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Examining heart and blood vessel health in women with a history of high blood pressure during pregnancy using ultrasound and eye scans

Submission date 10/03/2025	**Recruitment status** Recruiting	[_] Prospectively registered [X] Protocol
Registration date 09/06/2025	**Overall study status** Ongoing	[_] Statistical analysis plan [_] Results
Last Edited 11/05/2026	**Condition category** Circulatory System	[_] Individual participant data [X] Record updated in last year

Plain English summary of protocol

Background and study aims

High blood pressure during pregnancy affects about 12% of pregnancies. This can lead to serious problems during pregnancy, such as restriction of the baby's growth or life-threatening complications for the mother. At the most serious extent, it can lead to pre-term birth or loss of mum and/or baby. Women who have high blood pressure during pregnancy are likely to develop heart and blood vessel problems later in life. It is important to know who might get heart and blood vessel problems later in life.

Small blood vessels play an important role in blood pressure disorders. Retinal imaging is currently used to identify changes in the tiny blood vessels of people who have had a stroke or diabetes and can be used for early detection.

This study will investigate if imaging of small blood vessels can help measure the health of blood vessels in women after pregnancy to identify those who are at risk of future cardiovascular disease.

This research goal is to explore the use of retinal imaging, ophthalmic ultrasound and blood tests to evaluate small blood vessels' function and structure after pregnancy. This will help better understand potential risk of heart disease later on in life.

The researchers intend to study women who had high blood pressure during pregnancy who are more likely to develop raised blood pressure and heart problems later in life. They will identify women who had hypertension during pregnancy and compare them to women who did not suffer from hypertension during pregnancy. They will use new monitoring methods which are quick and easy which could in the future improve the identification of women who are likely to have complications later in life.

Who can participate?

Women aged 18 years and over who were pregnant 6 to 60 months ago and who either had normal blood pressure or high blood pressure during pregnancy

What does the study involve?
1. Retinal imaging: retinal imaging takes a digital photograph of the back of the eye. It shows the retina and blood vessels. This helps to look at the health of the tiny blood vessels.
2. Ultrasound: the ultrasound is a painless and safe test that uses sound waves to make images of the region of interest.
3. Eye ultrasound (ophthalmic ultrasound): done on the closed eye it looks at the blood vessel (ophthalmic artery) that goes to the eye.
4. Neck ultrasound (carotid ultrasound): ultrasound of the neck will measure blood flow through the carotid blood vessel, creating a picture of the blood flow using sound waves. The elasticity of the blood vessels will also be measured. A small pen-like device will be placed gently on the neck and at the same time a cuff is placed on the thigh.
5. Blood sample: the procedure involves collecting blood, labelling the tubes, and sending them to the laboratory for analysis.

What are the possible benefits and risks of participating?
There will be no direct benefits from participating in the study. However, the information gathered will be helpful for future pregnant women, as it will aid in better identifying women at risk of high blood pressure and allow for the early detection of complications later in life.
All blood vessel assessments are non-invasive, and there are no significant risks in taking part in the study. However:
1. Ultrasound: pressure may be felt, but no pain, during the ultrasound examinations.
2. Retinal photograph: this will not cause any pain. A photograph is quickly taken when the eye is open, similar to a visit to the optician.
3. Blood sampling: blood sampling is invasive, but the risk is low. A brief prick may be felt when the needle is inserted into the skin, but any discomfort should quickly subside.

Where is the study run from?
Ninewells Hospital, Dundee, Scotland (UK)

When is the study starting and how long is it expected to run for?
October 2023 to June 2026

Who is funding the study?
University of Dundee (UK)

Who is the main contact?
1. Dr Colin Murdoch, c.z.murdoch@dundee.ac.uk
2. Ms Sarah Alkhurainej, 2590444@dundee.ac.uk

Contact information

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Additional identifiers

Integrated Research Application System (IRAS)
350550

Sponsor ID
2-003-25

Study information

Scientific Title
Investigating cardiovascular function in women with a history of gestational hypertension using ultrasound imaging

Study objectives
Hypothesis 1: Retinal imaging in postpartum women who experienced gestational hypertension will show persistent endothelial dysfunction (e.g., altered vessel diameter, tortuosity).

Hypothesis 2: Postpartum retinal metrics will correlate with Doppler indices and blood biomarkers, indicating prolonged cardiovascular risk.

Ethics approval required
Ethics approval required

Ethics approval(s)

approved 07/05/2025, Health and Social Care Research Ethics Committee A (HSC REC A) (Lissue Industrial Estate West, 5 Rathdown Walk, Lisburn, BT28 2RF, United Kingdom; +44 28 9536 1400; info.orecni@hscni.net), ref: 25/NI/0055

Study design
Single-centre cross-sectional observational study

Primary study design
Observational

Study type(s)
Screening

Health condition(s) or problem(s) studied
Future cardiovascular diseases in women with gestation hypertension

Interventions
This is a cross-sectional study of women with a history of normal and hypertensive pregnancies. The researchers propose to examine:
1. Long-term (0.5-5 years) postnatal cardiovascular changes in women who have experienced gestational hypertension compared to those with non-hypertensive pregnancies.
2. The correlation between circulating biomarkers of cardiovascular dysfunction and vascular functional (blood flow) changes.

The researchers will look at two groups of women: women who had high blood pressure during pregnancy (gestational hypertension) and women who had non-hypertensive pregnancies (~n = 20).

The goal is to see if we can identify early changes in blood vessel function or structure in vasculature, particularly how well the blood vessels are working and their stiffness, between those who had gestational hypertension and those who did not. This will provide measurements to determine if there are continued changes in the microvasculature post-pregnancy.

This is a single-centre study that will take place at the School of Medicine & Ninewells Hospital, Dundee.

An email or letter from the care team will be sent to women postpartum (6 months - 5 years). Women who had gestational hypertension may also be recruited to act as controls. Potential participants interested in participating in the study may contact the study (research) team either via email or telephone directly using information from the PIS received from the care team. A minimum of 24 hours will be given prior to consent being obtained.

There are no site-specific requirements for this study.

Participants will need only one visit for all examinations. Women recruited for the study will undergo the following investigations: All participants will have baseline assessments, including height and weight. A questionnaire will be administered to assess modifiable risk factors.

Non-invasive imaging will be conducted to evaluate vascular and endothelial function, including assessments of blood pressure, ultrasound Doppler measurements, and retinal imaging.

1. Doppler Ultrasound for Neck (Carotid) and Eye (Ophthalmic):
The ultrasound is a painless, safe test that uses sound waves to create images of the area of interest. The ophthalmic artery will be examined in both (closed) eyes, and the carotid artery will be examined on the right side only.

Carotid Artery Doppler:
This non-invasive evaluation assesses the thickness and elasticity of the blood vessel walls. For this test, ultrasound images will be taken by scanning the neck. The participant will lie down and be at rest while the images are taken. Three measurements from the images will be made (carotid intima-media thickness, pulse wave velocity, and strain of the vessel). These ultrasound images will help predict any potential risk of cardiovascular disease.

Ophthalmic Ultrasound:
Eye ultrasound is performed through a closed eyelid to visualize the space around and behind the eye cannot be directly imaged. This test helps to measure the ophthalmic artery. Reflected sound waves create a picture of the eye structure and ophthalmic artery.
The test is conducted while the participant lies back with their eyes closed. A gel will be placed on the skin of the eyelids, and a small device will be gently placed against the front of the eye to perform the test. Participants will not feel any discomfort or pain. They may be asked to look in different directions to improve the ultrasound image or to view different areas of the eye.

2. Arterial Stiffness:
SphygmoCor is a non-invasive, CE-marked device used to measure the elasticity of the blood vessels. This test provides information about arterial pressures that represent systemic arterial stiffness, measured through aortic pulse wave velocity and augmentation index. The participant will lie on a bed and acclimatize for 10 minutes, after which blood pressure will be measured in triplicate. The waveforms from the volunteer's arteries will be recorded at the neck (carotid artery) and groin (femoral artery) using a micromanometer with the SphygmoCor PWV system. The augmentation index, heart rate, and carotid-to-femoral pulse wave velocity will be calculated using this software. This test carries no risks to the participant's health.

3. Retinal Imaging:
Retinal imaging takes a digital picture of the back of the eye, showing the retina and blood vessels. The participant's chin and forehead will be placed on a support to keep the head steady. They will need to open their eyes and stare straight ahead at an object while a laser scans the eyes, and then the images are uploaded to a computer.

4. Blood Samples:
A blood sample (approx. 20 ml) will be taken from the participant during the investigation. The samples will include sFlt-1, PLGF, and endothelin-1. Blood samples from both groups will be assessed for biomarkers of endothelial function, including sFlt-1 and PLGF (clinically used to diagnose preeclampsia), endothelin-1 (a marker of endothelial dysfunction), and peroxynitrate (oxidative stress), centrifuge to separate plasma from serum using standard procedures, that will be conducted for the control group of participants. UoD Immunoassay biomarker core facility will conduct biomarker assessment, following manufacturer and UoD SOP and procedure guides.

The above measurements (1-4) will be taken sequentially. This is likely to be in the order as listed above but in some cases the order may be changed.

Retinal imaging and ultrasound (including carotid and ophthalmic artery Doppler) will be conducted in the Tayside Clinical Research Centre/Clinical room at the Division of Cardiovascular

Research (Blood Flow Lab), Ninewells Hospital, on the same day of investigation. All participants (control and patient groups) will have the same procedures.

As part of a collaboration with St Georges London, a previously published study (Giorgione et al 2023; Ultrasound in Obs&Gyn; Angiogenic markers and maternal echocardiographic indices in women with hypertensive disorders of pregnancy. https://doi.org/10.1002/uog.27474 / REC reference: 19/LO/0794, sponsor: EU Horizon2020 iPlacenta) demonstrated changes in cardiovascular by ultrasound in women 6-18 months post pregnancy with n = 25 control comparing n = 34 gestational hypertension women. Using this previous data a Power Analysis (G*power)) -A Piori carried out to compute the required sample size for the Wilcoxon-Mann Whitney test (2 groups). With α = 0.05 and a power of 95% to detect an effect size of 20%, each group requires n = 22.

Intervention Type
Other

Primary outcome(s)
1. Retinal vascular health measured using retinal imaging (Canon camera) (VAMPIRE: Vascular Assessment and Measurement Platform for Images of the REtina)
2. Endothelial function measured using retinal imaging and ultrasound pulse-wave Doppler
3. Cardiovascular function biomarkers measured using blood biomarker analysis (sFlt-1 & PLGF, endothelin-1)

Measured at a single timepoint per participant (6 to 60 months postpartum)

Key secondary outcome(s))
Long-term cardiovascular risk indicators measured using cardiovascular risk assessment tools (e. g., blood pressure, etc) at a single timepoint per participant (6 to 60 months postpartum)

Completion date
01/06/2026

Eligibility

Key inclusion criteria
Case group:
Women who:
1. Are aged 18 years or above
2. Are able to give written informed consent (ICF)
3. Have given birth in the last 6-60 months
4. Were diagnosed with gestational hypertension (systolic BP≥ 140 mmHg or diastolic BP ≥90 mmHg) in their last pregnancy.

Control group:
Women who are:
1. Aged 18 years or above
2. Able to give written informed consent (ICF)
3. Have no history of gestational hypertension

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 years

Upper age limit
60 years

Sex
Female

Total final enrolment
0

Key exclusion criteria
Exclusion criteria are the same for both case and control groups:

Case group:
1. Women with ophthalmic disorders
2. Women who had hypertension prior to pregnancy
3. Maternal age less than 18 years at delivery.
4. Women who are not capable of giving informed consent (ICF).
5. Individuals participating in the clinical phase of another interventional trial/study or have done so within the last 30 days (unless they are participating in the follow-up phase of another interventional trial/study, or who are enrolled in an observational study, will be co-enrolled where the CIs of each study agree)

Control group:
1. Women with any history of gestational hypertension (systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg))
2. Women with ophthalmic disorders
3. Women who had hypertension prior to pregnancy
4. Maternal age less than 18 years at delivery.
5. Women who are not capable of giving informed consent (ICF).
6. Individuals participating in the clinical phase of another interventional trial/study or have done so within the last 30 days (unless they are participating in the follow-up phase of another interventional trial/study, or who are enrolled in an observational study, will be co-enrolled where the CIs of each study agree)

Date of first enrolment
01/06/2025

Date of final enrolment
31/05/2026

Locations

Countries of recruitment
United Kingdom

Scotland

Study participating centre
Ninewells Hospital
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Sponsor information

Organisation
University of Dundee

ROR
https://ror.org/03h2bxq36

Funder(s)

Funder type
University/education

Funder Name
University of Dundee

Alternative Name(s)
Dundee University, Oilthigh Dhùn Dè

Funding Body Type
Government organisation

Funding Body Subtype
Universities (academic only)

Location
United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan

The datasets generated during this study will be available upon request from Dr Colin Murdoch (c.z.murdoch@dundee.ac.uk). Anonymization will be ensured and access will align with ethical guidelines and consent obtained.

IPD sharing plan summary

Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Participant information sheet			19/03/2025	No	Yes
Protocol file			19/03/2025	No	No