

Reduced heart rate fluctuations due to disruption of the body's internal clock may double risk of death in diabetics

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Disruption to normal variations in daily heart rate (HR) is associated with a much higher risk of dying in people with type 1 and type 2

diabetes over 21 years, according to new research presented at the [Annual Meeting of The European Association for the Study of Diabetes](#) (EASD), held in Madrid (9–13 Sept).

A reduction in 24-hour HR variations was associated with twice the risk of dying from cardiovascular causes, while the inability to reduce HR during sleep was linked with a 39% increased risk.

The results held true even after adjusting for a wide range of influential factors including age, sex, BMI, good vs. poor glycemic control, type of [diabetes](#), and uncontrolled hypertension ([high blood pressure](#)).

"Impaired circadian [heart](#) rate fluctuations are common in individuals with long-standing diabetes and are linked with microvascular disease and increased long-term risk of cardiovascular and all-cause mortality," explained lead author Dr. Lorenzo Nesti from the University of Pisa, Italy.

"Identifying these conditions with 24h ambulatory blood pressure and [heart rate monitoring](#) is relatively inexpensive and easily measured, and could be used to identify people at greater risk of dying in this high-risk population."

Circadian heart rate (HR) refers to the natural variations in heart rate that occur over a 24-hour period, influenced by the body's circadian rhythm and the ability of the nervous and cardiovascular systems to modulate vital functions to meet the body's requests. This rhythm is like an internal clock that regulates physiological processes, including heart rate and blood pressure, especially in response to movement and rest.

Typically, heart rate is lower during sleep and increases upon waking, reaching its peak in the mid-morning and during [daily activities](#). Blood pressure also follows a circadian rhythm, with 10% to 15% lower values

during night time than during day time.

"High variations in HR during the day are a characteristic of healthy individuals, while reduced variations are an indicator of poor health, independent of other risk factors," explained Dr. Nesti.

"The inability to regulate cardiovascular responses to everyday activities is a clear sign of disease, while the inability to regulate HR in response to sustain effort, as well as the inability to reduce it during rest, indicates advanced cardiovascular dysfunction."

While previous research has identified associations between alterations in circadian HR fluctuations and cardiovascular events in the general population, including the onset of heart attack, stroke, and arrhythmias, little is known about HR variations and mortality in individuals with diabetes.

To fill this important evidence gap, researchers analyzed blood pressure and HR data in 349 adults with type 2 or type 1 diabetes (average age 57 years, 52% women, BMI 29.4 kg/m², HbA1c 8.6%, 81% type 2 diabetes).

All participants wore 24h ambulatory blood pressure and HR monitors (ABPM) to record their data, and underwent an assessment of diabetic microvascular complications.

To explore the association of impaired circadian heart rate fluctuations and mortality, participants were classified according to low daily variations in HR (reflecting normal [high] vs. reduced variations in HR in response to daytime activities; 174 participants [50%]) and blunted dipping of night time HR (indicating the inability to reduce HR during rest or sleep (107 participants [31%]) defined as a drop in average HR at night lower than 10% compared with day-time values.

Mathematical modeling was used to investigate associations between low 24h-HR and blunted nocturnal HR and the risk of dying from a cardiovascular cause or any cause over a 21 year follow-up.

The researchers found that low 24h-HR and blunted nocturnal HR dip were associated with an adverse cardiometabolic risk profile and high rates of cardiac autonomic neuropathy (a serious complication of diabetes that is strongly associated with a five-fold increased risk of cardiovascular mortality) and nephropathy (kidney damage associated with diabetes).

During 6,251 person-years of follow-up (21 years), 136 (39%) participants died, and over two-thirds of these deaths (68%; 100) were due to cardiovascular causes.

The researchers found that having low variations in 24h-HR was associated with double the risk of dying from cardiovascular causes and a 50% greater risk of dying from any cause compared to experiencing normal (high) daily HR fluctuations (reflecting an insufficient increase during daytime activity and/or paradoxical non-decrease during rest).

Similarly, experiencing a blunted dipping of [night time](#) HR was associated with a 39% higher risk of dying due to cardiovascular causes or from any cause compared to those with preserved nocturnal HR dip.

Further analyses of microvascular complications found that disrupted HR variations were associated with a higher burden of multiorgan damage.

"Our findings are retrospective and observational and can't tell us about the direction of causality, but they reinforce the idea that the identification of abnormal HR patterns in individuals with diabetes can identify those at higher risk of cardiovascular events and premature

death, prompting the search of complications and the early initiation of more intense preventive strategies before symptoms arise," said Dr. Nesti.

Provided by Diabetologia

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