Predicting Risk for Pregnancy Complications

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Abstract

For years, it has been a challenge to identify women at risk of Preeclampsia (PE) and Preterm Birth (PTB), one of the leading causes of maternal and perinatal morbidity and mortality. Despite an increasing number of clinical and statistical prediction models being developed, which have been shown to outperform traditional approaches based on maternal history, due to complex underlying relationships and gene-environment interactions, identifying women at risk based on a single time-point, especially during early stages of pregnancy, remains a challenge.

Therefore, this study not only aims to identify potential predictors for pregnancy outcomes and develop prediction models based on combinations of clinical measurements and Single-nucleotide polymorphisms (SNP) predictors, but also to establish a tiered prediction system by integrating risk estimates at various stage of pregnancy.

This thesis contains both theoretical development and practical application of the models, with results of best models written as manuscripts for future publication. Critical issues in real-life statistical analysis, including subgroup differences, and model and variable selection (with FDR control) were discussed, as well as novel strategies on the tiered prediction model development.

The results from tiered models provide prediction for PE and spontaneous preterm birth (SPTB) that not only outperform traditional approaches, but also provide an earlier prediction applicable to all pregnant women, including healthy nulliparous women. This approach also allows for regular monitoring and revision of predicted risk throughout pregnancy. This may assist in providing tailored antenatal care or interventions that could benefit both the mother and child, and to avoid unnecessary interventions for low-risk individuals, while modifiable predictors could also be addressed to reduce the risk or severity of PE or PTB.

Declaration

I, Shalem Y. Leemaqz, hereby declare that this work contains no material that has been accepted for the award of any other degree or diploma in any university or other tertiary institution. To the best of my knowledge and belief, it contains no material previously published or written by any other person, except where due reference is made in the text.

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- Leemaqz S.Y., Dekker G.A., Roberts C.T. (2013) "Tiered Prediction System for Preeclampsia: an integrative application of multiple models " International Congress on Modelling and Simulation (MODSIM) 2013. pp 2041-2046 ISBN: 978-0-9872143-3-1.

- Dekker G.A., Lee S.Y., North R.A., McCowan L.M., Simpson N.A.B., Roberts C.T., (2012) "Risk factors for preterm birth in an international prospective cohort of nulliparous women" PLoS ONE. 7(7):e39154. doi:10.1371/journal.pone.0039154

- Lee S.Y., Lee S.X., Dekker G.A., Roberts C.T. (2012) "Multivariate Visual Clustering of Single Nucleotide Polymorphisms and Clinical Predictors using Chernoff Faces" Proceedings of the 5th Annual Conference in Applied Statistics Education and Research Collaboration (ASEARC 2012). pp 56-59

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Publications arising from this thesis

- **Leemaqz** S.Y., Dekker G.A., Roberts C.T. (2013) "Tiered Prediction System for Preeclampsia: an integrative application of multiple models " *International Congress on Modelling and Simulation (MODSIM) 2013*. pp 2041-2046ISBN: 978-0-9872143-3-1.

- Dekker G.A., **Lee**‡ S.Y., North R.A., McCowan L.M., Simpson N.A.B., Roberts C.T., (2012) "Risk factors for preterm birth in an international prospective cohort of nulliparous women" *PLoS ONE*. 7(7):e39154. doi:10.1371/journal.pone.0039154

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‡ *Last name changed to Leemaqz from Lee in 2013.*

Conference presentations and abstract publications arising from this thesis

- **Leemaqz** S.Y., Dekker G.A., McCowan L.M.E., Roberts C.T. (2014) “Prediction Model for Spontaneous Preterm at 15 weeks of Gestation” *American Journal of Obstetrics & Gynaecology*. 120(1) pp S380-381

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- **Lee** S.Y., Lee S.X., Dekker G.A., Roberts C.T. (2012) "Multivariate Visual Clustering of Single Nucleotide Polymorphisms and Clinical Predictors using Chernoff Faces" *5th Annual Conference in Applied Statistics Education and Research Collaboration (ASEARC 2012)*. 2-3 February 2012.