubs, are highly recommended to be used to provide shade during the day, and reduce heat throughout the day. Acacia trees are shade trees that are native to Saudi Arabia and can be a used for the aforementioned reasons. Using trees native to the land is important because they are well adapted to the climate which results in less costs spent on maintaining them and higher chances of survival.

3.2 Shading systems

Providing adequate shade from the sun is essential in parks as it attenuates direct sunlight that can cause a range of health issues and it reduces glare, blocks heat and alleviates general sun-caused discomfort during the day. The presence of shade structures will encourage individuals to be active at beneficial times of the day instead of only enjoying parks after sunset. In a paper published by Colter et al., (2019), it was documented that architectural structures such as ramadas, seen in figure 12, can mitigate heat and assist in reaching thermal comfort.

***Figure* 12.** *Ramada, retrieved from shadecomfort.com, 2022*

3.3 Misting systems

One way to overcome heat is to install cooling misting systems. One might question if a misting system would be as effective in a humid area like Jeddah. The answer would be yes. A successful application of these systems can be found in the UAE specifically in AlDhafra parks in AbuDhabi. The installed high pressure misting systems have a 20 degrees Celsius reduction capacity. They are placed on trees or can be free standing units. They are cost effective and can be equipped with timers to reduce water waste and electrical consumption.

3.4 Refreshments

Specific solutions should be tailored to specific problems. Heat exhaustion and dehydration are common factors in elderly not visiting parks and thus having less physical activity during their day. Water fountains are an overlooked element in the design of parks. Having a source of fresh, cold water at hand is a benefit for park goers, not only is it convenient but is also environmentally friendly.

3.5 Maintenance

Maintenance of a park refers to, but is not limited to, up keeping of plantation, constant system checks on installed shading and misting systems and water fountains, and maintain pathways. Poorly maintained parks can become hazardous and can have reverse effects on the community. In conclusion, all of the aforementioned solutions are great but are eventually worthless without adequate maintenance.

3.6 Materials

Materials used in parks such as those used in constructing paths and pavement play a role in either increasing or decreasing heat in the area they are used in. In the research paper “Materials to Mitigate the Urban Heat Island Effect for Cool Pavement: A Brief Review” the authors delved into the most optimum materials to reduce heat. These include the following:

3.6.1 Solar reflective coating: 7–9◦C reduced in the solar environment by the coating-material usage of 0.8 kg/m2. Using epoxy-based coating reduced the surface temperature of asphalt pavement by 13.4◦C. Wang et al. (2022).

3.6.2 Waste tiles can reduce surface temperature of asphalt 4.1-9.6◦C. Wang et al. (2022).

4. Manual

**Table 3.** Results’ manual.

| **Category** | **Specification** | **Benefit** | | |
|---|---|---|---|---|
| | | Thermal comfort | Natural vs. artificial | Heat Reduction |
| **Vegetation** | Shade trees | ✓ | Natural | 1–5◦C<br>Average= 3◦C |
| | Ground cover | ✓ | | |
| | Deciduous trees | ✓ | | |
| **Materials in pavement** | Solar reflective coating | ✓ | Artificial | 7–9◦C<br>Average= 8◦C |
| | Waste tiles | ✓ | | 4.1-9.6◦C<br>Average= 6.85◦C |

| | | | | |
|---|---|---|---|---|
| **Shading system** | Ramadas | ✓ | | ✓ |
| **Misting system** | - | ✓ | | Up to 20◦C<br>Average= 10.5◦C |
| **Results** | / | / | / | Average= 7.09◦C |

**Recommendations**

Worldwide data revealed the importance of urban parks for communities and cities. On this basis, it is recommended that special focus be paid into their designs and the functions/environment they offer to visitors.

Both previous and recent studies corroborated the negative impacts increased heat has on individuals, especially elderly and those with pre-existing health conditions. A thorough literature review and data analysis have shown that thermal comfort should be reached in urban parks. Thus, it is highly recommended that the responsible parties for urban planning should implement heat regulating changes to urban parks in the city of Jeddah, and that more research be made on innovative ways to further solve the problem of heat and to encourage elderly to visit parks more often in general.

**5. Conclusions**

Recent missions in Saudi Arabia have been solely focused on improving the quality of life for citizens and creating a sustainable and greener environment. Urban parks have long been viewed as a city's green hub, with the great value they add to individuals, communities and the environment alike.

This paper provided details about thermal comfort and the concept of urban heat islands. These two concepts have garnered worldwide attention with the impending dangers global warming inflicts on the world. The paper, through survey and site analysis, identified a major cause for the absence of elderly and their companions from Jeddah's urban parks. The data collected from the surveys proved that the elderly are in dire need of physical activity and their companions aren't exempt either, with both groups falling short on the fitness scale.

Heat, although simple to understand is quite complex in the many ways it affects both the environment and the individual. These effects vary from physical to emotional and mental. Where it can be detrimental to all. Identifying said effects and searching for ways to eradicate them is essential for enhancing the quality of life. Although the climate is rather impossible to change in the grand scheme of things, that does not justify not implementing changes that have been proven to enhance the temperature within specific parameters, such as in and around urban parks. Amongst many solutions given in this paper, urban greening have shown the greatest effect on reaching human thermal comfort. That, in addition to shading from direct sunlight, is guaranteed to improve the elderly's experience in Jeddah's parks and encourage citizens to lead a healthier life.

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