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GIS/Neighbourhood Mapping: Mike Sawada, PhD

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Ian Graham, PhD, FCAHS

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Farhana Alarakhiya, BSc Eng, MSc  
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**Keynote Speaker**  
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MSc Epi, MSc HCM  
Reflections on Right Information,  
Right Hands, Right Time –  
The Future of Maternal Child Care



# **Development of a Public Health Core Indicator on Gestational Weight Gain using BORN Data**

Becky Blair, RD MSc

Mary-Anne Pietrusiak, MHSc

BORN Ontario Provincial Rounds

October 16, 2014



# **Context for the Core Indicator: Gestational Weight Gain Guidelines in Canada**

Becky Blair, RD MSc

# Background

- 2009 - Health Canada released revised guidelines for gestational weight gain (GWG)
  - Based on Institute of Medicine Report
  - AHRQ systematic review (2008) of observational research
  - Revision of 1990 guidelines
    - Demographic changes of women of reproductive age
    - Revised body mass index (BMI) categories, added rate of weight gain, guidance for twin pregnancies

# Health Canada Guidelines for GWG

Table 1. Guidelines for total weight gain in singleton pregnancies

Pre-pregnancy BMI	Mean <sup>a</sup> rate of weight gain in the 2nd and 3rd trimester		Recommended total weight gain <sup>b</sup>	
	kg/week	lb/week	kg	lbs
BMI < 18.5	0.5	1.0	12.5 - 18	28 - 40
BMI 18.5 - 24.9	0.4	1.0	11.5 - 16	25 - 35
BMI 25.0 - 29.9	0.3	0.6	7 - 11.5	15 - 25
BMI ≥ 30.0 <sup>c</sup>	0.2	0.5	5 - 9	11 - 20

a. Rounded values.

b. Calculations for the recommended weight gain range assume a gain of 0.5 to 2 kg (1.1 to 4.4 lbs) in the first trimester (Siega-Riz et al., 1994; Abrams et al., 1995; Carmichael et al., 1997).

c. A lower weight gain may be advised for women with a BMI of 35 or greater, based on clinical judgement and a thorough assessment of the risks and benefits to mother and child (Crane et al, 2009; Oken et al, 2009; Hinkle et al, 2010).

# Health Canada Guidelines for GWG

Table 2. Guidelines for total weight gain in twin pregnancies

Pre-pregnancy BMI <sup>a</sup>	Recommended total weight gain <sup>b</sup>	
	kg	lbs
BMI 18.5 - 24.9	17 - 25	37- 54
BMI 25 - 29.9	14 - 23	31 - 50
BMI $\geq$ 30	11 - 19	25 - 42

a. There is insufficient information to develop guidelines for underweight women carrying twins (IOM, 2009).

b. These provisional guidelines reflect the interquartile (25th to 75th percentiles) range of cumulative weight gain among women who delivered twins, who each weighed  $\geq$  2,500 g on average at term (IOM, 2009).

# GWG and Health Outcomes

Potential ↑ risks associated with being above the GWG range:

## Maternal

- Caesarean section
- Postpartum weight retention up to three years post index pregnancy

## Child

- Large for gestational age
- Overweight/obesity in childhood

(Viswanathan et al., 2008; Nehring et al, 2011; Mannan et al, 2013; Mamun et al, 2014; Tie et al., 2014)

# GWG and Health Outcomes

Potential ↑ risks associated with being below the GWG range:

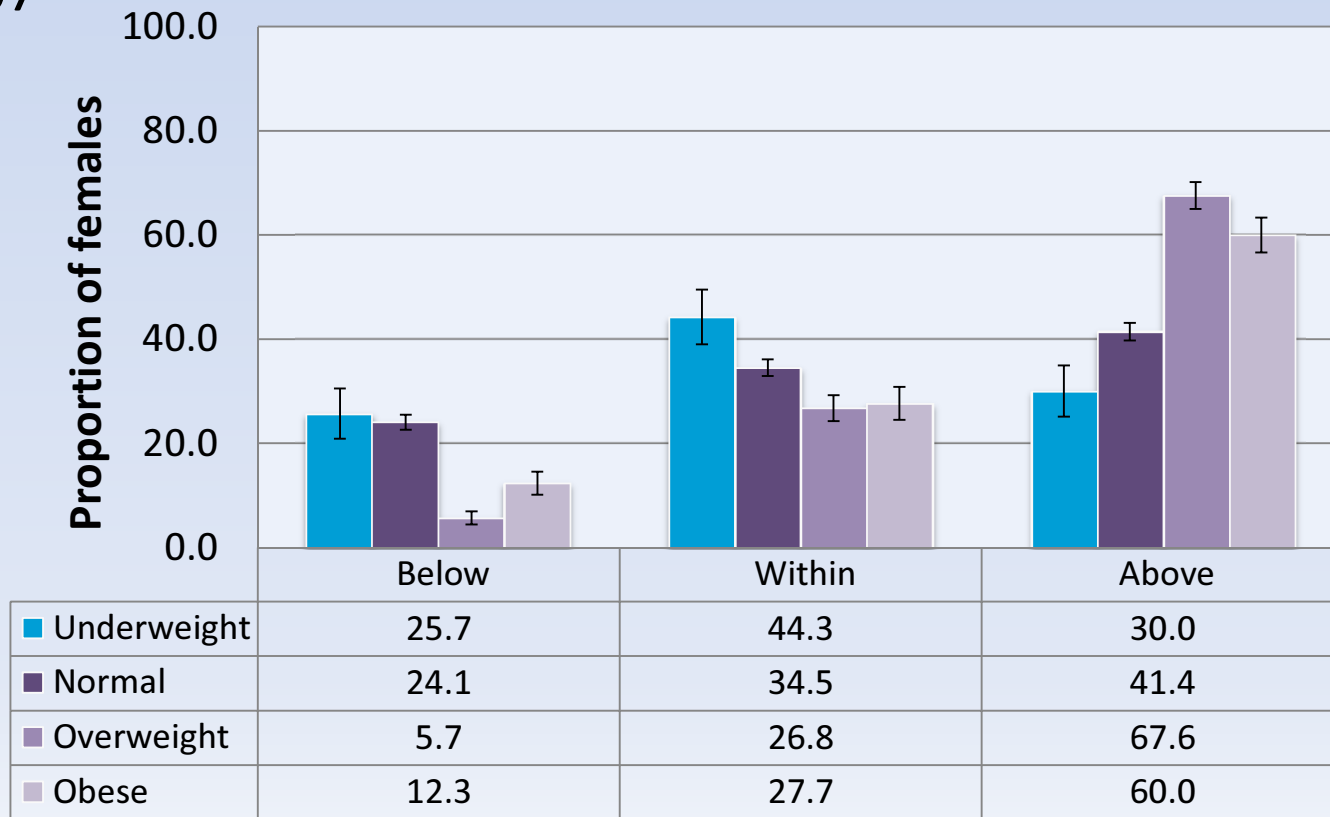
- Preterm birth
- Small for gestational age

(Viswanathan et al., 2008)



# GWG in Canada

Figure 1. Proportion of women by GWG category, Canada, 2006-2007



## Gestational Weight Gain relative to Recommendations

Source: Maternity Experiences Survey, Public Health Agency of Canada. (2006-2007).

Error bars show 95% confidence intervals around the estimates.

# GWG and Health Outcomes

## Limitations:

- Misclassification error
  - Self-reported data vs. measured data
    - Agreement can range from 44.5%-87%
    - Bias towards the null?
- Recall bias
  - When was weight measured anyway?
  - Florida database study found high agreement between measured weights in 1<sup>st</sup> trimester and weights reported after birth

# GWG and Health Outcomes

## Possible Exclusions:

### *Preterm Births:*

- Gestational week of delivery will confound overall associations between GWG and health outcomes if not controlled (Hutcheon et al., 2012)

### *Diabetes/Gestational Diabetes:*

- No evidence to suggest weight gain trends or health outcomes are different for women with diabetes



## **The Core Indicator and the Data**

Mary-Anne Pietrusiak, MHSc  
(for Jessica Deming)

# Core Indicator: Background

- Launch of BORN Information System (BIS) in 2012 presented an opportunity for a new Core Indicator on GWG
- Previous to BIS, no data source in Ontario existed to measure GWG at a public health unit (PHU) level
- PHUs access to the BIS as of mid-2014

# Core Indicators in General

- Initiative of the Association of Public Health Epidemiologists in Ontario (APHEO)
- Began in 1998 to systematically define and operationalize a core set of health indicators in Ontario
- Resources for epidemiologists to generate these indicators – very specific information
- See [apheo.ca](http://apheo.ca)

# Reproductive Health Core Indicators

- Updated 14 indicators e.g. pregnancy rate, birth weights, perinatal mortality
- Currently working on 5 new indicators:
  - Maternal obesity
  - Gestational weight gain
  - Maternal mental health
  - Alcohol use in pregnancy
  - Substance use in pregnancy

All 5 use BORN data

# GWG Core Indicator: Overview

## Based on:

- Health Canada's GWG guidelines

## Indicators:

- Proportion of pregnant females in a given population who gained less/gained more/stayed within GWG recommendations

## Corresponding indicators from other sources:

- Maternal Experiences Survey (2006-2007) – Data not at health unit level



# BORN Data Elements

Table 3. Data Elements in the BORN Information System relevant to the Gestational Weight Gain Core Indicator

Data Element	Response Categories	Variable
The mother's self-reported weight closest to conception and no later than 12 weeks of gestation	Numeric (kg)	M0018
Maternal Height	Numeric (cm)	M0017
Pre-pregnancy Maternal BMI (calculated)	Numeric (kg/m <sup>2</sup> )	M0019
Self-reported Maternal Weight at the end of pregnancy	Numeric (kg)	M0202
Maternal Weight gain during pregnancy (calculated)	Numeric (kg)	M0203

# Analysis Check List

## Exclusions:

- Women with pre-pregnancy BMI <18.5 (i.e., underweight; twin pregnancies only)
- Women carrying more than two fetuses (higher order multiples)

## Should either exclude or analyze separately:

- Pregnancies that ended prior to 37 weeks' gestation
- By singleton versus twin pregnancies

## Consider excluding or analyzing separately:

- Women with pre-pregnancy BMI of 35.0 or greater (Obese Class II +)
- Women with gestational diabetes

**Note: Exclusions should be done for both numerator and denominator**

# Analysis Check List

- Ensure all BORN data has been acknowledged by institutions for a given time period prior to using
- If missing data  $>10\%$ , interpret results with caution

# Method of Calculation

Number of pregnant females **within** GWG recommendations X 100  
Total number of pregnant females who delivered live births

Number of pregnant females **above** GWG recommendations X 100  
Total number of pregnant females who delivered live births

Number of pregnant females **below** GWG recommendations X 100  
Total number of pregnant females who delivered live births

# BORN GWG Variable: How it's calculated

## "Recommended Weight Gain Category" variable

- Calculated field that requires the following data elements:
  - Pre-pregnancy BMI (height, pre-pregnancy weight)
  - Maternal weight gain (pre-pregnancy weight, maternal weight at end of pregnancy)
  - Number of fetuses
- If any of above are missing, then variable is missing
- If # of fetuses > 1 and pre-pregnancy BMI of <18.5 (underweight), then variable is missing

# BORN GWG Variable: How it's calculated

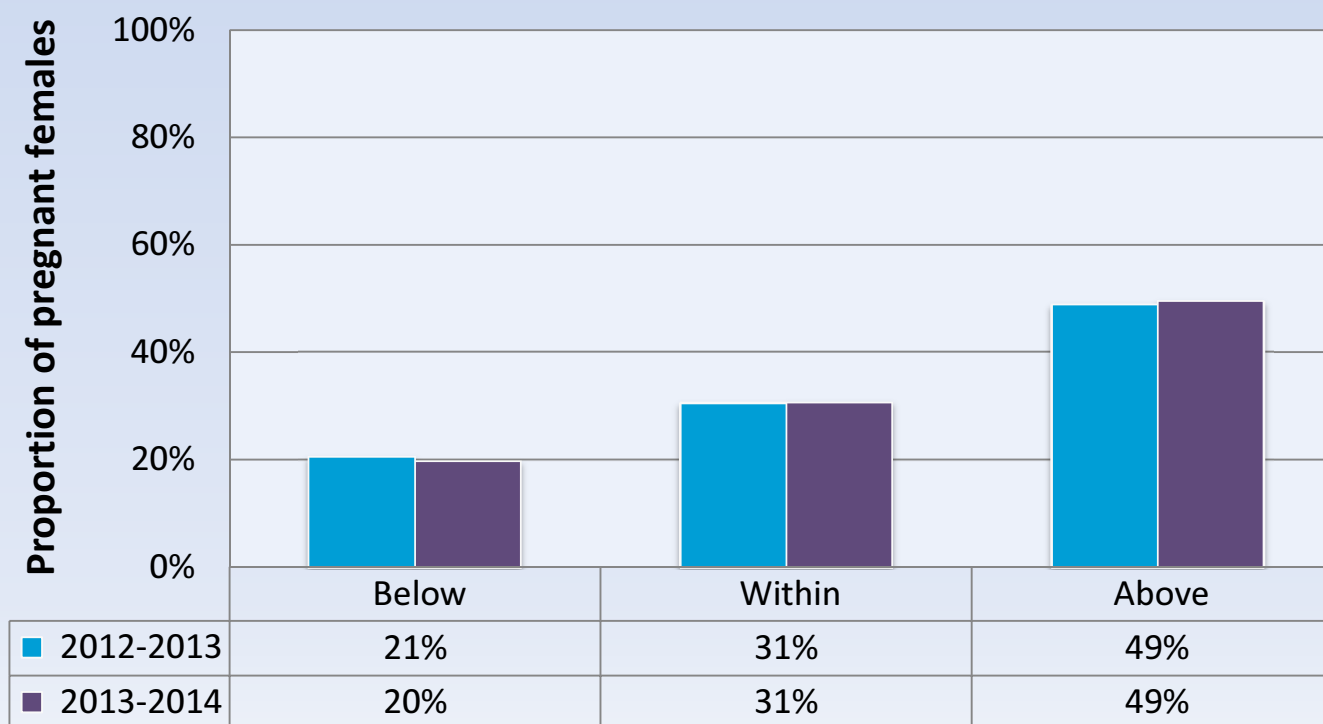
## "Recommended Weight Gain Category" variable calculation

- **Note 1:** Society of Obstetricians and Gynecologists of Canada (SOGC) guidelines used – slightly different than those from Health Canada
- **Note 2:** twin recommendations are applied to all pregnancies where fetuses >1
- **Note 3:** calculations done using kilogram (kg) weight gain ranges (which vary slightly from the ranges in pounds (lbs) due to rounding)

Recommended weight gain: 2011 SOGC guidelines for singleton pregnancy were used to calculate recommended weight gain for non-obese pre pregnancy BMI. IOM 2009 guidelines were used for all other pregnancies (obese & multiple gestations)

# GWG Data: Ontario

Figure 2. Proportion of pregnant females with full-term singleton pregnancies, by GWG category, Ontario, 2012-2013 & 2013-2014



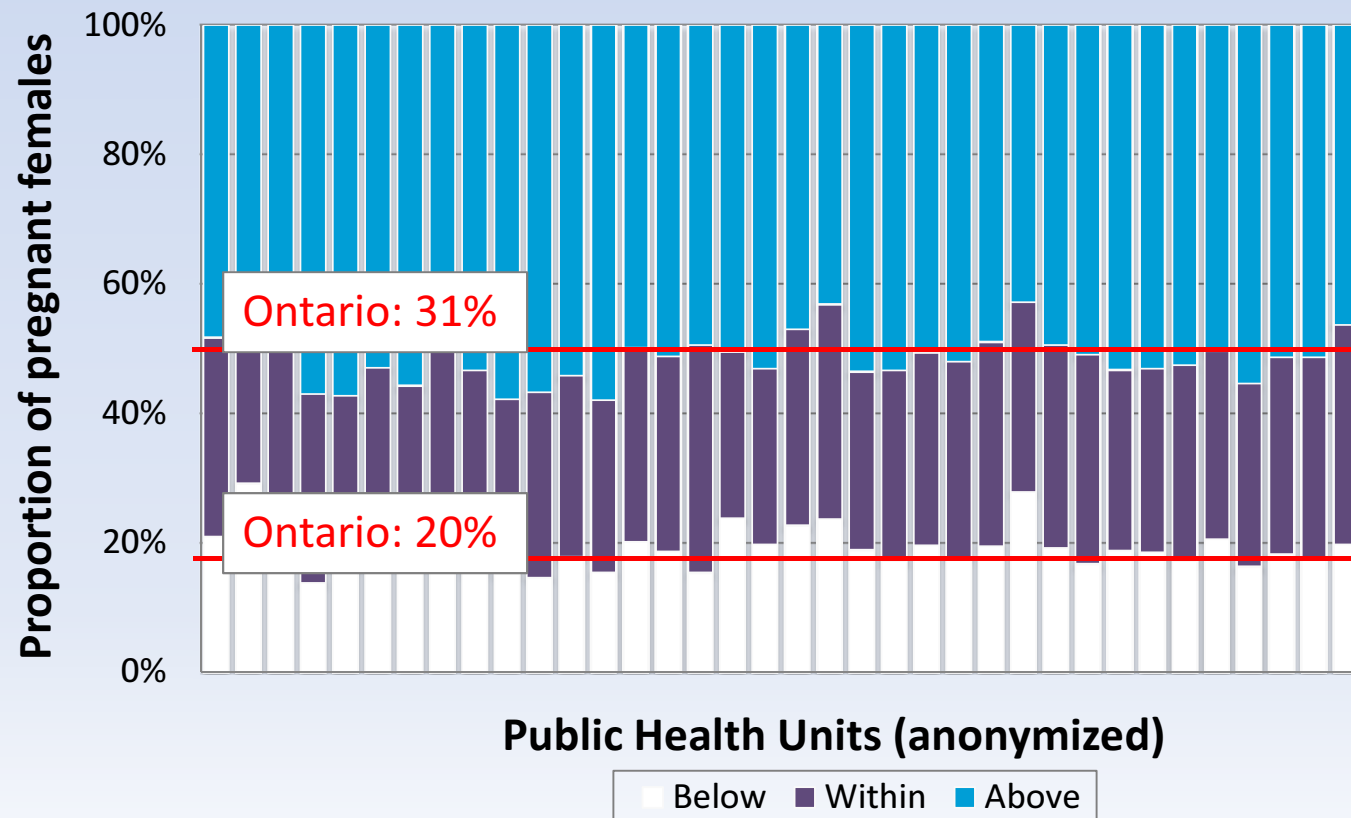
## Gestational Weight Gain relative to Recommendations

Source: Custom Data Request, BORN Ontario, BORN Information System. (2012-2014)  
 Extracted from BORN Public Health Cube: August 28, 2014.

Note: missing data were excluded from analysis.

# GWG Data: by Public Health Unit

Figure 3. Proportion of pregnant females with full-term singleton pregnancies by GWG category, by public health unit, Ontario, 2013-2014



Source: Custom Data Request, BORN Ontario, BORN Information System. (2012-2014)  
 Extracted from BORN Public Health Cube: July 27, 2014.

Note: missing data were excluded from analysis.

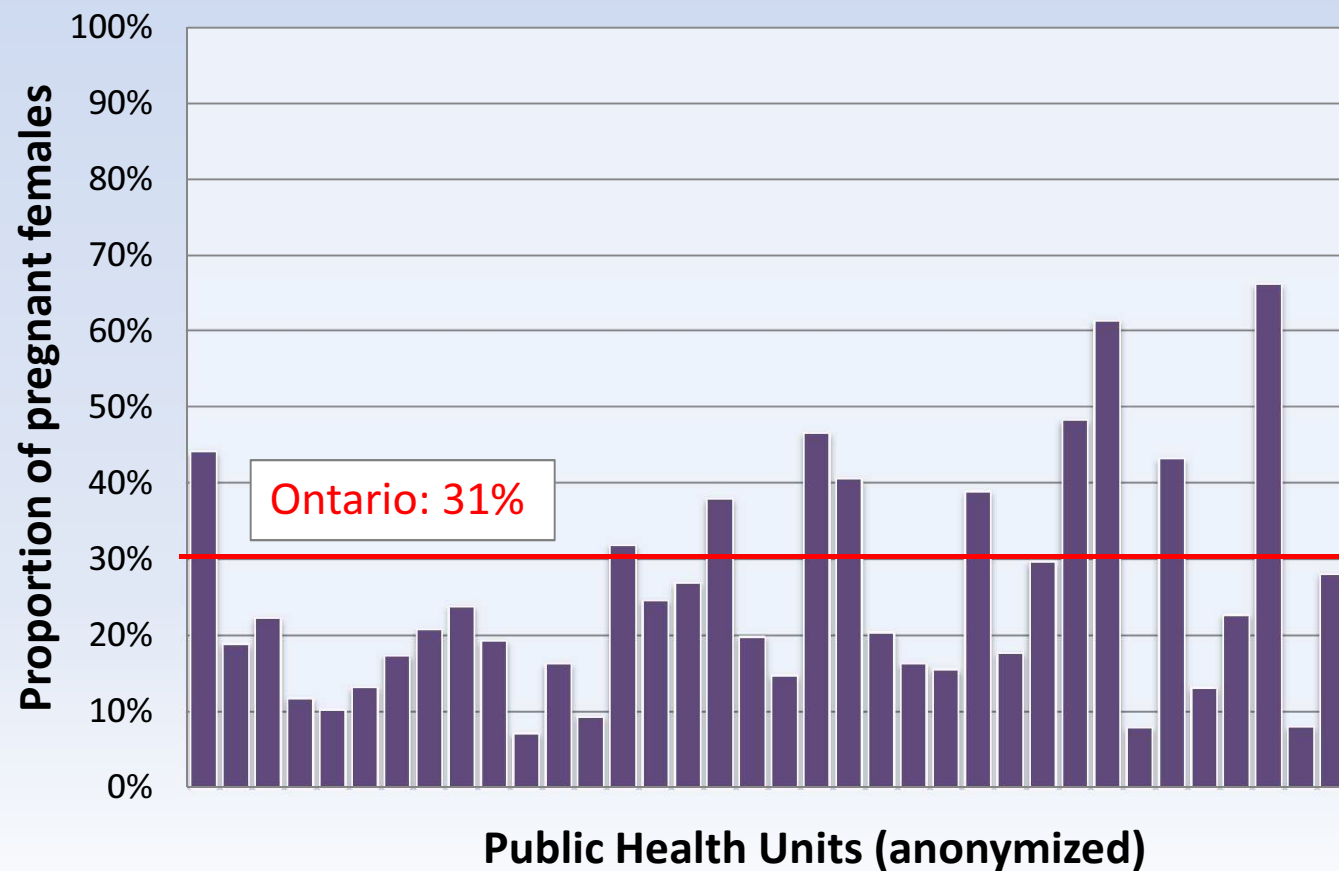


# GWG Data: Words of caution

- Data presented by fiscal years; indicator should be calculated by calendar year
  - Fiscal year 2013-2014 not yet closed
- Small number of records (N=395, 0.1%) had unknown PHU and were excluded from PHU analysis
- Missing data is a significant issue
- Only full-term singleton pregnancies reported

# GWG: Missing Data

Figure 4. Proportion of pregnant females with full-term singleton pregnancies with missing GWG category, by PHU, Ontario, 2013-2014



# Types of missing data

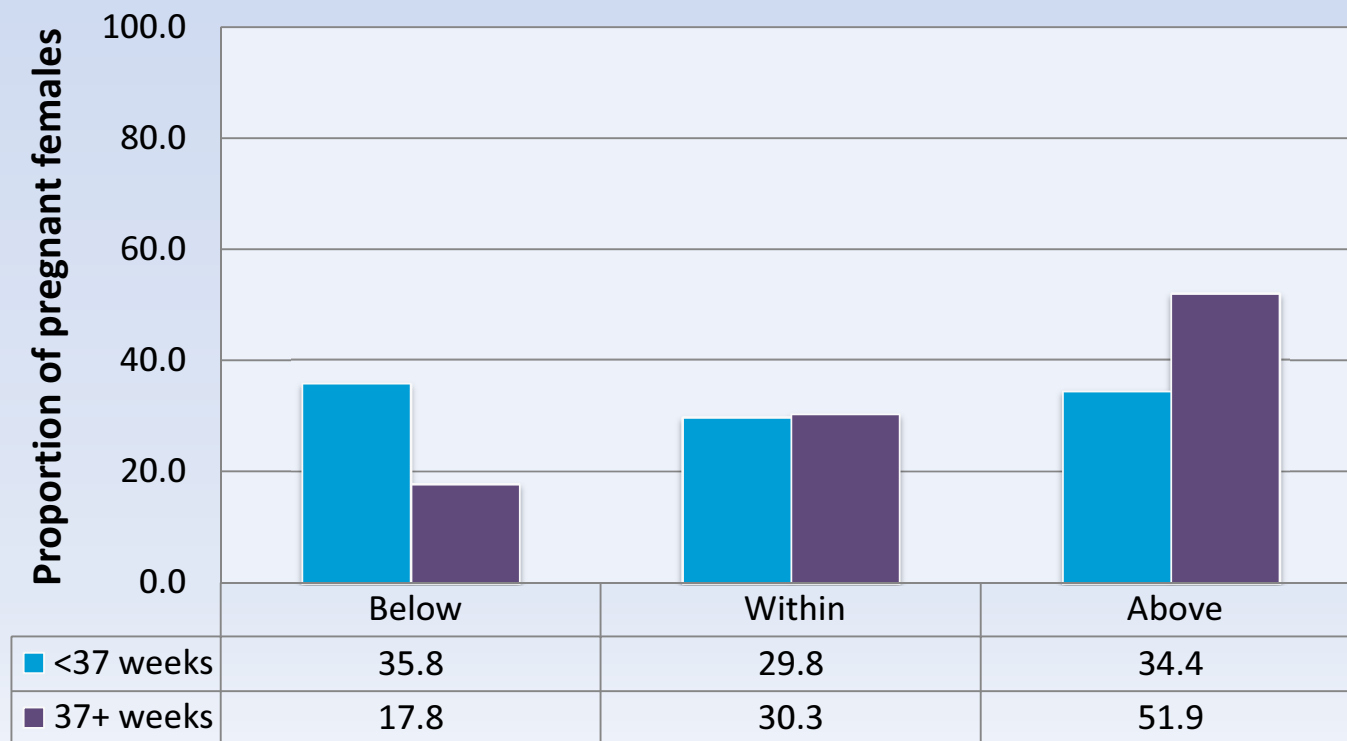
Table 4. Distribution of missing data for 'Recommended GWG category' calculated field, Waterloo, 2012-2013 & 2013-2014

Type of missing value	Number of missing values	Per cent of missing values
<b>Logical missing values</b>	<b>1643</b>	<b>85.8</b>
Maternal weight gain missing	369	19.3
Pre-pregnancy BMI missing	1268	66.2
Number of fetuses missing	1	0.1
Twin pregnancies with underweight BMI	5	0.3
<b>Negative maternal weight gain</b>	<b>163</b>	<b>8.5</b>
<b>Unexplained missing (all required fields present)</b>	<b>109</b>	<b>5.7</b>
<b>Total</b>	<b>1915</b>	<b>100.0</b>

We have since found that negative weight gain is being recorded under missing data

# GWG: Gestational age effect

Figure 5. Proportion of pregnant females, by GWG category and gestational age, Waterloo, 2013-2014



**Gestational Weight Gain relative to Recommendations**

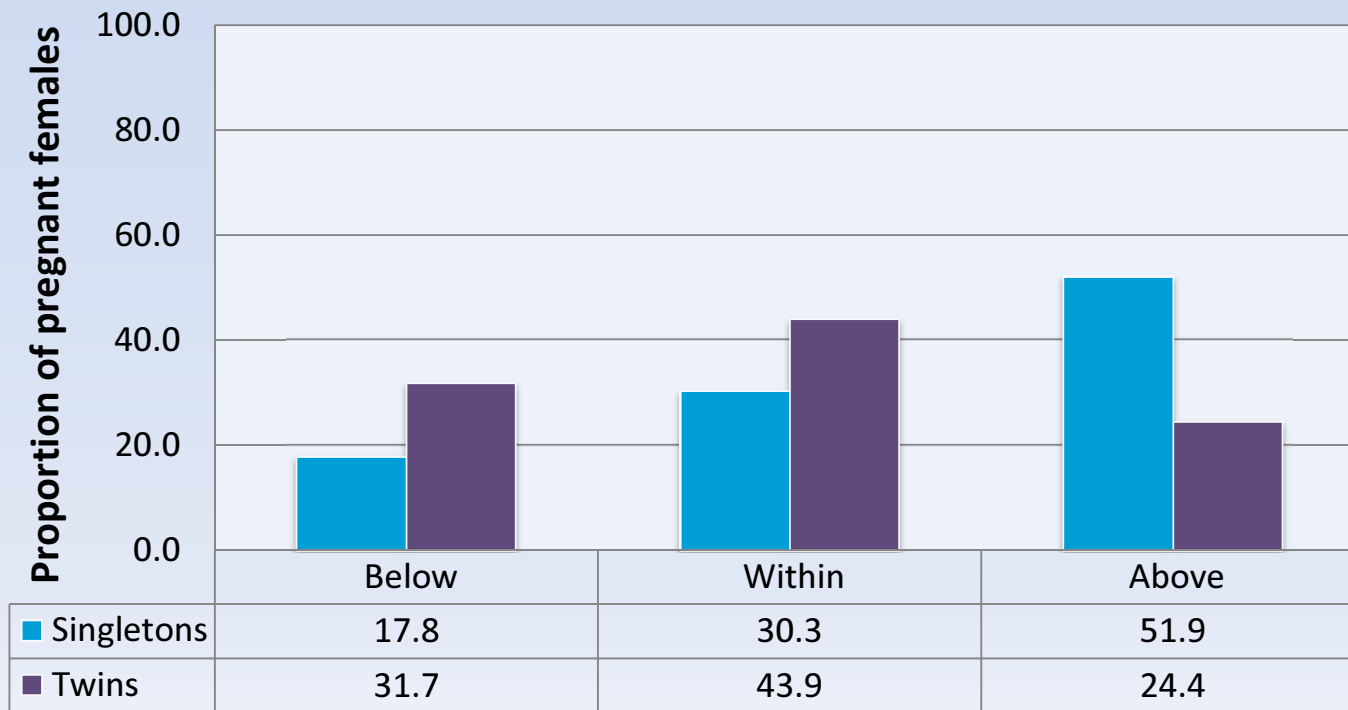


Source: BORN Ontario, BORN Information System. (2013-2014) Extracted from BORN Public Health Cube: October 6, 2014.

Note: missing data were excluded from analysis.

# GWG: Twin vs. singleton pregnancies

Figure 6. Proportion of pregnant females, by GWG category and number of fetuses, Waterloo, 2013-2014



**Gestational Weight Gain relative to Recommendations**

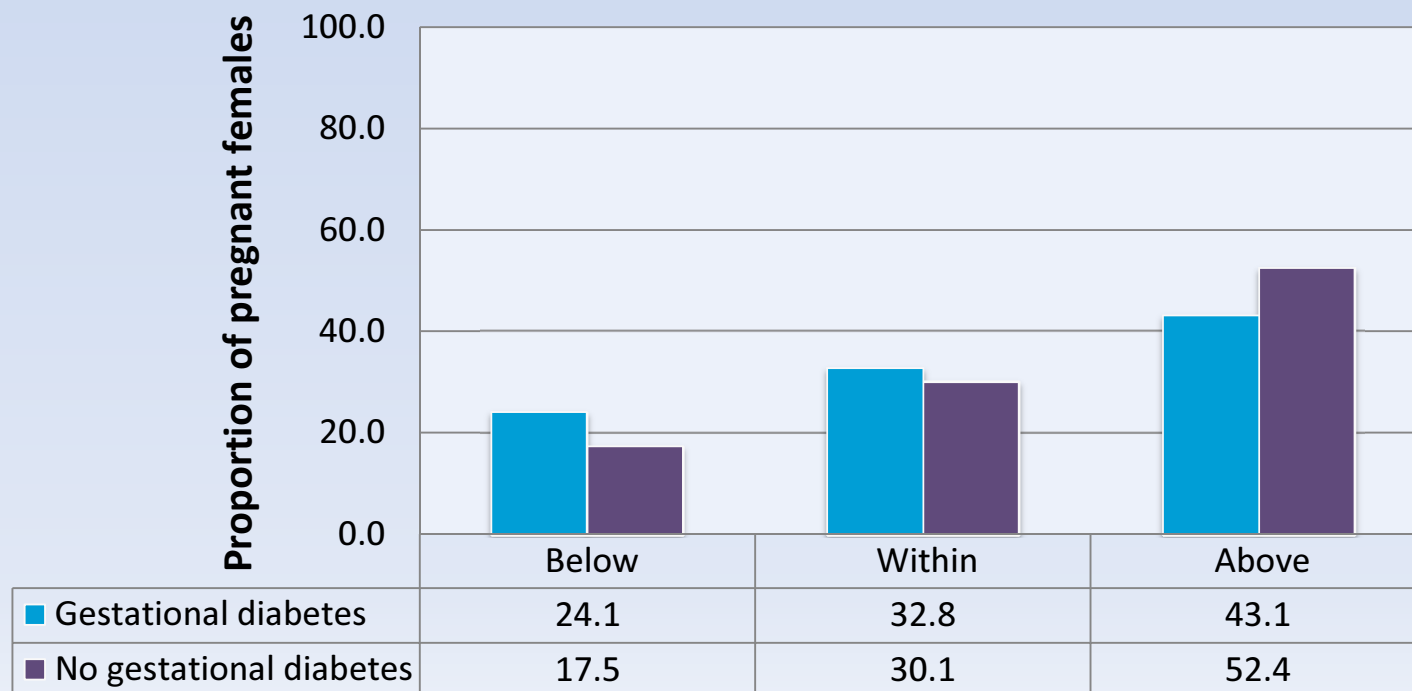


Source: BORN Ontario, BORN Information System. (2013-2014) Extracted from BORN Public Health Cube: October 6, 2014.

Note: missing data were excluded from analysis. Includes full-term (37+ weeks) pregnancies only.

# GWG: Gestational Diabetes Effect

Figure 7. Proportion of pregnant females, by GWG category and presence of gestational diabetes, Waterloo, 2013-2014



**Gestational Weight Gain relative to Recommendations**

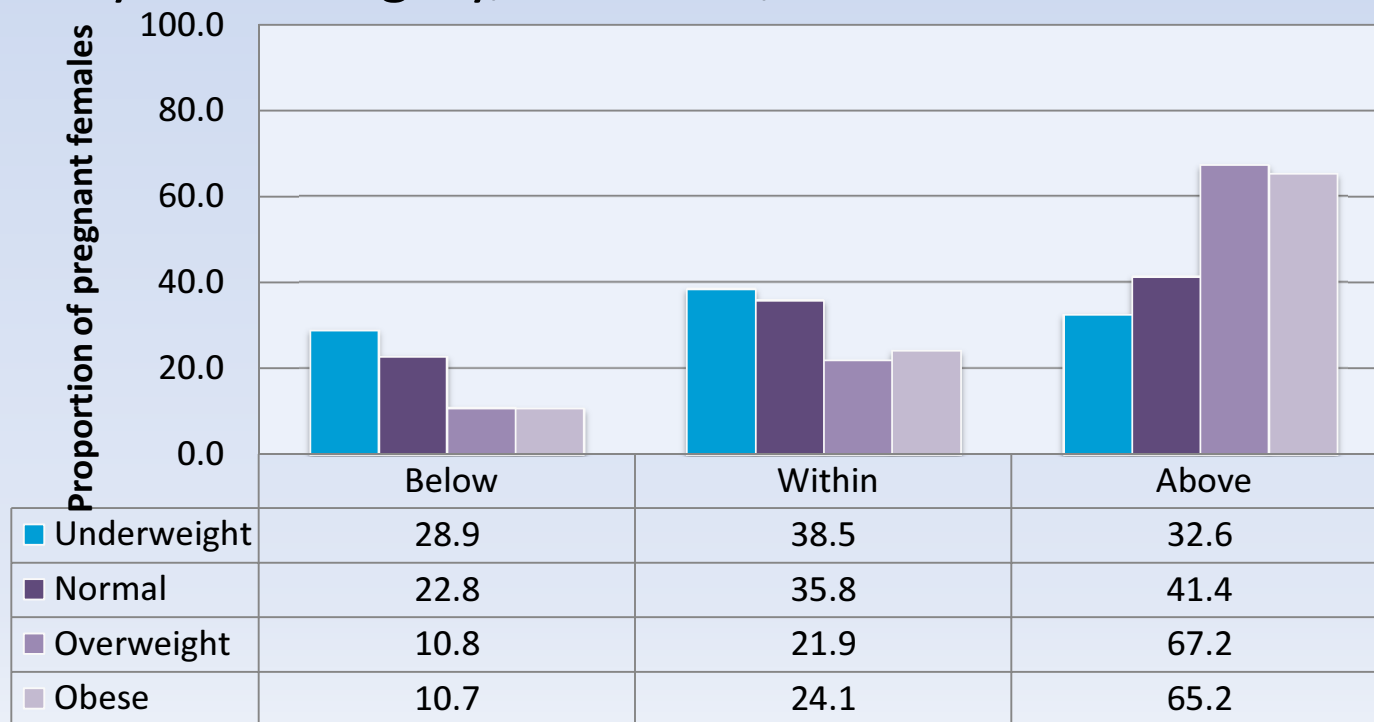


Source: BORN Ontario, BORN Information System. (2013-2014) Extracted from BORN Public Health Cube: October 6, 2014.

Note: missing data were excluded from analysis. Includes full-term (37+ weeks) singleton pregnancies only.

# GWG by Pre-Pregnancy BMI

Figure 8. Proportion of pregnant females, by GWG category and pre-pregnancy BMI category, Waterloo, 2013-2014



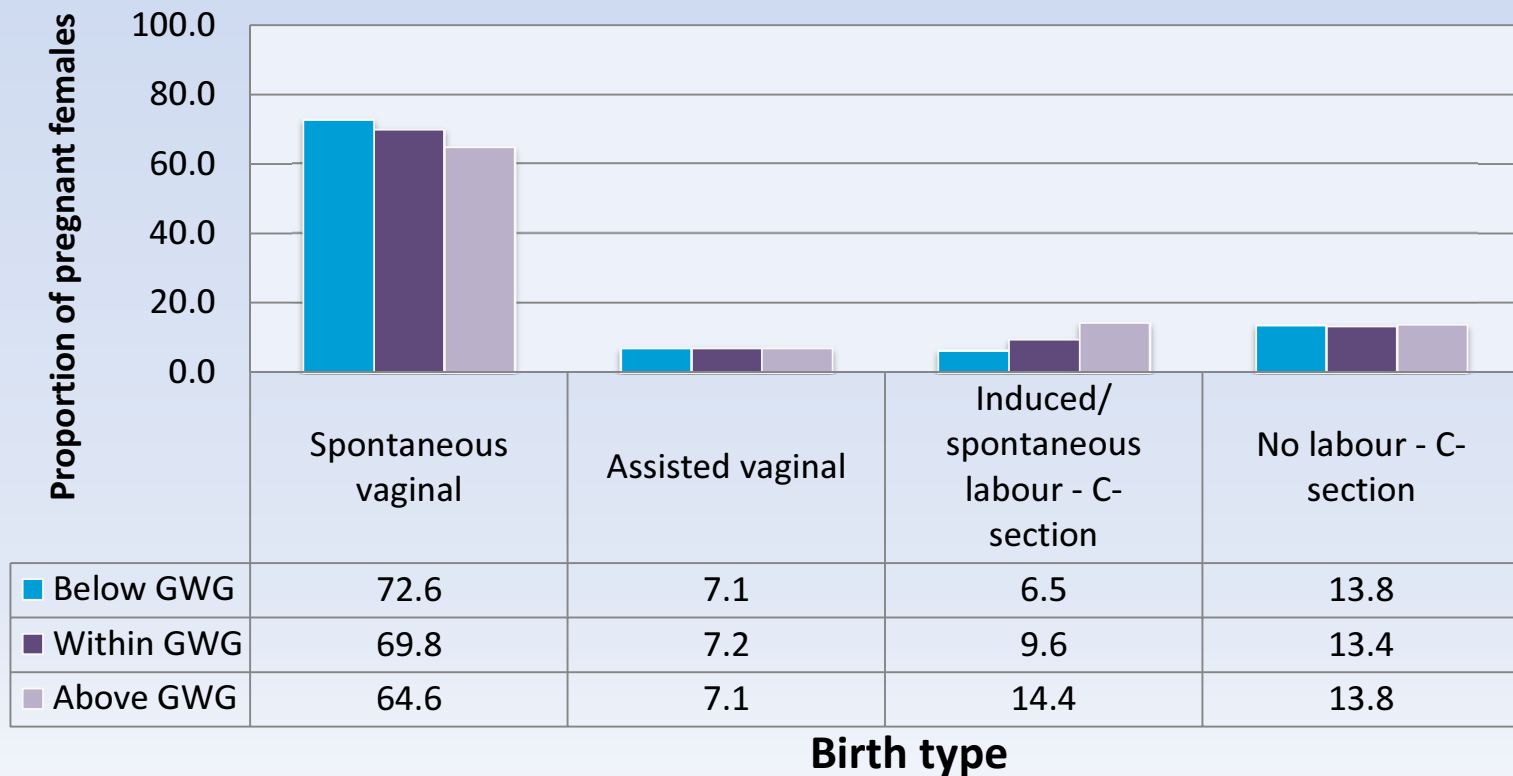
## Gestational Weight Gain relative to Recommendations

Source: BORN Ontario, BORN Information System. (2013-2014) Extracted from BORN Public Health Cube: October 6, 2014.

Note: missing data were excluded from analysis. Includes full-term (37+ weeks) singleton pregnancies only.

# GWG by Type of Delivery

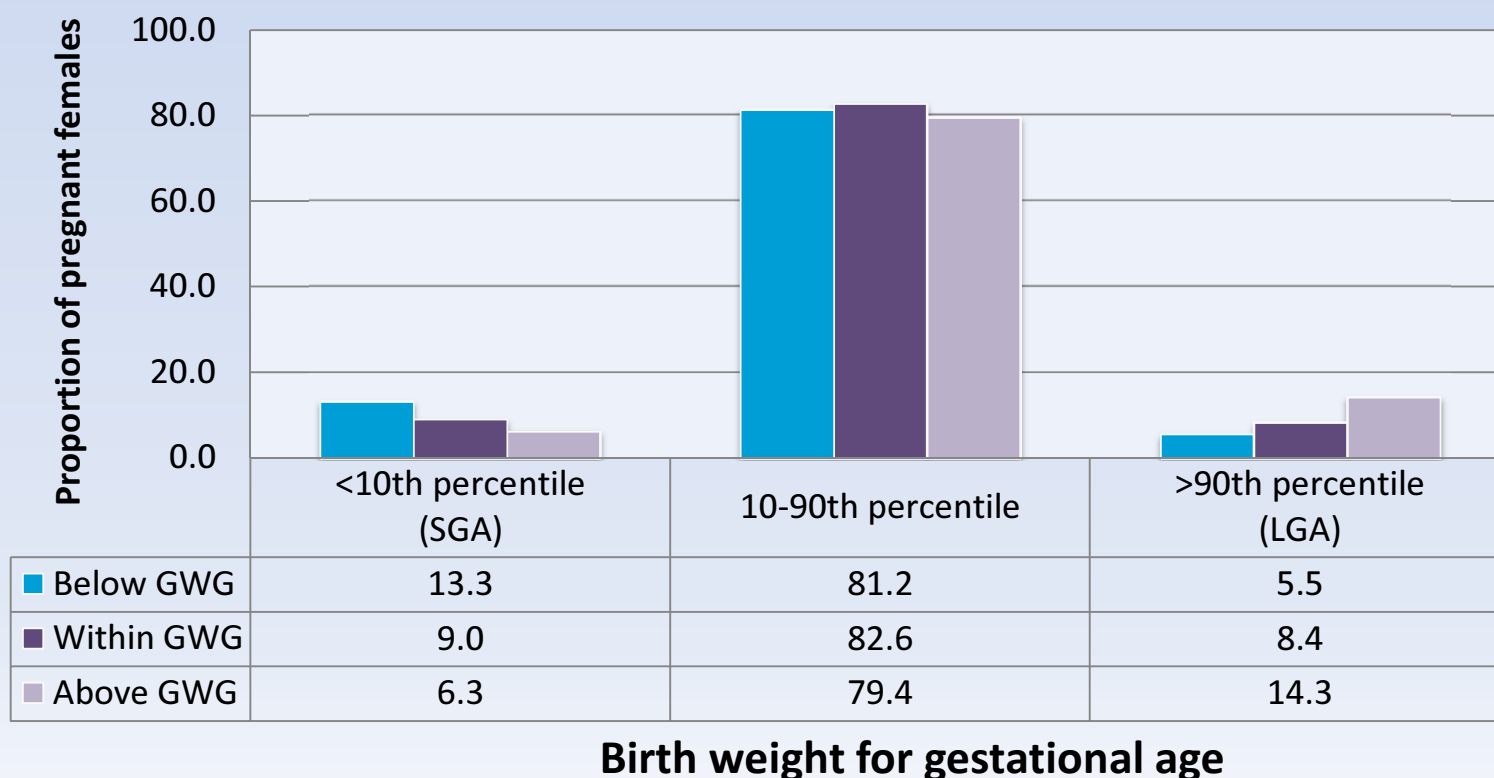
Figure 9. Proportion of pregnant females, by GWG category and type of delivery, Waterloo, 2013-2014





# GWG by Birth Weight for Gestational Age

Figure 10. Proportion of pregnant females, by GWG category and infant's birth weight for gestational age, Waterloo, 2013-2014



# In summary

- 50% of women gain more weight during pregnancy than recommended.
- Overweight and obese women are significantly more likely to gain more weight during pregnancy than recommended.
- First time we have had this data available at a population level – very important for public health.
- Coding of derived variable needs to be assessed.
- High percentage of missing needs to be addressed.
- The data will improve the more we work with it.

# We couldn't have done it without...

- APHEO Reproductive Health Core Indicators Work Group
- Erin Graves, Paula Morrison & Daniel Bedard, BORN Ontario
- Sharon Bartholomew, PHAC



Association of Public Health  
Epidemiologists in Ontario

**Thank you!**

**Questions?**

***Thank you for attending BORN Provincial Rounds.***



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