



# Examining the relationship between gestational diabetes mellitus and childhood obesity

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## Abstract

**Background** Gestational diabetes mellitus (GDM) occurs during pregnancy, when a woman who was previously not diabetic experiences high blood glucose levels. The prevalence of GDM has increased dramatically since 1984 (Getahun et al., 2008). Studies have suggested a link between GDM and an increased risk in childhood obesity in the mothers offspring. The aim of this literature review was to determine if there was in fact a correlation between GDM and childhood obesity.

**Methods** Several studies from the body of literature were reviewed to assess the methods and evidence. Search words used included: gestational diabetes, GDM, childhood obesity, epidemiology, birth weight, and intrauterine exposure. The studies found were conducted in different regions around the globe but were primarily conducted in developed countries. Limits included the absence of studies not written in English, the absence of studies in developing countries, and the lack of attention towards women of different ethnic backgrounds. The University of Ottawa library was used to search across many databases at once; searches were not conducted across databases individually.

**Results** Fourteen studies were reviewed in total. Of the fourteen, 13 indicated a positive correlation, suggesting that GDM is associated with increased BMI and obesity in children. Only 1 study indicated minimal or no correlation. The evidence suggests a potential causal relationship between gestational diabetes mellitus and childhood obesity.

**Conclusion** These results may pose a concern due to the multiple health risks associated with obesity, such as high blood pressure, type 2 diabetes and cardiovascular disease. Further research may be required to determine various areas of impact of childhood obesity beyond physiological, such as economical, psychological and on public health systems. Another area of potential future study could include more links to what causes GDM, as the literature reviewed seemed divided as to whether it was related to maternal BMI. Primary prevention measures should also be considered.

## Introduction

It has long been debated that intrauterine exposure to GDM increases the risk of adverse outcomes on the mothers' offspring. It is suggested that children of mothers with GDM are at a higher risk of being overweight or classified as obese throughout their childhood. Childhood obesity is a growing problem in many countries around the world and raises many health concerns. Developed countries are the most affected, including the United States, where childhood obesity has more than doubled in children and quadrupled in adolescents in the past 30 years (CDC, 2014). It is important to identify the underlying causes and potential risk factors for childhood obesity in order to put in place the proper intervention and prevention measures to reduce these high obesity rates and also reduce the adverse health effects and outcomes associated with obesity. Establishing a positive association between GDM and childhood obesity could help in accomplishing these goals. The prevalence of GDM has seen an increase as shown in a study by Getahun et al., with a prevalence of 1.9% in 1989-1990 to 4.2% in 2003-2004 (2008). Studies have also shown that women who are overweight or obese compared to normal-weight women were at a higher risk of developing gestational diabetes (Shin Y. et al., 2005). These studies then suggest that GDM may be in part attributable to an increased BMI and obesity. The question remains whether or not children born from mothers with GDM are at a higher risk of developing childhood obesity than children born from non GDM mothers. This structured literature review attempts to answer this question by looking at several studies which attempt to establish a relationship between GDM and childhood obesity.

### Research Question

Are children born from mothers with gestational diabetes mellitus (GDM) at a higher risk of developing childhood obesity than children born from non-GDM mothers?

## Methods and Materials

**Research method :** Structured literature review

**Keywords :** gestational diabetes, GDM, childhood obesity, epidemiology, birth weight, intrauterine exposure

**Databases:** University of Ottawa Library, PubMed, Google Scholar

Studies included in this literature review were all quantitative as they collected data using anthropometric and biochemical measurements to quantify and measure obesity rates among children born from GDM mothers and non GDM mothers. All of the studies were peer reviewed which provides merit and validity to this body of literature. Study methods varied. Some were prospective cohort studies, where they selected a cohort of pregnant women from which they collected baseline information and then followed subjects and their offspring longitudinally. Other studies were retrospective cohort studies which selected children and then determined whether or not their mothers suffered from GDM during pregnancy. A case control approach was used in order to establish a relationship between GDM and childhood obesity.

**Inclusion criteria:**

Studies using large sample sizes  
Peer reviewed

**Exclusion criteria:**

Case studies

## Results

Of the 14 studies included in this literature review, 13 found a positive correlation between GDM and childhood obesity. The study that did not, Whitaker et al., found "no increased risk of childhood obesity of mothers with mild, diet treated GDM and found no association between the metabolic markers of GDM and childhood obesity" (1998). However, the methods used in this study involved looking at medical records and looking at height and weight measurements. There are validity threats to this methods design, as hospital records can be an inaccurate source of information due to misclassification, error, etc. This is especially relevant because the data used in this study was from 1985-86 where there might not have been any computerized data collection or data audits, leading to a higher chance of false information. The study stated that "there is no established BMI cut-point to define childhood obesity", so this could result in a misclassification bias in that study for how obesity was classified, and led to the researchers not finding a correlation. Many of the studies used measures like BMI, hip/waist circumference, and skin folds as a means of determining obesity in either the mothers or the children or both. Some of the studies went more into depth and did blood tests, amniotic fluid insulin, and body composition tests. These anthropometric and biochemical measurements were deemed appropriate for the purpose of these studies. Regardless of method, all but one of the studies found for this literature review found a positive association between gestational diabetes and childhood obesity.

## Discussion/Limitations

The results of this study have many implications toward population health. With gestational diabetes being relatively common, and obesity in adolescence and adulthood on the rise, it is important to try and tackle these factors however possible, to try to decrease the risk for as many people as possible. Potential biases in these findings include a misclassification bias on what BMI is considered obese. A few of the studies stated that there was no official number that determined an obese BMI, and each of these studies gave their own parameters. This could have been avoided by using a measurement other than BMI, or having a regulated BMI scale. Of the 14 studies used in this literature review, 13 of them found a positive correlation between mothers having gestational diabetes and their children being overweight or obese. The results seemed very consistent across the literature, and contrary evidence at this point would be surprising. For the future, it is recommended that future studies focus on the prevention of GDM, as well as alternative obesity measurements than BMI because BMI is widely known as less of a reliable method of determining obesity and doesn't take into consideration the fat vs. muscle ratio.

Some limitations for this literature review included the time allotted to conduct the search being short, and therefore there was only a limited amount of time to structure the review and find articles. A more technical limitation is that terms not included in the search parameters (defined in methods) might have led to an exclusion of some studies. Another limitation similar to this was the exclusion of studies not written in English, as translation resources were not able to be used due to time constraints conducting this review. The results of this review may not be generalizable to developing countries, as studies containing data about GDM and childhood obesity in these areas could not be found. There is also a possible limitation in the generalizability of these results across different ethnic backgrounds, as many of the studies found used mainly white women and children in their sample.

Study	Sample	Methods	Result
Nehring et al.	7355 mother-child dyads	Crude and adjusted logistic regression models for BMI and waist circumference (WC)	Positive correlation
Page et al.	62 Mexican-American mother-child pairs	Medical history outcome measured offspring BMI, BMI percentiles, hip circumference (HC) and WC.	Positive correlation
Whitaker et al.	58 offspring of mothers with GDM, 257 without	Medical history collected, obtained lifetime height and weight measurements	No correlation
Wroblewska-Seniuk et al.	43 children of mothers with PGDM and 34 children of mothers with GDM	Incidence of overweight, obesity, impaired glucose tolerance, and insulin resistance analyzed and statistical analysis performed	Positive correlation
Catalano et al.	90 infants, 37 of mothers with GDM	Body composition performed at birth, follow up weight taken. Skin folds, blood pressure, dietary history, estimates of insulin resistance and lipid profile obtained	Positive correlation
Silverman et al., 1993	Size not stated, mothers with GDM AND PGDM, mostly white	Metabolic control monitored, measurements of hemoglobin A, plasma fuels and hormones	Positive correlation
Silverman et al., 1995	Same as above	Fetal cell function assessed by amniotic fluid, plasma glucose and insulin measured yearly	Positive correlation
Boney et al.	84 children of large gestational age and 95 children of appropriate gestational age who were offspring of mothers with GDM	Obesity, hypertension, dyslipidemia, and glucose intolerance were evaluated	Positive correlation
Gillman et al.	7981 girls and 6900 boys age 9-14 who participated in the Growing Up Today Study, a US study of diet, activity, and growth	Participants self-reported height, weight, diet, activity, and other variables by questionnaire	Positive correlation
Lawlor et al.	280 866 singleton-born Swedish men from 248 293 families	Record linkage prospective cohort study	Positive correlation
Chandler-Laney et al.	51 children aged 5-10 with and without intrauterine exposure to GDM	Lipid profile obtained by fasting blood draw, insulin sensitivity and secretion by liquid meal tolerance test	Positive correlation
Crume et al.	82 children exposed to GDM and 379 unexposed youths 6-13 years of age	Retrospective cohort study. Measured BMI, WC, skinfold thickness, and visceral and subcutaneous abdominal fat	Positive correlation
Hillier et al.	9439 mother child pairs (children aged 5-7)	Measured weight in offspring was measured 5-7 years. Adjustments for potential confounders including maternal weight gain, maternal age, parity, ethnicity, etc.	Positive correlation
Buhrer et al.	324 pregnancies of Caucasian women with GDM	Recorded BMI before pregnancy, maternal glycemic values, fetal abdominal circumference	Positive correlation

Chart 1. Summary of Results.

## Conclusions

Through our structured literature review we can conclude that there is in fact a positive association between gestational diabetes mellitus and childhood obesity. Evidence shows that children born from GDM mothers have an increased risk of developing childhood obesity compared to children born from non-GDM mothers. Since the evidence seems indubitable, and since researchers seem to have reached a consensus, further research should focus on potential intervention methods targeting primary prevention of GDM in pregnant women. Adverse health effects can be seen in both the women with GDM and their offspring, therefore emphasizing the importance of prevention. Investigating further into prevention and implementing guidelines would be a valuable investment into maternal and pediatric health.

Picture credit: <http://pinshark.com/pregnant-woman-silhouette-png.htm>



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