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Original Article

Implication of Obesity in Pregnancy Outcome

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Abstract

Obesity during pregnancy can affect not only women´s health, but also the health of the offspring. We evaluate blood biomarkers, and clinical development of 139 pregnant and their offspring. Obese pregnant shows increased levels of NO_3/NO_2, proteins and DNA oxidation. Likewise, pregnant with obesity has higher risk of diabetes, abortion, and offspring with obesity and respiratory infections. These results reinforce that obesity during pregnancy increase the risk of complications for the mother and the offspring.

Keywords: Obesity; Oxidative stress; Morbidity; Offspring; Pregnancy

Introduction

Obesity has increased enormously in the last few decades, becoming a health problem worldwide. The epidemic is especially marked in women in reproductive age. Obesity during pregnancy increases the use and budget of the health system, as well as the risk of pregnancy complications and adverse birth outcomes [1,2].

Many studies have documented the increase of oxidative stress in obesity [3,4]. Oxidative stress results from an imbalance between the production of Reactive Oxygen Species (ROS) and antioxidant capacity [5]. It has been associated with the pathogenesis of several diseases. Some of these diseases are related with obesity [6]. Increased oxidative stress during pregnancy has also being associated with complications such as: preeclampsia, gestational diabetes and childhood insulin resistant [7,8].

Obesity during pregnancy has been associated with several diseases both in the mother and in the offspring. Obese pregnant has increased risk of spontaneous miscarriages, pre-term delivery, pre-eclampsia and gestational diabetes mellitus. In the same way, after conception, these women still has an increased risk of develops diabetes mellitus, high blood pressure and psychosocial disorders. The children born from obese pregnant women also present increased risk of metabolic disorders and obesity [9-11].

The aim of this study was to determine whether obesity during pregnancy increase morbidity in mother and offspring.

Methodology

General Design

The study included 139 pregnant women that were attended in Health Centers of Havana (45 with obesity 38 overweight and 56 normal weight pregnant). Blood was collected by venous puncture in the period of the gestation nearby to week sixteen. This week was selected in order to use the same blood collected for the alpha-fetoprotein determination and avoid extra-blood extractions.

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Oxidative Stress Markers

The level of MDA (Malonildialdehyde), AOPP (advanced oxidative products of proteins), 8-oxo-dG (8-oxo-deoxyguanosine) were measured as indicator of lipid, protein and DNA oxidative damage respectively. The measurement of concentration of nitrites in plasma lets evaluating the bioavailability of nitric oxide which also allows evaluating the state of health of the vasculature. The concentration of GSH was measured as an indicator of antioxidant capacity in plasma.

Measurement of GSH: The determination of this antioxidant was carried out by the method of Beutler [12]. GSH is able to react with the dye 5,5dithiobis 2 benzoic acid (DNTB) and gives rise to a colored compound that absorbs at a wavelength of 412 nm. The concentration was calculated by means of a standard curve of GSH. The results are expressed in nmol/mL.

Measurement of MDA: The total concentration of MDA was determined by means of the quantification of reactive substances to thiobarbituric acid (TBARS) by a spectrophotometric technique [13]. MDA, the lipid peroxidation product, reacts with TBA under conditions of high temperature to form a colored compound that absorbs light in the visible range (532 nm). The sample underwent a process of elimination of proteins by acid hydrolysis, and the complex TBA-lipoperoxide was extracted in n-butanol. Concentrations were computed by reference to a calibration curve prepared by assay with 1,1-3,3 tetra-ethoxy-propanol The values were expressed as nmol/mL. The plasma levels of TBARS are considered within the normal range when they are below 1,90 nmol/mL.

Measurement of AOPP: Spectrophotometric determination of AOPP levels was performed by modification of Witko's method [14]. Samples were prepared in the following way: Two hundred micro liters of supernatant were diluted 1:3 in PBS, 100 μL of 1.16 mol/L potassium iodide (KI, Sigma) were then added to each tube, two minutes later followed by 200 μL of acetic acid. The absorbance of the reaction mixture was immediately read at 340 nm against a blank containing 1200 μL of PBS, 100 μL of KI, and 200 μL of acetic acid. Concentrations of AOPP were calculated by using the extinction coefficient of 26 mM^{-1}/cm^{-1}.

Assay of 8-oxo-7,8-dihydro-20-deoxyguanosine: DNA hydrolysates were dissolved in High Performance Liquid Chromatography (HPLC) grade water and filtered through a 0.2 mm syringe filter before applying the samples to a Waters ODS HPLC column (5 mm particle size). The amount of 8-oxo-dG and dG in the DNA digest was measured by electrochemical and UV absorbance detection, respectively [15].

Nitrates and nitrites determination: NO_3 and NO_2 (nitrates and

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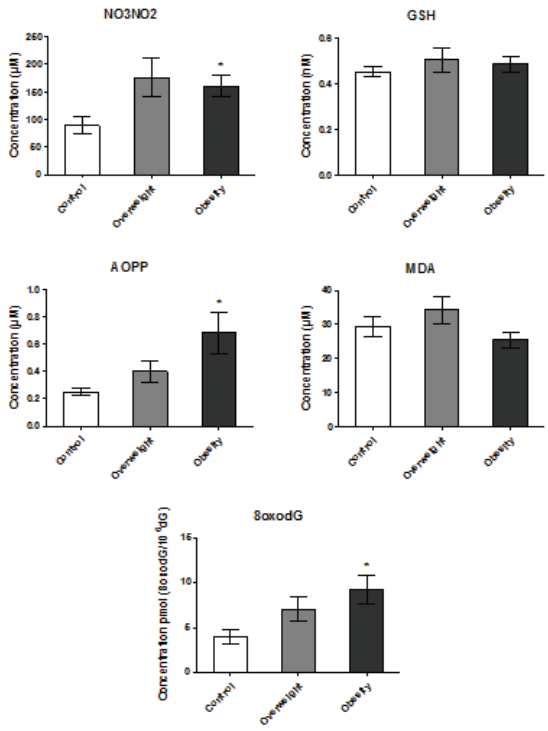

Figure 1: Effect of maternal weight on oxidative stress biomarkers. Data are presented as the mean ± SEM. *p < 0.05 in relation to control.

nitrites) was measured as marker of production of ERO (pro-oxidizing state) and bioavailability of nitric oxide. The proceeding implies the spectrophotometric quantification to 540 nm of the concentration of present nitrites in the sample plus the nitrites obtain by the action of nitrate reductase enzyme which substratums are nitrates plasmáticos with Gries reactive in the medium. Concentration expresses in μM unit [16].

Clinical Data Achieving

All clinical records were consulted during the pregnancy and up to 5 years after delivery. A datasheet was created to annotate mothers and offspring complications such as mothers presenting dystocic delivery, abortion, High Blood Pressure and Diabetes Mellitus and offspring congenital malformation at birth, recurrent respiratory infections, obesity or allergies further until 5 years old.

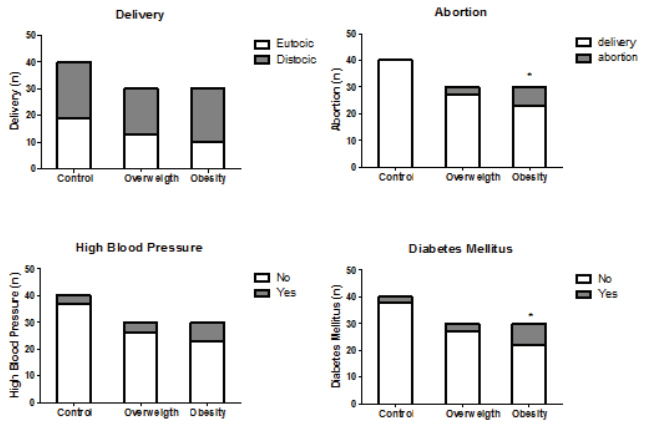

Figure 2: Effect of maternal weight on maternal morbidity during pregnancy and up to 5 years later. Data are presented as the number mothers presenting distocic delivery, abortion, High Blood Pressure and Diabetes Mellitus. *p< 0.05 in relation to control.

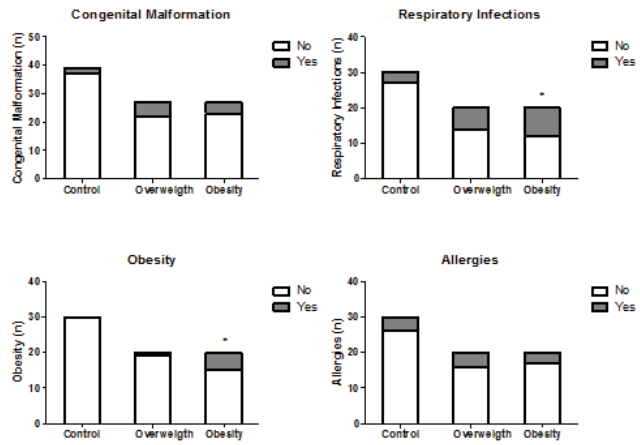

Figure 3: Effect of maternal weight on offspring´s morbidity up to 5 years old. Data are presented as the number of child's presenting congenital malformation, recurrent respiratory infections, obesity or allergies. *p< 0.05 in relation to control.

Statistical Analysis

In all graphics, data were expressed as mean ± SEM or frequencies. The statistical analysis was performed by one-way Analysis of Variance (ANOVA) or Kruskal-Wallis test followed by a Dunn's post-test for multiple comparisons or by Fisher test and relative risk, using the Graph Pad Prism 5 statistical software package (Graph Pad Software, Inc., San Diego, CA, USA). A p-value of 0.05 indicated statistical significance for all analyses.

Ethical Issues

The studies were in compliance with the Helsinki Declaration standards. Informed consent was obtained from all individual participants included in the study. The experiments were conducted in accordance with the ethical guidelines for experimental investigations and were approved by the Ethical Committee of the Institute of Basic and Preclinical Sciences Victoria de Girón, (approval number 09-11) Havana, Cuba.

Results

Obesity during Pregnancy Affects Oxidative Stress Biomarkers

Oxidative stress biomarkers were determined in the all groups of pregnant (Control, Overweight and Obesity). As summarized in Figure 1, the rate NO_3/NO_2 was 1.8 folds higher while the concentration of AOPP and 8oxodG were 2.7 and 3.4 folds higher respectively in the group with obesity when compared with control. The concentration of GSH and MDA were not different between groups.

Obesity during Pregnancy Affects Maternal Health

The frequency of eutocic and distocic delivery, abortions, vascular hypertension and diabetes from the diagnosis of pregnancy and until the age of 5 later to the childbirth is shown in Figure 2. Obesity during pregnancy increments risk of abort in 1,3 fold as well as the appearing of different type of diabetes in 1.29 fold during pregnant and until 5 years after the childbirth. The risk of distosic delivery and HBP did not increase significantly.

Obesity during Pregnancy Affects Offspring Health

The health of the offspring is also compromised by maternal obesity. The frequency of congenital malformation, allergies, recurrent respiratory infections and obesity in the offspring are represented in Figure 3. The obesity during pregnancy increase the risk of recurrent respiratory infections and obesity in the offspring (by 1.5 and 1.33 fold respectively) while the risk of congenital malformation and allergies did not increase significantly.

Discussion

This study revealed changes in oxidative stress marker in pregnant with obesity as well as an association between obesity during pregnancy and maternal and offspring morbidity. Obesity has been related with oxidative stress, metabolic syndrome and chronic inflammation. It is also a risk factor for several diseases like cancer, metabolic and cardiovascular diseases. Obesity during pregnancy represent additional complication for mother and offspring health [1,2,8].

Obesity during pregnancy is associated with higher oxidative stress in the mother, placenta and the offspring. Oxidative protein damage, lipid peroxidation and nitric oxide levels has been reported to be higher in pregnant with obesity and their placenta, as well as a decrease in antioxidant capacity. The offspring of pregnant with obesity also present higher levels of MDA and NO [17,18]. In accordance, here we report an increase in oxidative damage to DNA and proteins in pregnant with obesity when compared to control. As well as a higher rate NO_3/NO_2. On the other hand, no difference in reduced glutathione or lipid peroxidation was detected; this could be due to a strict dietetic and metabolic control to the overweight and pregnant with obesity.

Oxidative stress and metabolic syndrome has been linked to the pathogenesis of several diseases such as cancer, metabolic and cardiovascular diseases [3,6]. Obesity during pregnancy increase the risk of abortion, HBP and DM [19] 1, 6, 41. In this study we show a higher risk of abortion and DM in pregnant with obesity when compared to control, while the risk of HBP and dystonic delivery were not significantly higher.

Several authors report an increase in congenital malformations in the child of mothers with obesity and overweight [20]. In this study we didn´t find a higher risk of congenital malformation but the high frequency of abortion in pregnant with obesity can be hidden some kind of malformations. It is known that congenital malformation causes near 50% of all abortion [21,22]. Bearing this in mind, several of the abortion reported here could be due to congenital malformation incompatible with life. In the same way obesity during pregnancy has been associated with childhood obesity [23] and respiratory infections [24]. Here we report an increased risk of recurrent respiratory infections and obesity in the offspring of mothers with obesity up to 5 years after bird. Respiratory infections could be due to dysfunction in the immune system caused by the maternal obesity [25,26] while epigenetic reprograming during intrauterus life cloud be responsible for the childhood obesity [27].

Conclusion

Summarizing these results show that maternal obesity increase oxidative stress and lead to a high risk of maternal and offspring complications such as Diabetes Mellitus in the mother, abortion, recurrent respiratory infections and obesity in the offspring.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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References

1. Poston L, Caleyachetty R, Cnattingius S, Corvalán C, Uauy R, Herring S, et al. 2016. Preconceptional and maternal obesity: epidemiology and health consequences. Lancet Diabetes Endocrinol. 4: 1025-1036.
2. Marchi J, Berg M, Dencker A, Olander EK, Begley C. 2015. Risks associated with obesity in pregnancy, for the mother and baby: a systematic review of reviews. Obes Rev. 16: 621-638.
3. Savini I, Gasperi V, Catani MV. 2016. Oxidative Stress and Obesity. Obesity. 65-86.
4. Marseglia L, Manti S, D'Angelo G, Nicotera A, Parisi E, Di Rosa G, et al. 2014. Oxidative stress in obesity: A critical component in human diseases. Int J Mol Sci. 16: 378-400.
5. Pruchniak MP, Araźna M, Demkc U. 2016. Biochemistry of oxidative stress. Adv. Exp. Med. Biol. 878: 9-19.
6. Matsuda M, Shimomura I. 2013. Increased oxidative stress in obesity: Implications for metabolic syndrome, diabetes, hypertension, dyslipidemia, atherosclerosis, and cancer. Obes Res Clin Pract. 7.
7. Turpin CA, Sakyi SA, Owiredu WKBA, Ephraim RKD, Anto EO. 2015. Association between adverse pregnancy outcome and imbalance in angiogenic regulators and oxidative stress biomarkers in gestational hypertension and preeclampsia. BMC Pregnancy Childbirth. 15: 189.
8. Catalano PM, Shankar K. 2017. Obesity and pregnancy: Mechanisms of short term and long term adverse consequences for mother and child. BMJ. 356: 1-21.
9. Broskey NT, Peng W, Nan L, Junhong L, Weiqin L, Leishen W, et al. 2017. Early Pregnancy Weight Gain Exerts the Strongest Effect on Birth Weight, Posing a Critical Time to Prevent Childhood Obesity. Obesity. 25: 1569-1576.
10. Catalano PM, Shankar K. 2017. Obesity and pregnancy. Bmj. 281.
11. Quiner T, Perlow JH. 2017. The Global Burden of Obesity on Pregnancy Outcomes in the Developed World [17Q]. Obstet Gynecol. 129.
12. Beutler E, Gelbart T. 1986. Improved assay of the enzymes of glutathione synthesis: γ-glutamylcysteine synthetase and glutathione synthetase. Clin Chim Acta. 158: 115-123.
13. Gutteridge JMC. 1982. Free-radical damage to lipids, amino acids, carbohydrates and nucleic acids determined by thiobarbituric acid reactivity. Int J Biochem. 14: 649-653.
14. Witko V, Nguyen AT, Descamps-Latscha B. 2005. Microtiter plate assay for phagocyte-derived Taurine-chloramines. J Clin Lab Anal. 6: 47-53.
15. Espinosa O, Jiménez-Almazán J, Chaves FJ, Tormos MC, Clapes S, Iradi A, et al. 2007. Urinary 8-oxo-7,8-dihydro-2′-deoxyguanosine (8-oxo-dG), a reliable oxidative stress marker in hypertension. Free Radic Res. 41: 546-554.
16. Mori H. 2001. Determination of Nitrate in Biological Fluids Using Nitrate Reductase in a Flow System. J Heal Sci. 47: 65-67.
17. Malti N, Merzouk H, Merzouk SA, Loukidi B, Karaouzene N, Malti A, et al. 2014. Oxidative stress and maternal obesity : Feto-placental unit interaction. Placenta. 35: 411-416.
18. Gallardo JM, Gõmez-Lõpez J, Medina-Bravo P, Juárez-Sánchez F, Contreras-Ramos A, Galicia-Esquivel M, et al. 2015. Maternal obesity increases oxidative stress in the newborn. Obesity. 23: 1650-1654.
19. Yang W, Han F, Gao X, Chen Y, Ji L, Cai X. 2017. Relationship between Gestational Weight Gain and Pregnancy Complications or Delivery Outcome. Sci Rep. 71-79.
20. Fernández RAH, Collazo LV, Hernández SC, Cruz AL. 2015. Relationship between Maternal Obesity and Congenital Malformation in a Subpopulation of Havana. J Diabetes Metab. 6: 498.
21. Hassold TJ, Chen N, Funkhouser J, Jooss T, Manuel B, Matsuura JS, et al. 1980. A cytogenetic study of 1000 spontaneous abortions. Ann Hum Genet. 44: 151-178.

22. Kwinecka-Dmitriew B, Zakrzewska M, Latos-Bieleńska A, Skrzypczak J. 2010. Frequency of chromosomal aberrations in material from abortions. Ginekol Pol. 81: 896-901.

23. Leonard SA, Rasmussen KM, King JC, Abrams B. 2017. Trajectories of maternal weight from before pregnancy through postpartum and associations with childhood obesity. Am J Clin Nutr. 106: 1295-1301.

24. Rajappan A, Pearce A, Inskip HM, Baird J, Crozier SR, Cooper C, et al. 2017. Maternal body mass index: Relation with infant respiratory symptoms and infections. Pediatr Pulmonol. 52: 1291-1299.

25. Wilson RM, Messaoudi I. 2015. The impact of maternal obesity during pregnancy on offspring immunity. Mol Cell Endocrinol. 418: 134-142.

26. Rizzo GS, Sen S. 2015. Maternal obesity and immune dysregulation in mother and infant: A review of the evidence. Paediatr Respir Rev. 16: 251-257.

27. Ávila JGO, Echeverri I, de Plata CA, Castillo A. 2015. Impact of oxidative stress during pregnancy on fetal epigenetic patterns and early origin of vascular diseases. Nutr Rev. 73: 12-21.

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