

**Mercedes Muñoz Martínez.**

Diabetes Educator Nurse  
General University Hospital of Ciudad Real (Ciudad Real, Spain)

**Antonia Horcajada Jimenez.**

Diabetes Educator Nurse  
General University Hospital of Ciudad Real (Ciudad Real, Spain)



# Therapeutic education to prevent the effects of heatwaves in people with diabetes

In 1992, the United Nations Framework Convention on Climate Change was signed, and within it, climate change was defined as: "a change in climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which adds to the natural climate variability observed over comparable time periods."

Meteorologists agree that the emission of greenhouse gases is the primary cause of the current trends in global warming. This sharp increase is mainly attributed to the burning of fossil fuels and industrial processes, which are responsible for nearly 78% of this rise. Since greenhouse gases trap heat, the higher the atmospheric concentration, the higher the temperature. This unprecedented atmospheric concentration has raised the global average temperature by about 0.85°C between 1880 and 2012. According to current trends, the atmospheric concentration of these gases will nearly quadruple pre-industrial levels by the end of this century.

One of the most dangerous consequences of global warming is heatwaves. A heatwave is an extended period of unusually hot weather relative to the expected conditions of the area for that time of year. This meteorological phenomenon is becoming more frequent during the current century. Heatwaves increase deaths from cardiovascular and respiratory conditions and are also associated with a higher number of suicides.

### HOW DO HEATWAVES AFFECT DIABETES MANAGEMENT?

Short-term exposure to extreme temperatures has an impact on people with diabetes. Two recent meta-analyses showed that heatwaves increase mortality and morbidity among people living with diabetes. Proposed underlying pathogenic mechanisms include the impairment of the thermoregulatory mechanism along with the deterioration of the autonomic nervous system responses to high temperatures, electrolyte imbalances, and rapid deterioration of kidney function. Additionally, excessive sweating has been associated with longer diabetes duration and poorer glycemic control in diabetes patients. In a more recent study conducted in Castille-La Mancha, Spain, a 4% reduction in the time in range of interstitial glucose was observed in people with type 1 diabetes mellitus during the 2 weeks following the largest heatwave recorded in Europe during the summer of 2022.

Some previous descriptive studies had shown a negative association between glucose levels and temperature in different climatic zo-

nes. In fact, the lowest levels of glycated hemoglobin A1c are observed in summer, while the highest are recorded during the winter months in Southern Europe. Another study conducted from the perspective of the Mediterranean climate found an inverse relationship between plasma glucose and temperature in women with gestational diabetes, although a positive correlation was detected after the oral glucose tolerance test. Therefore, seasonal variations in diabetes control were observed in our climatic area.

All these changes in glycemic control in diabetes can be categorized into 2 groups: (1) factors dependent on sun/temperature exposure, such as physical activity, vitamin D deficiency, and serum melatonin concentration; and (2) factors independent of sun/temperature exposure, such as school and work stress, the amount of free time, behavioral changes related to high temperatures, mild upper respiratory tract infections and other "seasonal" infections, seasonal dietary patterns related to the seasonal availability of "healthy foods," and seasonal endogenous hormonal variations (e.g., cortisol).

### WHAT RECOMMENDATIONS CAN PEOPLE WITH DIABETES FOLLOW TO AVOID THE EFFECTS OF HEATWAVES?

Here are some recommendations to avoid the effects of heatwaves:

#### General Recommendations:

##### 1) Keep your home cool and avoid heat:

- Try to keep your living space cool. Check the temperature between 8:00 and 10:00, at 13:00, and in the evening after 22:00. Ideally, the room temperature should be < 32°C during the day and < 24°C at night. Take advantage of the cool night air to refresh your home.
- Open all windows and shutters at night and early in the morning when the outside temperature is lower.
- Reduce thermal load inside the house. Close windows and shutters (if you have them), especially those facing the sun during the day.
- Turn off artificial lighting and as many electrical appliances as possible. >>

## EXCESS HEAT CAN DAMAGE BLOOD GLUCOSE METERS AND OTHER ELECTRONIC EQUIPMENT USED FOR DIABETES MANAGEMENT

## Avoid the effects of a heatwave in your diabetes

### What is a heatwave?

A **heatwave is a prolonged period of unusually hot weather relative to the expected conditions of the area for that time of year.** This phenomenon is primarily caused by **climate change**, due to the burning of fossil fuels and industrial processes. Heatwaves are becoming more frequent, leading to increased deaths from cardiovascular and respiratory conditions, as well as being linked to a higher number of suicides.

### General Recommendations:

#### 01 Keep your home cool and avoid the heat:

- Ideally, keep the room temperature < 32°C during the day and < 24°C at night.
- Take advantage of the cool night air to refresh your home. Open all windows at night and early in the morning.
- Reduce the indoor thermal load by keeping windows, curtains, and blinds facing the sun closed during the day.
- Turn off artificial lighting and as many electrical appliances as possible.
- If you have air conditioning, turn it on as needed and keep doors and windows closed to maintain a cool environment. It's recommended to set it between 23°C and 27°C in summer.
- Electric fans can provide relief, but when the temperature exceeds 35°C, they may not prevent heat-related illnesses.
- Move to the coolest room in the house, especially at night.
- If it's not possible to keep your home cool, spend 2-3 hours a day in a cool place (like a public building with air conditioning).
- Avoid going outside during the hottest hours of the day and stay in the shade.
- If engaging in intense physical activity, do so during the coolest times of the day, usually before 8:00 am.

#### 02 Keep your body cool and hydrated:

- Take cool showers or baths. Alternatives include cold compresses, towels, sponges, foot baths, etc.
- Wear lightweight, loose clothing made from natural materials. If you go outside, wear a wide-brimmed hat or cap and sunglasses.
- Use light bedding and sheets and avoid cushions to prevent heat accumulation.
- Drink regularly to stay hydrated. The best liquid for hydration is water.
- Elderly people, those with cognitive impairment, and small children may not properly feel thirst, so they should be reminded and encouraged to drink fluids regularly.

- » - Hang blinds, curtains, awnings, or grids on windows that receive morning or afternoon sun.
- If your home has air conditioning, close doors and windows and keep the air conditioner running continuously, except, if possible, during the cooler hours of the day.
- Electric fans can provide relief, but when the temperature < 35°C, they may not prevent heat-related illnesses.
- Move to the coolest room in the house, especially at night.
- If it's not possible to keep your home cool, spend 2-3 hours a day in a cool place (such as a public building with air conditioning).
- Avoid going outside during the hottest hours of the day.
- If you can, avoid strenuous physical activities. If you are going to engage in intense physical activity, do it during the coolest hours of the day, typically in the morning between 5:00 and 8:00.
- Stay in the shade.

#### 2) Keep your body cool and hydrated:

- Take cool showers or baths. Alternatives: cold compresses, towels, sponges, foot baths, etc.
- Wear lightweight and loose clothing made of natural materials. If you go outside, wear a wide-brimmed hat or cap and sunglasses.
- Use light bedding and sheets, and avoid cushions, to prevent heat accumulation.
- Drink regularly, especially if you feel thirsty, but avoid alcohol and excessive caffeine or sugar. Elderly people, those with cognitive impairment, or small children may not notice thirst properly, so they should be reminded and encouraged to drink fluids regularly.

#### Recommendations for people with diabetes:

Check your glucose more frequently to ensure it is within the desired range, regardless of what the summer may bring. It's especially important to recognize the symptoms of low blood sugar and treat it as soon as possible. The symptoms of excessive heat (e.g., heatstroke) can resemble those of low blood sugar (hypoglycemia), so check your glucose if you experience any similar symptoms.



- » Protect yourself from the sun with a hat and sunglasses.

Drink plenty of water to avoid dehydration. Avoid alcohol and caffeine-containing drinks like coffee and sugary energy drinks, as they can raise your glucose levels. The best liquid for staying hydrated is water.

Check your glucose level before, during, and after any physical activity. You may need to adjust your insulin dosage. Ask your health care team for help adjusting the dose if you're unsure how to do so.

Wear sunscreen and a hat when outdoors. Sunburn can raise blood sugar levels.

Do not go barefoot, even at the beach or pool.

Use air conditioning, or if you don't have it, go to a building or shopping center with air conditioning to stay cool. In extreme heat, a room fan may not be enough to cool you down.

Do not store insulin or oral diabetes drugs in direct sunlight or a hot car. Check the drug's information to see how it can be affected by high temperatures. In general, insulin should not be exposed to temperatures > 30°C.

If traveling, store insulin and other drugs in a portable refrigerator. Do not place insulin directly on ice or a gel pack.

Excessive heat can damage blood glucose meters and other electronic equipment used for diabetes management. Do not leave them in a hot car or in direct sunlight by a pool, on the beach, or in direct sunlight. The same applies to supplies like test strips.

But don't let summer heat stop you from leading an active life. You can take your diabetes medications and supplies with you when you go out. You'll need to be able to test your glucose and take action if it's too high or low. Just make sure to protect your diabetes equipment from the heat.

Tips for people with diabetes who use glucose sensors and/or insulin pumps:

Follow the manufacturer's guidelines regarding the temperature limits of the electronic equipment you use.

If you wear a sensor and need to change it, avoid getting sunscreen or oil in the insertion area. Clean the area well before applying a new sensor »

## Avoid the effects of a heatwave in your diabetes

### How do heat waves affect diabetes?

Exposure to extreme temperatures particularly impacts chronic conditions like diabetes, increasing the risk of complications, even death. These recommendations aim to prevent the harmful effects of heat waves on health.

### Recommendations to Avoid the Effect of Heat on Your Diabetes:

- 01** Check your blood glucose more frequently. The symptoms of heat overexposure may resemble those of low glucose.
- 02** Check your glucose level before, during, and after any physical activity.
- 03** Drink plenty of water but avoid alcohol and drinks with caffeine and/or sugars, as they can raise your glucose levels.
- 04** Use sunscreen, as sunburns can increase blood sugar levels.
- 05** High temperatures can alter the medication needs for your diabetes. Consult your health care team if you have any doubts.

### How to Protect Insulin from High Temperatures:

- If the temperature > 30°C, it is best to store insulin in the refrigerator. Insulin should be carried in a cooled bag, wallet, or case.
- If insulin turns a brownish color, DO NOT use it, as it indicates heat damage.

### Recommendations for the Safe Use of Diabetes Technology:

- Do not leave sensors or test strips inside a car or in the sun, near a pool, or at the beach.
- If your symptoms do not match the readings on your glucose sensor or meter, verify them by another method if possible.
- Cover the pump and/or sensor with a towel when sunbathing to prevent the insulin or the electronic device from overheating.
- You may need to change the pump reservoir more frequently due to insulin overheating.
- Avoid using sunscreen or oils on the areas where you insert the sensor or insulin pump.

## HEATWAVES INCREASE DEATHS DUE TO CARDIOVASCULAR AND RESPIRATORY CONDITIONS AND ARE ALSO ASSOCIATED WITH A HIGHER NUMBER OF SUICIDES



## EXCESSIVE SWEATING HAS BEEN LINKED TO A LONGER DURATION OF DIABETES AND POORER GLYCEMIC CONTROL IN DIABETES PATIENTS

» to ensure proper adhesion. The same applies to an insulin pump if you need to change the insertion site.

Keep in mind that it may be necessary to change the pump reservoir more frequently due to insulin heating.

Cover the pump and/or glucose receiver with a towel when sunbathing to prevent insulin or the electronic device from overheating. If your blood sugar levels seem higher for no apparent reason, the insulin in the reservoir may have been damaged by the heat, so consider changing it. When insulin is damaged by heat, it usually turns cloudy. Insulin exposed to intense sunlight may sometimes take on a brownish color. Do not use insulin with this appearance.

When the temperature > 30°C, it's best to store insulin in the refrigerator. If you're away from home, carry insulin in a properly cooled bag, case, or pouch. **D**

### CONCLUSIONS

Climate change will be a significant challenge for the world's health care systems in the coming decades. As we have seen, high temperatures and the increasing frequency of heatwaves can affect health in many ways, especially if chronic diseases like diabetes are already present. It is essential to develop and implement personalized prevention and management strategies to mitigate the harmful effects of global warming and heatwaves on the health of people with diabetes.



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