**Project Title**

Can daily deep, slow breathing using a mobile device App reduce obstetric intervention in women with pregnancy-induced hypertension? A feasibility study.

**Project Summary**

Pregnancy induced hypertension (PIH) affects approximately 10% of women and is a major cause of maternal morbidity and mortality worldwide (1). Prophylactic measures such as calcium and aspirin require further evidence to support routine use (2), making early detection and treatment the primary approach to managing PIH.

Dysfunctional breathing may play a role in the development of PIH and preeclampsia (3,4), by influencing autonomic nervous system balance (5) and baroreflex sensitivity (6). Furthermore, daily practice of deep slow breathing (DSB) induces chronic antihypertensive effects (7). This studentship explores a novel method of influencing blood pressure in pregnant women, by using DSB, delivered using a bespoke mobile device App (BU App). Developed by the primary supervisor (AM), and based on fundamental physiological research into cardiorespiratory interactions, the BU App drives breathing dynamically to maximise baroreflex stimulation. It is reasonable to presume that maximising this stimulus will maximise antihypertensive effects of DSB.

This studentship will explore feasibility and efficacy of translating knowledge developed within fundamental physiological research into a clinical setting.

The main study within this PhD project will be a randomised, blinded, placebo controlled (RCT) (DSB vs. placebo).

- **Population** = Women having PIH, defined by NICE as ‘new hypertension presenting after 20 weeks without significant proteinuria’(8), and recruited from Poole Maternity Hospital, which receives ~40 women with PIH each month, of which ~25% will be referred immediately for obstetric-led care, leaving 160 eligible for this study.
- **Intervention** = personalised DSB implemented using the BU App, which will run on the women’s own mobile device, linked to a finger heart rate sensor. During the 10-minute DSB session, breathing frequency will be adjusted each minute to maximise baroreflex stimulation.
- **Control** = placebo breathing intervention implemented using an ostensibly identical App delivering a breathing frequency of 15 breaths/minute, which provides minimal baroreflex stimulation.
- **Outcome** = proportion of women referred for obstetrician-led care due to 30 mg.mmol-1 in a spot urinary protein, symptom exacerbation, and/or increase in DBP (8). This is part of the clinical pathway and easily detected from the records.

Secondary, physiological outcomes will provide insights relating to effect size, dose-response and underlying mechanisms, addressing plausibility for sample size calculations for changes in:

1. Systolic and diastolic blood pressures
2. Spontaneous breathing pattern
3. Indices of cardiovascular system control, such as heart rate variability.

Pre- and post-intervention measurements will occur in a temporary laboratory within Poole Maternity Hospital antenatal clinic (supported by both midwifery and research staff at Poole). Feasibility measures of recruitment and compliance (quantified automatically by the BU App) will be secondary outcomes. Pregnancy outcomes, such as mode of birth, induction, preeclampsia rates, and the need for antihypertensive medication will be collected from women’s records.

Preliminary estimate of effect size for dichotomous outcomes (e.g., primary outcome) will be made using logistic regression and secondary outcomes using analysis of covariance (adjusting for baseline values). Mean within
participant changes in secondary outcome measures will be estimated. Associations between compliance and changes in secondary outcome variables, and between spontaneous breathing pattern and cardiovascular function will be summarised using correlation coefficients.

**Academic Impact**

This studentship aims to translate knowledge from fundamental integrative physiological research into clinical practice in maternal health. The student will be supported by an interdisciplinary team from integrative physiology, midwifery, and health services research. The interdisciplinary nature of the research will result in greater academic impact than would normally be expected from a PhD studentship.

The RCT will:

- translate physiological insights gained in the laboratory into a novel clinical intervention, viz., personalised DSB delivered using the BU App;
- provide preliminary data regarding the influence of the intervention upon key clinical and physiological outcomes;
- combine outcome and compliance data to permit a preliminary evaluation of any dose-response relationships;
- test the feasibility and acceptability of a RCT, including recruitment and compliance rates.

A key output will be data on the primary outcome (referral rates for obstetric-led care) to inform the design of a larger, adequately powered trial to test efficacy and safety.

Given the inter-disciplinary nature of this project, we anticipate a minimum of three academic papers for submission in leading journals such as BJOG: An International Journal of Obstetrics & Gynaecology (IF 3.72), Respiratory Physiology & Neurobiology (IF 1.77).

**Societal Impact**

The studentship addresses a major issue of concern for national and international organisations. Although this is an early stage project, if successful it has the potential to scale-up substantially and to provide a mechanism to address the second major cause of direct maternal death worldwide.

Early Patient and Public Involvement (PPI) work with 11 pregnant women from Poole Maternity Hospital has confirmed the value of the research to women in the UK. This included motivation to take part and the popularity of Apps during pregnancy. Their feedback has informed the BU App development (features to include, or exclude).

The project is part of a larger programme of research exploring the efficacy and mechanisms underlying the influence of DSB upon cardiovascular reflex control. Collectively, this programme of research has the potential to make a substantial impact upon the non-pharmacological management of hypertension.

**Training Opportunities**

The student will benefit from the expertise of a multidisciplinary team. Prof McConnell has 25-years experience of physiological research in cardiorespiratory physiology. She will provide training in cardiorespiratory physiology, including laboratory techniques. The student will also benefit from involvement in other projects using the BU App that will be led by Prof McConnell, and from engagement with industry in the ongoing development of the BU App. Prof Hundley has over two decades of experience in midwifery research and will provide guidance with regard to maternal health and access to national and international networks. Peter Thomas has over 20-years’ experience of designing and analysing randomised controlled trials, including feasibility studies. He will provide oversight of research design and statistical aspects of the study. In addition, the student will benefit from working closely with the research midwife at Poole Maternity Hospital (Stephanie Grigsby). The interdisciplinary nature of the research will result in greater academic impact than would normally be expected from a PhD studentship.

The training programme will have the following objectives: (i) Formal training in cardiorespiratory laboratory techniques, including non-invasive measurement of breathing, beat-by-beat blood pressure, heart rate and blood pressure variabilities in both time and frequency domains (using specialised software); (ii) Seeking ethical approval for research within the NHS; (iii) Statistical techniques and methods for analysing both physiological outcomes and clinical feasibility trial data; (iv) Understanding the mechanisms and challenges of clinical data collection.

The student will also benefit from the direct tutelage of one of Prof McConnell’s previous PhD students, who will be
employed at BU as a PDRF until July 2016.

SUPERVISORY TEAM

<table>
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<th>First Supervisor</th>
<th>Alison McConnell</th>
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| Additional Supervisors | Vanora Hundley  
Peter Thomas |

Recent publications by supervisors relevant to this project


INFORMAL ENQUIRIES

To discuss this opportunity further, please contact Alison McConnell via email: amcconnell@bournemouth.ac.uk

ELIGIBILITY CRITERIA

All candidates must satisfy the University’s minimum doctoral entry criteria for studentships of an honours degree at Upper Second Class (2:1) and/or an appropriate Masters degree. An IELTS (Academic) score of 6.5 minimum (or equivalent) is essential for candidates for whom English is not their first language.

HOW TO APPLY

Please complete the online application form by Friday 10 February 2017. Further information on the application process can be found at: www.bournemouth.ac.uk/studentships