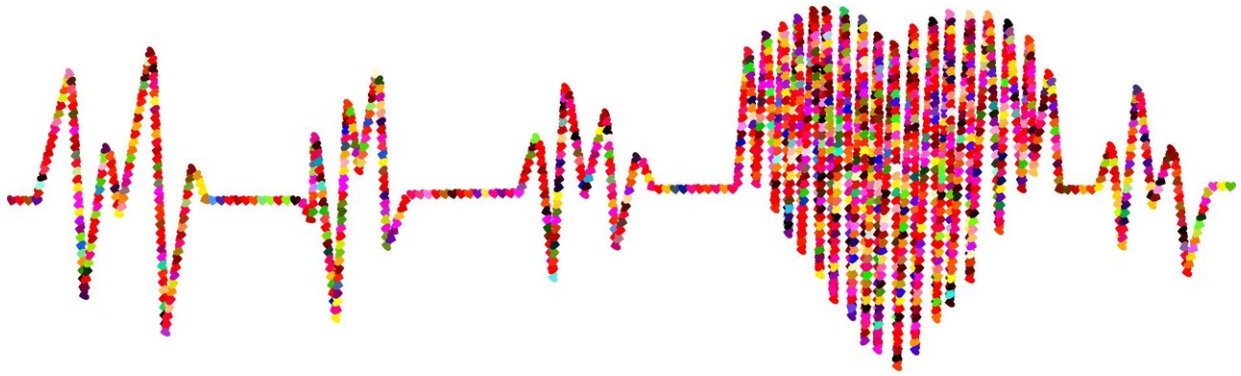
High blood pressure in midlife is linked to increased brain damage in later life

November 26 2020



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Higher than normal blood pressure is linked to more extensive brain damage in the elderly, according to a new study published today in the *European Heart Journal*.

In particular, the study found that there was a strong association between diastolic blood pressure (the blood pressure between heart beats) before the age of 50 and brain damage in later life, even if the diastolic blood

pressure was within what is normally considered to be a healthy range.

The findings come from a study of 37,041 participants enrolled in UK Biobank, a large group of people recruited from the general population aged between 40 and 69 years, and for whom medical information, including MRI brain scans was available.

The research, carried out by Dr. Karolina Wartolowska, a clinical research fellow at the Centre for Prevention of Stroke and Dementia, University of Oxford, UK, looked for damage in the brain called "white matter hyperintensities" (WMH). These show up on MRI brain scans as brighter regions and they indicate damage to the small blood vessels in the brain that increases with age and blood pressure. WMH are associated with an increased risk of stroke, dementia, physical disabilities, depression and a decline in thinking abilities.

Dr. Wartolowska said: "Not all people develop these changes as they age, but they are present in more than 50% of patients over the age of 65 and most people over the age of 80 even without high blood pressure, but it is more likely to develop with higher blood pressure and more likely to become severe."

Information on the participants was collected when they enrolled in UK Biobank between March 2006 and October 2010, and follow-up data, including MRI scans, were acquired between August 2014 and October 2019. The researchers adjusted the information to take account of factors such as age, sex, risk factors such as smoking and diabetes, and diastolic as well as systolic blood pressure. Systolic blood pressure is the maximum blood pressure reached each time the heart beats and is the top number in blood pressure measurements.

"To compare the volume of white matter hyperintensities between people and to adjust the analysis for the fact that people's brains vary

slightly in size, we divided the volume of WMH by the total volume of white matter in the brain. In that way, we could analyse the WMH load, which is the proportion of the WMH volume to the total volume of white matter," said Dr. Wartolowska.

The researchers found that a higher load of WMH was strongly associated with current systolic blood pressure, but the strongest association was for past diastolic blood pressure, particularly when under the age of 50. Any increase in blood pressure, even below the usual treatment threshold of 140 mmHg for systolic and below 90 mmHg for diastolic, was linked to increased WMH, especially when people were taking medication to treat high blood pressure. [2]

For every 10mmHg increase in systolic blood pressure above the normal range, the proportion of WMH load increased by an average (median) of 1.126-fold and by 1.106-fold for every 5mmHg increase in diastolic blood pressure. Among the top 10% of people with the greatest WMH load, 24% of the load could be attributed to having a systolic blood pressure above 120mmHg, and 7% could be attributed to having diastolic blood pressure above 70mmHg, which reflects the fact that there is a greater incidence of elevated systolic rather than diastolic blood pressure in older patients.

Dr. Wartolowska said: "We made two important findings. Firstly, the study showed that diastolic blood pressure in people in their 40s and 50s is associated with more extensive brain damage years later. This means that it is not just the systolic blood pressure, the first, higher number, but the diastolic blood pressure, the second, lower number, that is important to prevent brain tissue damage. Many people may think of hypertension and stroke as diseases of older people, but our results suggest that if we would like to keep a healthy brain well into our 60s and 70s, we may have to make sure our blood pressure, including the diastolic blood pressure, stays within a healthy range when we are in our 40s and 50s.

"The second important finding is that any increase in blood pressure beyond the normal range is associated with a higher amount of white matter hyperintensities. This suggests that even slightly elevated blood pressure before it meets the criteria for treating hypertension has a damaging effect on brain tissue.

"Our results suggest that to ensure the best prevention of white matter hyperintensities in later life, control of diastolic blood pressure, in particular, may be required in early midlife, even for diastolic blood pressure below 90mmHg, whilst control of systolic blood pressure may be more important in late life. The long time interval between the effects of blood pressure in midlife and the harms in late life emphasises how important it is to control blood pressure long-term, and that research has to adapt to consider the very long-term effects of often asymptomatic problems in midlife."

Potential mechanisms for the development of WMH include damage to the delicate blood vessels in the brain through sustained elevated pressures over time that directly cause damage to the blood vessels; this leads to the lining of the vessels becoming leaky and results in WMH. Alternatively, diastolic pressure might cause large blood vessels to become stiffer with time, which increases pulsations of blood pressure to the brain; this causes high blood pressure with each heart beat, rapid changes in blood pressure, and blood flow that is too low between heart beats, resulting in damage to white matter.

As MRI scans were only available at one time point, the researchers could not quantify the progression of WMH directly. Other limitations include that further analysis is needed to identify differences in different regions of white matter, and that although the researchers showed associations with smoking and diabetes, the potential complex interaction between risk factors, which also include high cholesterol levels, obesity and kidney problems, require further investigation.

More information: Karolina Agnieszka Wartolowska et al, Midlife blood pressure is associated with the severity of white matter hyperintensities: analysis of the UK Biobank cohort study, *European Heart Journal* (2020). DOI: 10.1093/eurheartj/ehaa756

Provided by European Society of Cardiology