An Automated Supine Pressor Test: Implications for the Diagnosis of Preeclampsia

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Development of Automated Early Detection Test for Preeclampsia

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Background

- Preeclampsia is a condition in pregnancy associated with **excess protein in urine + hypertension + pre-term birth**
- Preeclampsia leads to **increased risk of morbidity and mortality** for mother and fetus, causing **>70,000 deaths** worldwide [1]
- The **Supine Pressor Test (SPT) is a diagnostic tool** which predicts a pregnant woman's risk for preeclampsia by **comparing blood pressure** taken in the lateral recumbent and supine position [2]

Renal venous outflow obstruction → Increased intra-renal pressure → RAAS activated → Increased blood pressure

Objective

Develop a fully automated SPT to:

1) Assess **usability and feasibility** of performing SPT autonomously
2) Determine and **quantify baseline change** in BP between shifting positions in pregnant vs non-pregnant females
3) Create cohesive device that **incorporates BP cuff, position sensor, and smartphone app** to detect risk of preeclampsia

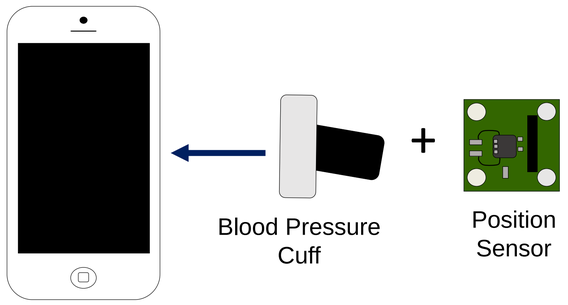


Figure 1. We want to combine elements of the BP cuff, position sensor, and smartphone app to make an automated tool for pregnant females to monitor their BP and predict risk of preeclampsia

Methods

Automated Supine Pressor Test (SPT):

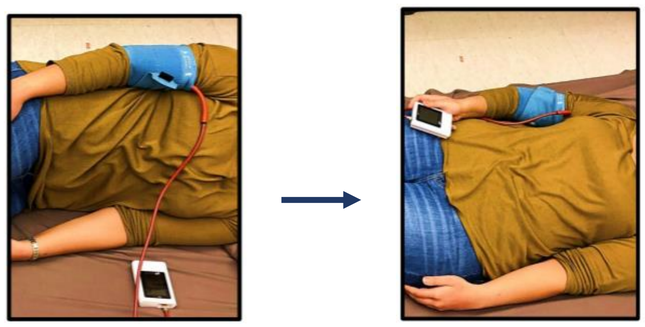


Figure 2. Subjects had blood pressure taken in the left lateral recumbent position (left) and supine position (right) [3].

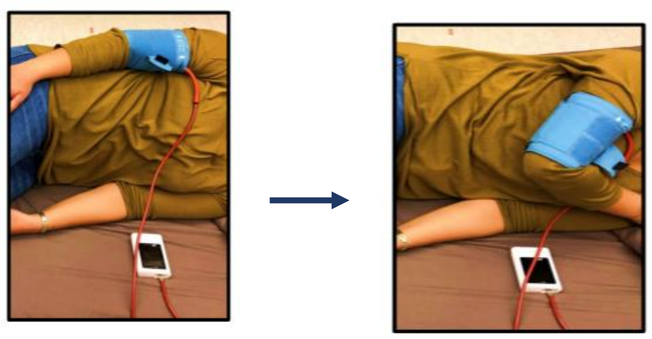
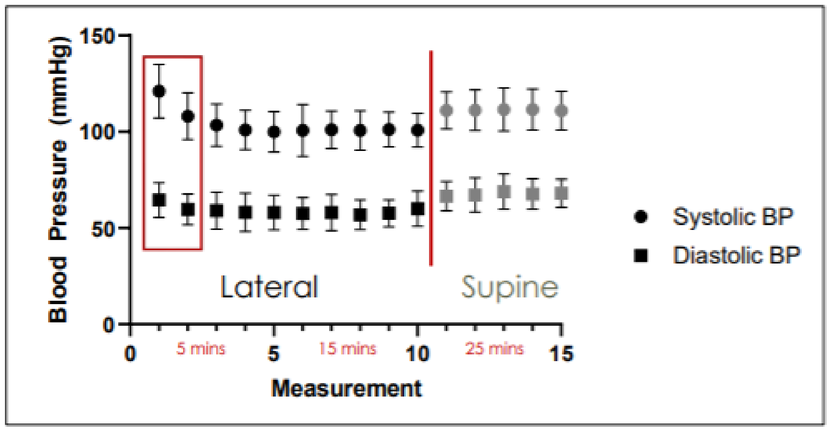


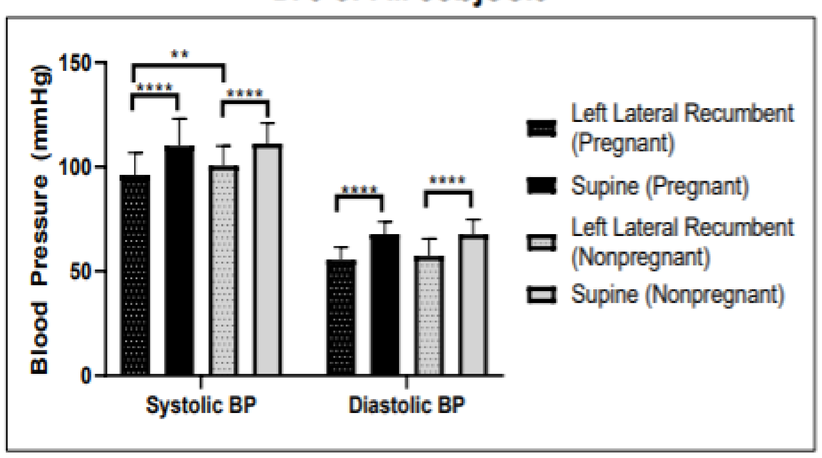
Figure 3. Subjects had blood pressure taken in the left lateral recumbent position with their arm on the side (left) and arm across their chest (right) [3].

Results

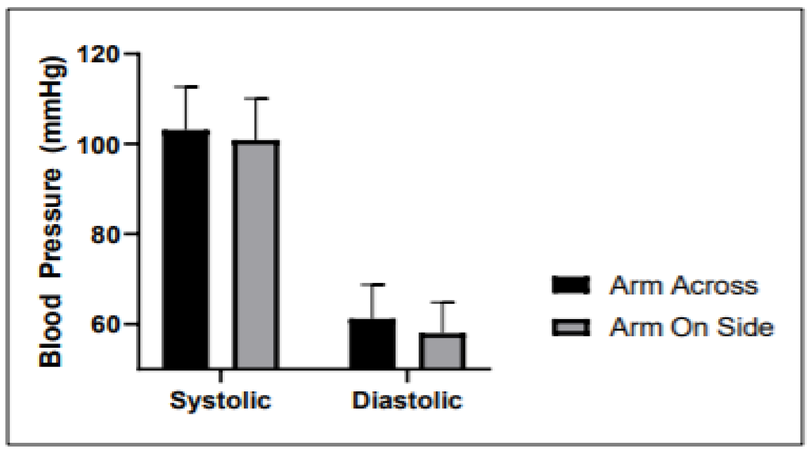
A) BP Measurements Post-Exercise



B) BPs of All Subjects



C) BP Measurements with Varying Arm Position



D) Survey Feedback From All Subjects

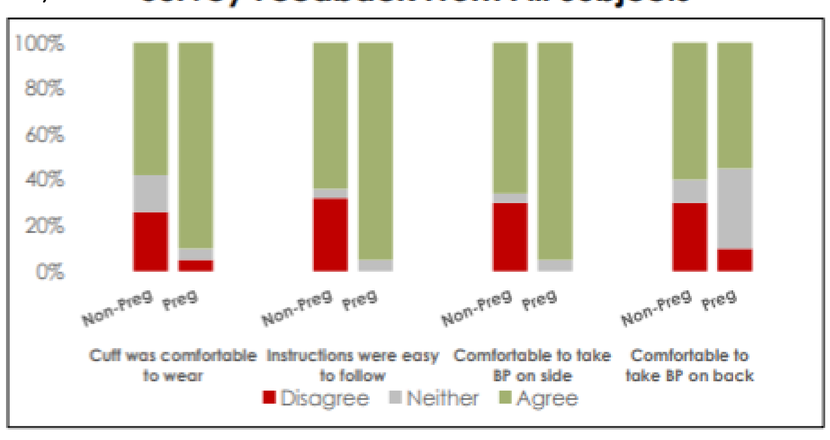
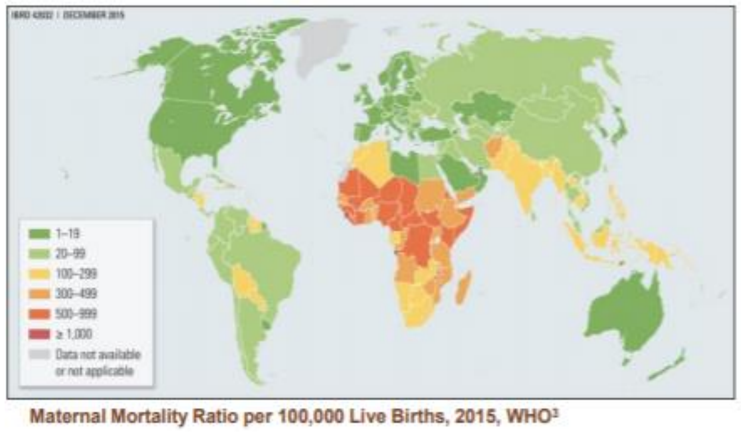


Figure 4. A) Blood pressures tend to stabilize after ~4-5 minutes [3]. B) Non-pregnant females experience a baseline increase in BP when shifting to the supine position. BPs are significantly higher when shifting from left lateral to supine position (*p<0.0001*) C) Arm position not statistically significant (*p>0.05)*, indicating shift in different positions not due to cuff position [3]. D) Both non-pregnant and pregnant females were relatively comfortable performing the SPT autonomously.

Conclusion

- Non-pregnant females experience a **baseline increase in BP** when shifting into supine position
- BPs taken in supine position were **significantly higher** than those taken in lateral position
- **Determined parameters** for **fully automating the SPT**
- The SPT can be **automated and used autonomously**
- Prototype system currently in development to integrate **BP cuff, position sensor, and data processing algorithms.**

Ongoing Work & Next Steps



Maternal Mortality Ratio per 100,000 Live Births, 2015, WHO[3]

Figure 5. Our goal is to make our device accessible to expecting mothers in low-resource areas where preeclampsia can affect up to 10% of pregnancies (National Center for Biotechnology Information, U.S. National Library of Medicine; https://www.ncbi.nlm.nih.gov/books/NBK361904/figure/part2.ch7.sec1.map1/)

- Perform **longitudinal clinical study** to monitor entire pregnancy period with cohesive device.
- Develop animal model to **further characterize pathophysiology** of renal compartment syndrome.
- Collaborate with colleagues (i.e. Kenya) to **expand global utility** of automated SPT.
- Conduct outreach to **promote safe sleeping practices.**

References

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[2] D. Reuter et. al, "Can preeclampsia be considered a renal compartment syndrome? A hypothesis and analysis of the literature", *Journal of the American Society of Hypertension*, vol. 10, no. 11, pp. 891-899, 2016.

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