



PhD project: Turning the tide on hyperglycemia in pregnancy



Hyperglycemia in pregnancy is increasing, risking the health of women and babies

We developed a model that can test policy and program scenarios before implementation



Population level prevention of obesity can help turn the tide on HIP

Key messages

- Hyperglycemia in pregnancy (HIP, including gestational diabetes and pre-existing type 1 and type 2 diabetes) is increasing, with associated risks to the health of women and their babies.
- Population health interventions to prevent obesity across the lifecourse will be key to helping stabilise and reduce HIP.
- Interventions targeting high-risk individuals for HIP, can be beneficial for individuals, however they delivered small reductions in overall population incidence rates.
- Dynamic simulation models (DSM) can test policy and program scenarios before implementation in the real world.
- DSMs mature as new evidence becomes available and methods are advanced to facilitate further development.
- The impact of maternal weight status interventions on incidence of HIP were the first scenarios explored using this advanced DSM.

The project: Simulation modelling to support decision-making in gestational diabetes care

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Project start: April 2015 **Project end:** July 2019

Why is this issue important?

The rising prevalence of hyperglycemia in pregnancy (HIP) is having a significant impact on health service demand and resources, yet the strategies for screening, diagnosing, prevention and managing HIP remain contested.

Many of the risk factors for HIP are not modifiable, however weight status (overweight and obesity) is an important modifiable risk factor for both HIP and type 2 diabetes mellitus.

Exploration of effective decision support tools is needed to guide evidence-informed policy and programs for this complex problem.

What did we do?

A consortium of experts collaboratively developed a hybrid model of HIP comprising system dynamics, agent-based, and discrete event model components. The structure and guidelines drew on a range of evidence and data sources.

Scenarios comparing population-level and targeted prevention-interventions were simulated from 2018 to identify the intervention combination that could deliver greatest impacts.

What did we find?

This study brought together researchers, clinicians, and policy makers to develop collaboratively a novel, multi-scale DSM for HIP using the best available evidence and data.

The model can be used to explore the likely impact of population health policy and clinical service scenarios to prevent and manage HIP. The unique structure allows representation of the problem and synthesis of evidence at multiple levels including biological, individual level behavioural and service dynamics.

The tested scenarios highlighted the importance of public health interventions to maintain healthy weight status in childhood and support women to achieve healthy weight prior to pregnancy. These interventions were shown to improve insulin sensitivity and reduce the incidence of HIP in the modelled population. Interventions targeting high risk individuals did not impact on forecasted population incidence of HIP.

How might these results change the focus of research or clinical practice?

The modelled scenarios provide evidence illustrating the importance of population health interventions to prevent obesity through childhood and the early adult years to stabilise and reduce HIP.

Interventions targeting high-risk individuals, can be beneficial for individuals, however they delivered small reductions in overall population incidence rates.

DSMs mature as new evidence becomes available and methods are advanced to facilitate further development.

A key priority for future research is improved knowledge about the dynamics and heterogeneity in the causes of blood sugar or glycaemic dysregulation and diabetes mellitus development, and the impact of glycaemic control during pregnancy on perinatal outcomes.

What did we produce?

Publications

- Freebairn L, Atkinson JA, Qin Y, Nolan C, Kent A L, et al. 'Turning the tide' on hyperglycemia in pregnancy: Insights from multi-scale dynamic simulation modelling. *BMJ Open Diabetes Research & Care*. 2020;8:e000975. doi: 10.1136/bmjdr-2019-000975
- Freebairn L, Atkinson JA, Osgood ND, Kelly P, McDonnell G, Rychetnik L. Turning conceptual systems maps into dynamic simulation models: An Australian case study for diabetes in pregnancy. *PLOS One*. Online. 2019. doi: 10.1371/journal.pone.0218875
- Freebairn L, Atkinson JA, Kelly P, McDonnell G, Rychetnik L. Decision makers' experience of participatory dynamic simulation modelling: methods for public health policy. *BMC Med Inform Decis*. 2018; doi.org/10.1186/s12911-018-0707-6
- Freebairn L, Atkinson J, Kelly P, McDonnell G, Rychetnik L. Simulation modelling as a tool for knowledge mobilisation in health policy settings: a case study protocol *Health Res Policy Syst* 2016;14:71 doi: 10.1186/s12961-016-0143-y
- Freebairn L, Rychetnik L, Atkinson J, Kelly P, McDonnell G, Roberts N, Whittall C, Redman S. Knowledge mobilisation for policy development: implementing systems approaches through participatory dynamic simulation modelling. *Health Res Policy Syst*. 2017;15:83 doi: 10.1186/s12961-017-0245-1
- O'Donnell E, Atkinson JA, Freebairn L, Rychetnik L. Participatory simulation modelling to inform public health policy and practice: Rethinking the evidence hierarchies. *J Public Health Policy*. 2017; May;38(2):203–215. doi: 10.1057/s41271-016-0061-9

Fact Sheet

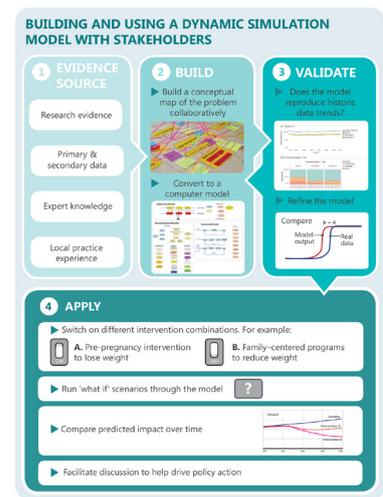
Preventing diabetes in pregnancy

Podcast

Tackling the pandemic of diabetes in pregnancy

Media

- Prevention Centre news, May 2017: Project expanded to tackle all forms of diabetes in pregnancy
- Freebairn L and Kelly P. Harnessing new technologies to inform health decision making: Dynamic simulation modelling as a decision support tool for diabetes in pregnancy. *ACT Population Health Bulletin*. Volume 6, Issue 2, May 2017, p, 31-32
- Prevention Centre news, June 2016: Simulation modelling helps to unpick causes of gestational diabetes



Next steps?

The insights from this advanced model provide evidence to help build the case for prevention. The importance of maintaining interventions promoting healthy weight in childhood and early adult years was demonstrated. Scenarios simulating the impact of scaling back these interventions showed that insulin sensitivity decreased significantly, increasing the risk for early development of diabetes mellitus.

DSMs are learning support tools that can mature over time as new evidence becomes available and methods are advanced to facilitate further development. This decision support tool for HIP was developed as a working model and is continuing to be improved with more detailed representation of childhood weight dynamics currently being implemented.

A key priority for future medical research is improved knowledge about the dynamics and diversity in the causes of glycemic dysregulation and diabetes mellitus development, and the impact of glycemic control during pregnancy on perinatal outcomes.

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