

Relationship Between Obese Moms and Kids – epigenetics, home environment or both?

Can moms' healthy food and exercise habits make any difference?

Frontier Voice of *Nutrition Remarks* (May 10, 2013)

Nalin Siriwardhana, Ph.D., interviewed Dr. Kristi B. Adamo, PhD., Research Scientist and CIHR New Investigator, Director of HALO Research Laboratory at Children's Hospital of Eastern Ontario (CHEO) Research Institute, 401 Smyth Rd. Ottawa ON K1H 8L1.

It is now well known that mother's obesity status and obesogenic home environment plays a significant (possibly a synergistic) role in childhood obesity. Obese kids face both physiological and psychological challenges during childhood. Childhood obesity is known to dramatically increase the risk for heart diseases, diabetes and bone problems. Being obese is also associated with negative behavioral and



physiological changes in children. Further, childhood obesity is a significant risk factor of child's future health in the early years and beyond. Most obese kids will be obese adults and are subsequently predisposed to type 2 diabetes, heart diseases (stroke and atherosclerosis), several types of cancer (breast, colon, endometrium, esophagus, kidney, pancreas, gall bladder, thyroid, ovary, cervix, and prostate cancers and multiple myeloma), and osteoarthritis.

Nutrition Remarks interviewed **Kristi B. Adamo, PhD.** to understand the potential health risks that children can be exposed to due to mothers' obesity status and obesogenic home environment. Below is a concise summary of the interview:

Question from Nutrition Remarks: What are the statistics of major health risks associated with childhood obesity?

Answer from Dr. Adamo: In 2002, the World Health Organization reported pediatric obesity to be the most prevalent, non-communicable disease in developed countries and for many children, obesity can be more than an aesthetic condition. If untreated, obesity-related risk factors such as sleep apnea, cardiovascular disease, non-alcoholic fatty liver disease and type 2 diabetes to name a few co-morbidities can develop in children. Population-based data from the Bogalusa Heart Study have shown that 70% of obese youth (5- 17

years old) had at least one risk factor for cardiovascular disease. Furthermore, these children are also at greater risk of bone and joint problems and children struggling with obesity are likely to carry their excess adiposity into adulthood. According to the Center of Disease Control, an estimated four of every five obese children will remain obese as adults, increasing their risk of chronic obesity and obesity-related disease (e.g. heart disease, diabetes, stroke, osteoarthritis and certain cancers). Many groups have also studied the psychosocial effects of childhood obesity. Evidence suggests that overweight children frequently develop negative self-image and low self-esteem accompanied by sadness, loneliness, nervousness and risk-taking behaviors in later part of the life. It is clear that obesity is associated with considerable health care burden. For example, obese children in the U.S. (research by Finkelstein and Trasande), Germany (research by Wenig and Breitfelder) and Canada (research by Kuhle) have proven to visit their pediatrician more often than children of healthy weight.

Question: How frequently will an obese mom's kids also become obese?

Answer: Most countries do not have this type of surveillance data available. We know from reviewing large population-based studies or birth cohorts from the U.S.A., U.K., Australia and Scandinavia that there is a **greater probability** that a child of an obese mother will go on to become obese themselves and there are many potential reasons for this (e.g. sub-optimal intrauterine environment, obesogenic post-natal environment, genetic or epigenetic predisposition). This cycle is by no means a guarantee. It is possible for a child of an obese mother to not experience obesity themselves (conversely, the child of a normal weight mother may go on to develop obesity in an unhealthy environment).

Question: What is the contribution from the home environment?

Answer: If a child was not exposed to an optimal intrauterine environment they are not 'doomed' but rather they can be set on the right track by parents or caregivers who model and encourage healthful behaviors. This includes, but is not limited to, high quality and age-appropriate nutrition, daily physical activity and good sleep hygiene. Thus if the prenatal growing environment was suboptimal (i.e., mother consumes large quantities of food that are high in saturated fats and refined sugar, gains excessive weight and is sedentary), an exemplary post-natal environment is imperative and protective health factors such as physical activity and healthy eating have proven to result in significant benefits for children and youth.

Question: What is the contribution from epigenetics?

Answer: The analogy we like best is this: if we consider genetics to be the alphabet of life – specifically the letters of the DNA sequence (A, C, G, T) carry the information – **epigenetics** is the grammar of life or the 'markings' that can modify the message. In short, epigenetic changes are heritable changes in gene expression that operate outside of changes in DNA itself. While the message remains the same (i.e., DNA) the way it is expressed (i.e., epigenetics) and thus the way proteins, organs and systems function can be altered by environmental exposures *in utero*.

Epigenetic regulation is a natural process that is required to ‘turn-on’ or ‘turn-off’ genes in certain systems or at specific points in time that contribute to typical development throughout life. However, different environmental conditions or disruptions can change the expected epigenetic patterns and thus lead to increased susceptibility to disease later on. In other words, epigenetic modifications can also be acquired over time, a simple example of which is gene-environment interaction. We know that identical twins have the same genetics but their epigenetic patterns in later life can be markedly different. This is because each twin may have been exposed to very different environments which have impacted their epigenetics markings and thus you can see differences when observing twins who grew up in different environments (this includes their lifestyles).

Question: What do we know about kids born to moms who were obese for long time vs. short time?

Answer: This is tough to answer as the data is not currently available although there are research teams exploring this issue.

While we are waiting for the evidence regarding the impact of the length of maternal obesity on offspring, there is some interesting evidence on the impact of maternal obesity on the intrauterine environment that comes from bariatric surgery. Children born to obese mothers prior to surgery have worse outcomes (ie, macrosomia and susceptibility to obesity) when compared to siblings from the same mother born after bariatric surgery.

Question: Why are minute changes during pregnancy and early childhood growth important in terms of childhood obesity?

Answer: Small decreases in birth-weight or adiposity, as demonstrated by maternal lifestyle interventions during pregnancy, can have dramatic effects at the population level with respect to shifting the birth-weight distribution of the entire population to one that begins closer to the appropriate for gestational age range. This does not come at the expense of increasing the number of small for gestational age neonates but rather lessens the effects of macrosomia (or big babies) by shifting the birth-weight distribution to the left (ie. more average for gestational age neonates). Given the strong relationship between high birth-weight and downstream obesity risk research suggests that even small changes during pregnancy and early childhood that aim to have every child grow within the optimal range (10th-90th percentile) are vital to child obesity prevention strategies over the long term.

Question: What do we know about kids born to moms who used to have normal weight and faced unusual weight gain during pregnancy?

Answer: Gestational weight gain (GWG) is an important factor for both mom and baby. The evidence clearly illustrates that excessive gestational weight gain can pose a significant challenge for both mom and baby. However, unlike maternal pre-pregnancy BMI (body mass index), GWG is a modifiable risk factor for many pregnancy related complications that all women should focus on. High GWG is associated with short and long-term obesity risk for the child regardless of the mom’s pre-pregnancy weight. Often women who

gain too much weight during pregnancy (i.e. above the Institute of Medicine Guidelines) also retain weight after pregnancy and therefore can enter a second or third pregnancy at a higher weight than the first which can propagate the cycle of obesity. Additionally, research also points to an intergenerational cycle of obesity whereby an overweight or obese mom (or a mom who exceeds GWG recommendations) gives birth to a large for gestational age infant who may continue to follow an inappropriate growth trajectory and continue through life struggling with weight issues.

Question: As kids are in the growing phase, can there be a synergy between obesogenic home environment and accumulated epigenetic changes?

Answer: Research by pioneers in the field of epigenetics and obesity, like Sir Peter Gluckman from the Liggins Institute in New Zealand, have clearly shown that the environment (e.g. what you eat) can impact epigenetic markings. This leads me and my colleagues to believe that the obesogenic home environment does contribute to epigenetic changes. Animal models and human evidence increasingly suggests that exposure to certain environmental factors during sensitive periods of development (e.g. before or after birth) can affect the ‘make-up’ of an individual (e.g. their body composition, their responsiveness to the environment, their susceptibility to disease etc.) later in life through adaptation or epigenetics. This could further contribute to the development of undesirable metabolic processes. In our opinion, it is very important for children to be exposed to the most healthful post-natal environment possible to ‘counter-act’ any risk-promoting adaptations or epigenetic changes that they may have inherited and to potentially build new ‘protective’ mechanisms within the body.

Question: What other important information would you like to address?

Answer: Ideally entering pregnancy at a healthy weight and engaging in a healthy active lifestyle during the gestational period gives babies the best start to life. However, knowing that the majority of pregnancies are unplanned this poses a challenge. Focusing on behaviors that can be ‘controlled’ such as eating habits, physical activity and sedentary behavior is key to keeping gestational weight gain within expected ranges. Pregnancy is not an excuse for ‘eating for two’ and halting all physical activity. The evidence supports that regular moderate intensity exercise is protective for mom and baby.

This interview was based on the following original scientific article published by Dr. Adamo. Additional general background information was acquired from PubMed, CDC and NIH sources.

Adamo et al, Can We Modify the Intrauterine Environment to Halt the Intergenerational Cycle of Obesity? Int. J. Environ. Res. Public Health 2012, 9(4), 1263-1307.

Dr. Kristi Adamo, a Research Scientist at the Children’s Hospital of Eastern Ontario Research Institute, is supported by a Canadian Institutes of Health Research (CIHR) New Investigator Award from the Institute of Human Development, Child and Youth Health. In addition to CIHR, her work is supported by other funding institutions including the Ontario Ministry of Research and Innovation, the Canada Foundation of

Innovation, the Ottawa Dragon Boat Foundation and the W. Garfield Weston Foundation. Her colleague, Dr. Zachary Ferraro is a research associate with her ‘prevention in the early years’ team.

More about Dr. Adamo

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