Title : 모성의 비만, 임신 중 합병증과 유아의 건강

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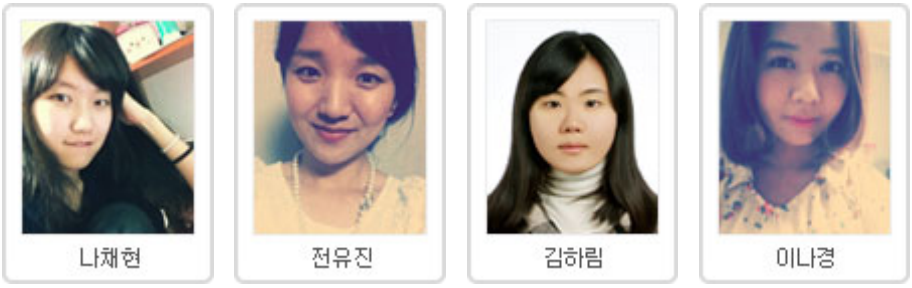

[1:48] Thank you very much for that introduction aside from confusion there, I was going to give you the same talk I was given to all of you yesterday.

[1:57] I'm sure you don't want to hear it for the second time.

[2:01] Today, we're focusing on maternal nutrition.

[2:05] And I've been asked specifically to talk with you about pregnancy… obesity during pregnancy and how that affects metabolism on the mother, effects on the offspring, and what we can do about it in terms of dietary interventions.

[2:27] I'd like to start, this is not in your book, this particular slide, but I decided this morning that it might be useful for me to tell you what the outset, what the take-home messages are, and then the rest of the talk is going to be giving you the evidence for these messages.

[2:47] And I hope that it will make it easier for you to follow me through this discussion.

[2:53] First of all, hopefully at the end of the talk, you will recognize that

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obese women are more likely to develop gestational diabetes and hypertension than non obese women during pregnancy.

[3:08] Also, babies of obese women are frequently larger at birth and are more likely to become obese themselves later in life.

[3:21] Why is this true?

[3:23] We think it's because the adipose tissue in obese mothers causes the mothers to develop a subclinical state of inflammation that leads to higher levels of blood glucose which leads to overfeeding the fetus with glucose during pregnancy.

[3:46] And how can we prevent that?

[3:49] We can encourage obese women to be more physically active, and to increase their dietary intake of complex carbohydrates and foods that are high in polyunsaturated fatty acids.

[4:04] These are the four things I'm going to try to demonstrate to you in my talk this afternoon.

[4:10] So first of all, now, the evidence, the prevalence of obesity in pregnant women has increased as it has in children and other segments of our population.

[4:23] In the united states, if we look at the incidents of obesity among women of reproductive age, that would be women between 18 to 40 years of age, we find that among the black women, using data from around 2000, about 50% are obese.

[4:45] This is up from 40% in the 1990.

[4:51] Hispanic women, the incidence is about 40%, and among white women, it's about 30%.

[5:00] So, across all ethnic groups of women of reproductive age, the incidence of obesity is around 35%.

[5:12] But obesity among women of reproductive age exists worldwide.

[5:18] It's not just in the United States.

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[5:20] And here are some international data, unfortunately I don't have data on Korea but maybe you can tell me the incidence of obesity among women of reproductive age in Korea.

[5:32] But you see, in the more developed countries around the world, the incidence of obesity is really quite high.

[5:41] And the country that gets the prize for having the highest incidence of obesity among women of reproductive age is Jordan.

[5:51] If you look at countries where they are still in developing states such as Bangladesh, you see this incidence is quite low.

[6:00] And then you look at Chile that is in a transition from being a developing country to a developed country, and you see it's up to the almost 25%.

[6:11] So, as economic situation of a country improves, it seems what goes with that is development of obesity in the population.

[6:26] Obese women are much more prone to have metabolic complications during pregnancy and one of the primary ones that you see among obese women is gestational diabetes.

[6:40] The national average for the incidence of gestational diabetes during pregnancy is 4%.

[6:49] However, if we separated out by BMI, you see these increases in stepwise fashion as the BMI grows up.

[7:00] So if the BMI is less than 20, just little over 1% get gestational diabetes.

[7:08] If they're overweight with the BMI between 25 and 30, about 2 and a half percent get gestational diabetes.

[7:17] If the BMI is above 30, it's up in 6%.

[7:22] But it is also influenced by ethnicity.

[7:27] And here, there is exception to the association with obesity.

[7:31] In the United States, the highest incident of gestational diabetes is

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seen among Asian women.

[7:40] And we think that they're must be related to genetic differences for the this point in time, no one has really sorted out what those differences are.

[7:53] And it's a study I am dying to do and hope to undertake one of those days.

[7:58] But you see the incidence of gestational diabetes among Asian women are over 7%, the next group that has the highest prevalence of obesity is the Hispanic women who often are obese as well.

[8:13] And then whites and blacks have similar rates of obesity.

[8:19] The hospital that I work in is currently doing a study on nutrition and obesity in a pregnancy in San Francisco general hospital, it is made primarily of Latina women, and the incidence among our obese Latino women with gestational diabetes is 16%.

[8:43] So it is a very common problem in that particular group.

[8:52] This slide gives you some data on the incidence of gestational diabetes across a wide spectrum of the population in the US.

[9:04] It is summary of meta-analysis of 20 studies on the incidence of gestational diabetes done between 1980 and 2006.

[9:15] And because it is meta-analysis of different studies, they did not use all same criteria for what they call obesity and severe obesity.

[9:27] Also, all of the studies did not adjust for other factors that influence the incidence of gestational diabetes in the same way.

[9:38] For example, a family history of diabetes predisposes the women to develop gestational diabetes.

[9:46] So that would be appropriate factor to adjust for.

[9:50] But that was not done in all of these studies.

[9:54] If you look at the data again, you see in the studies where they didn't adjust for other factors, the stepwise increase in the incidence of obesity with an increase in a body weight.

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[10:10] So that the severely obese which was roughly called, of BMI of greater than 35%, had an incidence above 8% in this group of unadjusted studies.

[10:25] If they are adjusted for other factors, it drops to about 5 to 6 percent.

[10:32] So I think the data are showing fairly clearly that gestational diabetes is associated with being obese during pregnancy.

[10:41] The other thing that has been observed over the last 20 years is that we have more big babies being born.

[10:51] A baby is classified as being big if it weighs over 4 kg at birth, which translates into 8 lb and 12 oz of weight.

[11:02] In other words, they are above 95 percentile for birth weight.

[11:09] And during the last 15 to 20 years, we see it in Denmark, there's been a 20% increase in large babies, Sweden 23%, Berlin 10%, Canada comes in at the top with 24%.

[11:27] In the US, the increase is nearly as large 9% among blacks, and 5% among whites.

[11:35] I suspect it's not as large in US and some other countries, because I think the birth weights in the US are probably higher than they were in some of these other countries at base line.

[11:48] However, they found that factors that was most associated with the increase in large babies was the maternal pregravid weight.

[12:02] As obesity became more prevalent, and mothers weigh more, there was greater tendency for a giving birth to a large baby.

[12:15] What is also quite interesting is there was little to no change in mean birth weight in this populations.

[12:25] You would think that they has this big increase in large babies that the mean birth weight should move up as well.

[12:33] But it did not.

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[12:34] The way I interpreted that to me, during that same period of time we've also have increase in delivery of preterm infants who are underweight, or small for gestational age.

[12:49] And so you put all of this together and you get no mean change in overall birth weight.

[12:56] So, this is the question that we are troubling over, is this increase in big babies related to maternal obesity?

[13:07] And those maternal alter fetal development?

[13:13] So that they are more likely to be overgrown in uterus, in other words, does developmental programming during pregnancy affect the development of infant more into a obese women, as well as what happens to underweight women.

[13:33] I know you're going to hear another talk later on this afternoon about fetal programming.

[13:37] So I'm just going to focus on how it might be influencing the development of large babies in a obese woman.

[13:46] But first, let me tell you a little bit about what developmental programming is.

[13:53] It's the permanent response of an organism to a stimulus or insult during a critical period of development.

[14:03] In other words, the development of baby in uterus is very plastic.

[14:10] It's not a fixed course.

[14:14] And if the mother is exposed in her environment to low oxygen supply for example, because she is living in high altitude, there will be developmental changes in her baby, so the baby can tolerate living at a high altitude more easily.

[14:33] If we have to go through genetic mutation every time our environment changed in order to exist helpfully in that environment, it would take too long and there will be too much wasting of lives trying to make the adjustment.

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[14:49] So we evolved with the plasticity, so we can make this adjustment very readily to whatever the environment is the mother is experiencing.

[15:00] And this occurs by making epigenetic changes in gene expression. In other words, DNA has a method group add to it. Usually on a certain [? 15:14] and map blocks of expression of that particular DNA and alters them the metabolism that result from that particular genes.

[15:26] We know that the changes during critical periods of development are irreversible and those critical periods are during the early stages of life placental implantation, embryonic cell differentiation, and during the fetal growth and development in the later stage of pregnancy and also during early infancy.

[15:49] The critical period for early infancy is not that well define. I have first four month on this slide. Some people think that it's less than four month, but we do know that how the infancy is [? 16:04] during early weeks or month of life has an impact on its programming.

[16:09] We've known for a long time that [? 16:15] programming occurs. We've known for over hundreds years that alligators have the gender of offspring born to alligators is influence by the temperature of the sand in which the eggs were laid.

[16:30] If the eggs are laid the surface of the sand so they are warmer, the offspring are male. If their done deeper into the sand or cooler, it is much more likely offspring are female. We might conclude from that maybe females are stronger than males. I don't know.

[16:59] Anyway, this has been known for a long time among reptiles and also birds, but the first real evidence that programming occurred in humans comes from some data were collected during World War II.

[17:14] During that period of time, it was found that Heat stroke among Japanese soldiers who were stationed in tropics occurred more commonly among those soldiers that were born in the northern part of Japan.

[17:31] And later they found out those particular soldiers had fewer sweat glands, and it has been found out the number of sweat glands that individual has is set in infancy by ambient temperature the infancy growth [? 17:53]. It does not change thereafter.

[17:58] I first became aware of that I was doing some studies in Africa on

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protein metabolism. I had studied protein metabolism in Berkely before going to Africa.

[18:09] And I knew the most of the nitrogen that is eliminated when you metabolized protein is excreted in urine, so we go to Africa doing nitrogen balance studies to do protein as protein requirements and we found very low amounts of nitrogen in urine and could not imagine why?

[18:30] Well, the study was done near the equator, it was very very warm and most of the nitrogen was being excreted in sweat. Therefore, there was very little in urine.

[18:42] So it makes difference our nutrition studies to know about some of this relationship.

[18:51] The Dutch famine during World War II provides with evidence that nutrition that the mother experiences during pregnancy has an effect on a development of the infant, and it's associated with development obesity in infant later in life.

[19:11] This data come from a study of 300,000 19 year old men who were in utero during the Dutch famine in 1944-45 where the total energy intake of the mother was around most 1900 calories a day.

[19:35] And they found out that if mother was in her first half of pregnancy during the seize when food was limited. It was much more likely that the man would be obese when they [? 19:53] into the army at 19 years of age.

[19:57] If she was in her last half of pregnancy, they could not find any effect on the development of obesity.

[20:05] However, study have been done since then have shown that if woman were in their pregnancy there is now the evidence that the offspring were much likely to develop type two diabetes.

[20:22] So the authors conclude deprivation in early pregnancy affected the differentiation of hypothalamic for we regulate our hunger and [? 20:33] feelings and alter subsequent food intake of the individual that led them to the development of obesity.

[20:42] It isn't just energy though that can affect the development of the [? 20:50]. These are some data from University of California at Davids done in

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mice not in humans where they look at the effect of depriving the [? 21:04] of Zinc during pregnancy and tested the effect on development of immune function in the offspring for three generations.

[21:16] Now we know the Zinc is essential for developing normal immune function. So it is not surprising if mice were fed losing diet from seven to of gestation to term, they had depression in their immune function.

[21:34] But what was really surprising was the children of these offspring and the grand children of these offspring also has depressed immune functions in comparison to the offspring of mice who had an adequate amount of Zinc in pregnancy.

[21:57] So this shows the development programming can persist for several generations.

[22:05] And some studies have been done now looking that the effect of dietary fat and its influence on development of the feeds there are some evidence that persist more than three generations maybe as long to five and seven generations.

[22:29] So back to our large newborn. Does the exposure to maternal obesity in utero cause developmental programming to increase risk of metabolic disease in the large baby later in life?

[22:47] Well, let me review some of the data with you. First, there is accumulating evidence big babies due tend to become big adults.

[23:00] Studies of maternal obesity in first trimester show there is doubling risk of child being overweight at 2 to 4 years old of age.

[23:29] Also there is evidence of maternal BMI can predict the incidence of childhood obesity, and higher birth weight predict overweight in teenagers, especially if mother had jus gestational diabetes.

[23:22] And it's been found nearly 50% of type two diabetes in youth can be attributed to intrauterine exposure to both diabetes and obesity.

[23:46] What is becoming evident in the work has been done is when you have diabetes and obese mother, this is very critical situation for predisposing particular child to obesity and diabetes later in life.

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[24:06] Here are some data from obese Pima Indian Mothers living in Arizona, and they did a study looking at the incidence of type two diabetes in siblings born to a mother before she got diabetes and after she got diabetes

[24:29] I don't know how much you know about our native Americans, but the prevalence of diabetes is extremely high in native Americans. Somewhere around 70% of native Americans have diabetes.

[24:44] What they found was that the number of infancy that first born infancy they were born before mother got diabetes was significantly lower.

[25:00] No, I'm saying this one. The incidence of type two diabetes infancy born before mother got diabetes was much lower than it was infancy was born to the mother after she got diabetes. In other words, seven of them got had diabetes whereas twenty one later in life if their mother had diabetes.

[25:22] Over here we look at the data from the father. You see there really is no evidence of whether the father had diabetes or not. So it's the mother that is creating the environment that leads to the increased risk of diabetes.

[25:42] So appearing the maternal obesity plus gestational diabetes does predispose to the development of obese diabetic offspring.

[25:55] Also, there data now showing the larger babies of woman with gestational diabetes are born with more body fat. This is the study done by doctor [? 26:09] where he measure the body fat other babies at birth.

[26:15] And a group of infancy that were appropriate weight when they were born and were born to woman with the normal glucose tolerance and he looked it large babies born to woman with normal glucose tolerance, and larger babies born to woman with gestational diabetes.

[26:34] You see the baby is born to the women who were just gestational diabetes had on average 16% body fat whereas those appropriate body size born to women without gestational diabetes was about 10%. 60% increase in body fat. In other word, these babies are born fat. They are already can be over fat at birth.

[27:04] There also evidence that large babies of mother with GDM are risk for development of metabolic syndrome. The metabolic syndrome is syndrome made up of hyper tension and high [? 27:24], high blood pressure as well as high levels of fasting glucose.

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[27:32] And so it is considered pre-diabetic state, and this particular study they compared metabolic syndrome in large gestational age baby versus those appropriate gestational age born to mothers with or without gestational diabetes.

[27:54] And they found if the infant was large at birth and born to a mother with GDM, that there was about a two full… an incidence about 50 percent of having Metabolic Syndrome which was at least two of the symptoms of a Metabolic Syndrome at 6 to 11 years of age.

[28:16] where it was much lower in the other group

[28:20] So it's beginning to look like these children, that are already at the pathway to becoming diabetic.

[28:28] So, in conclusion, there is an emerging evidence that large babies born to an obese mothers with GDM or impaired glucose tolerance are at risk for obesity and co-morbidities later in life.

[28:43] So what is the hypothesis

[28:45] of the underlined mechanism, that is causing this?

[28:52] And its thought that babies with a born increased the amount of body fat are also born with the resistance to leptin.

[29:01] One of the hormones that's involved in regulating appetite, and energy spendature

[29:09] which leads to hyperphagia, larger intakes, a decreased rates of fat oxidation.

[29:17] Insulin resistance, and eventually obesity and possibly diabetes later in life.

[29:25] We are very interested in this phenomena and had decided to undertake a study of obesity in pregnancy and try to [?29:37] what are the diabetic changes that are associated with obesity during pregnancy that could be contributing to fetal overgrowth.

[29:50] And we have come up with this hypothesis, it's a little bit simper than the one that we gave you, or I just gave you,

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[29:59] We hypothesizes that some cytokines that are secreted by placental and maternal adipose tissue induce maternal insulin resistance increasing fetal exposure to elevated maternal blood glucose levels and subsequent fat deposition

[30:15] We felt we had come up with a mechanism that immigrated excessive amount of body fat in an obese woman with being pregnant, to try to explain what is leading to the increase deposition of the fat in the fetus.

[30:36] And we think that it is cytokines that are secreted not only by the placental during pregnancy but also by adipose tissue

[30:45] That lead to maternal incident resistance,

[30:50] So there is a higher level of blood glucose going across the placenta so that the fetus is really over fat and has to deposit that extra glucose that's fat.

[31:02] So, what is the evidence that this hypothesis is the possible explanation?

[31:08] First we look to see that an obese woman has higher level of resistance during pregnancy.

[31:17] Or just the insulin sensitivity drop more during pregnancy

[31:22] So we did a study, in non-obese women and obese women, and we measured their insulin resistance at 12 weeks, 22 weeks, 28 weeks and 34 weeks of gestation

[31:39] It's very common for your insulin sensitivity to go down in pregnancy

[31:44] And you see that occurred in the [?31:47], it does come down.

[31:50] This is because the primary fuel for the fetus, the primary source of energy the fetus prefers is glucose.

[32:01] So the mother becomes insulin resistance to keep her glucose levels higher so they can defuse the [?32:09]

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[32:10] Not actively transported the [?31:12] it diffuses the [?32:14] and goes to the fetus.

[32:18] But we see though is in the obese woman, the drop of insulin sensitivity is about 65% whereas that of the mean woman is about 45%.

[32:35] Showing that they are even more insulin resistant and probably have higher glucose levels, and therefore more glucose is going to the fetus.

[32:46] So for many years, we debated what is it, the causes of this insulin resistance in pregnancy

[32:54] And if you go to the library and check out [?32:57] textbook, and look up insulin function pregnancy,

[33:02] Every single textbook will tell you that it is due to the hormones produced by the placenta.

[33:10] However, the group in [?33:11] that they are going to look at the side kinds as well as hormones.

[33:18] To see which one has the greatest fat on insulin sensitivity in pregnancy

[33:25] So they did a small study, only 15 women, 5 of whom were obese, with gestational diabetes.

[33:33] And you see, that they found a good, strong relationship between TNF-a, which is an inflammatory side kind,

[33:46] Is produced, not only by the placenta, but by adipose tissue by the mother and the fall and insulin sensitivity in pregnancy.

[33:57] In fact, the TNF-a explained 45% of variance in insulin sensitivity.

[34:08] Other factors that also explained the drop in insulin sensitivity, were Leptin and Cortisol

[34:16] Leptin is also produce by the placenta, and the adipose tissue, and Cortisol is produced by the placenta.

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[34:27] So these three factors accounted for about 60% of the variance in insulin sensitivity

[34:54] There was no evidence that human placenta [?34:32], and some other hormones produced by the placenta that we always stop because we are playing a role.

[34:46] So we decided to do a small study, to determine whether or not maternal obesity is associated with an increased roles of cytokines and its circulation

[34:57] And we recruited 67 women for the study, they were screened to be study for 28 weeks of gestation

[35:08] Their BMIs ranged from 21 to 54, so we had some large woman in our study, this woman came from [?35:17]

[35:20] They are pretty fat in San Francisco

[35:24] Well, but you see that the mean BMI was around 32 and that's true of 28 weeks of gestation

[35:32] The maternal BMI was associated with cytokines and adipocyte hormones which we found that correlated with significantly with [?35:44]

[35:33] The maternal BMI was associated with cytokines and adipocyte hormones, we found that they correlated significantly with active protein, which is an inflammation marker produced by the liver

[35:50] And it's secreted by the liver and responds to the cytokines all coming from the adipose tissue,

[35:57] But you also see the TNF-a, an inflammatory cytokines was associated with the BMI, and Leptin produced by the adipose tissue as well as the placenta was associated with BMI.

[36:12] IL-6 is a inter [?36:13] is an inflammatory cytokines but we did not find any association with BMI and IL-6.

[36:23] Well the crucial question in all of these is though whether or not

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maternal inflammation is associated with neonatal body fat.

[36:34] And so far, I've only been able to find one study that addresses this particular question

[36:42] In this particular study, done in Europe, they measured maternal IL-6 levels, and they also measured neonatal body fat

[36:53] I think I know why there are so few studies on this particular topic,

[36:59] It is very difficult to measure neonatal body fat.

[37:02] We have tried to do with the [?37:07] you have to have the infant lie really, really still in order to get a good measurement

[37:13] And somehow, a three to four days old infants doesn't understand when they need to be still so it's very difficult to get a good measurement

[37:24] But what these individuals find in the study was a step wide increase in inflammatory cytokines, IL-6, as the neonatal body fat increased in three tertiles.

[37:41] So there is some evidence that maternal cytokines levels can be associated with a body fat in the newborn but we need more studies in this area

[37:51] They also found in the study that the cold blood leptin levels were significantly associated with neonatal fat mass

[37:59] And that the higher fetal fat mass increased fatal leptin levels suggesting that there was a leptin resistance

[38:08] That there was a leptin resistance in the child at birth

[38:11] This would mean they are going to be less able to regulate their energy balance and to regulate their food intake

[38:20] Which will predispose them to obesity later in life

[38:24] OK, that's the evidence pretty much we have it right now

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[38:30] Currently, when obese woman come in for prenatal care, they get no special attention in the United States

[38:37] They are treated just like a mean pregnant woman

[38:41] And yet they are at such high risk for all metabolic disorders and for delivering babies that are over grown, that are at higher risks of becoming obese later in life.

[38:53] So maybe we should be planning some clinical interventions for obese woman, to reduce the prevalence of gestational diabetes and to break this vicious cycle of obese mothers having obese babies that have obese babies and this goes on and on.

[39:11] So there's three ways we could intervene, we could limit their weight gain

[39:19] we know from studies in non-pregnant individuals that if you get them to lose weight, their insulin sensitivity goes up

[39:27] And they are much less prone to a metabolic disease, diabetes.

[39:32] But people have been very nervous about telling woman that they can't gain weight

[39:38] However I am involved in the studying with the group of collaborators and organ right now

[39:43] For we're taking obese woman and asking them to maintain their weight during pregnancy

[39:50] Not gaining any additional weight

[39:52] So in a couple of years I will have to tell you what we found out

[39:55] The other thing we could do is to suggest that they be physically more active

[40:00] Or we could talk to them about the diet

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[40:04] And since I am a nutritionist, I am going to spend most of this time discussing potential dietary in her [?40:09]

[40:11] But before I do that, I want to say a few words about physical activities

[40:15] Because I think it's very important and we tend to overlook it

[40:19] Exercise improves insulin sensitivity

[40:25] I had a graduate student once who went to the doctor, she was pregnant, and the doctor said "Oh, it's look like you are going to develop gestational diabetes so I want you to go on a special diet"

[40:37] She came back to me and she was very upset

[40:40] Here she was a nutritionist of all things, and was going to get gestational diabetes

[40:46] And by the way it was an Asian woman

[40:48] I said, "Don't worry about it. Just walk an hour a day. Just walk an hour a day."

[40:53] So that's what she did, she went through the pregnancy fine, and she never developed gestational diabetes.

[41:00] So, a little bit of moderate activity can be very effective in improving insulin sensitivity.

[41:07] Data showed that exercise reduces the risk of GDM by about 2 fold in obese women

[41:14] It also reduces the TNF-α, the inflammatory cytokines, throughout pregnancy

[41:21] So there was less inflammation that will lead to the insulin resistance.

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[41:25] And an increased time and intensity of physical activity also lowered serum leptin levels

[41:32] Which made the programming changes in appetite among ..with.. of the fetus.

[41:39] So, don't forget exercise.

[41:41] Let's move on now to diet.

[41:45] The group in Harvard have been doing studies on diet patterns.

[41:51] And pregnancy outcomes.

[41:54] And they looked at diet patterns that are associated with the development of GDM,

[42:00] This was a prospective cohort study,

[42:03] Very large sample, 13,000 women

[42:07] And among these 13,000 women, little over 750 of them developed gestational diabetes over period of 8 years.

[42:18] They evaluated their food intake using a food frequency questionnaire

[42:24] And they compared different patterns of food intake across quintiles.

[42:32] All of the data I'm showing you here have been adjusted for BMI.

[42:36] So, we're just looking at the effect of the diet pattern alone.

[42:40] And you see, those women have followed the prudent diet.

[42:44] That's a diet that's high in whole grains, high in fruits, and vegetables.

[42:50] Had about a 40% decreased risk in developing gestational

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diabetes.

[42:57] Whereas those that were following the western diet had about a 60% increase

[43:02] A red meat diet, an almost 90% increase

[43:07] And processed meat, also, over 80% increase

[43:13] So, shifting a diet from western pattern to more prudent diet pattern looks like it could be effective in reducing the risk of GDM

[43:23] So let's talk a little bit more about the role of complex carbohydrates.

[43:27] Those are found in whole grains, steel cut oats, legumes, vegetables,

[43:32] I don't know if you have [?43:33] here in Korea, but all vegetables fall into that pattern and fruits.

[43:41] The same group at Harvard looked at the type of carbohydrate that was associated with the risk for developing gestational diabetes

[43:52] And they found, as it is been shown, that's the case for type 2 diabetes,

[43:58] That those foods considered high in fiber and lead to a high fiber intakes

[44:03] Such as serial fiber or fruit fiber reduces the risk of developing gestational diabetes.

[44:10] Whereas if one is consuming a diet that has been made up of foods with a high glycemic load

[44:16] That would be a diet high in refined carbohydrates and sugars

[44:22] So the blood sugar goes up readily after this is consumed

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[44:26] Had about a 60% increase risk of gestational diabetes

[44:33] We were interested to see if obese women responded as well to low glycemic diet, as slim women.

[44:42] So we took a group of obese women in yellow here and a group of 9 obese women

[44:49] And we fed them two breakfasts.

[44:53] One breakfast which had a very high glycemic load

[44:57] In fact it had so much sugar in it that the women didn't even like it very well

[45:01] And the other breakfast had a much lower glycemic load.

[45:05] Made up of whole grains

[45:09] The thing that is really interesting is, the first of all, you see,

[45:13] When you do the insulin levels after you fed the meal and glucose level,

[45:20] So, look at the area under the curve,

[45:22] In all cases, both for insulin and glucose, the levels are higher for the obese women than they are for the lean women

[45:31] But what is really encouraging is that when one feeds the obese woman,

[45:38] The lower glycemic meal she comes down to almost what was found in the lean women on a higher diet.

[45:45] For insulin, and for glucose it's far below.

[45:49] So you can lower insulin responses and you can lower blood glucose using diet in obese women.

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[45:57] We move on to a long-chain-poly-unsaturated-fatty-acids.

[46:04] And there are possible relationships to the development of gestational diabetes.

[46:10] These are the fats found in fatty cold water fish

[46:14] So just salmon, walnuts are excellent choice of the long chain fatty acids and flax seeds also.

[46:22] Canola, and soy products.

[46:26] As been found that a high ration of the poly unsaturated fatty acids to the saturated fatty acids

[46:35] Seems to be protective of developing the metabolic syndrome in non-pregnant individuals

[46:42] So, we're interested to see what its effect might be in a pregnancy.

[46:47] So, there are two studies that have been done, that have looked at this,

[46:53] One was the study done in North Carolina, where they looked at

[47:01] They did a food frequency at the second trimester, and out of the 1700 women studied,

[47:07] About 90 of them got gestational diabetes.

[47:11] And what they found was totally unexpected.

[47:15] Actually, this is wrong in your book. I noticed, so, you might want to change it.

[47:21] I… when I was reviewing my slides, this morning, I found the air.

[47:25] The risk for gestational diabetes dropped by 9% with every 100 calorie increase in carbohydrate.

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[47:37] That isn't what you would have expected to see.

[47:40] So, when they did some modeling, and they did in 50% increase in fat intake,

[47:47] While at the same time increasing the carbohydrate intake, by 50%

[47:54] They found that they can reduce the predicted risk of gestational diabetes by one half.

[48:02] Never before have we thought that high carbohydrate would reduce your risk for getting gestational diabetes.

[48:10] But I think this is reflecting the type of fat that the women in North Carolina eat.

[48:18] This is a part of the United States for their right to fry everything.

[48:21] In fact, if you go to county fair in North Carolina, they even dip fry over your cookies.

[48:29] And sell them at the fair, so they really like fried food.

[48:34] And I would suspect that most of them at the fair they were consuming saturated fat.

[48:39] The second study comes from a group of Italian women also where they had a 126 cases of GDM.

[48:51] And they looked at the relationship with intake of fat

[48:55] Both saturated and poly unsaturated

[48:58] And they found that the highest incidence of gestational diabetes was in the top quintile for the intake of saturated fat.

[49:07] And those women had a twofold increased risk

[49:10] Whereas the top quintile for the intake of poly unsaturated fat had a reduced risk for GDM by about 15 percent.

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[49:20] So I think it's suggesting that maybe the type of fat the women might consume is playing a role in risk for developing gestational diabetes.

[49:30] Here is the only study I know that has worked with this directly

[49:36] It's a study of Chinese women.

[49:40] Where they looked at the prevalence of impaired glucose tolerance not gestational diabetes

[49:47] But impaired glucose tolerance.

[49:49] And related it to their intake of poly unsaturated fatty acids.

[49:54] And you see that those women in the lowest tertile for intake of poly unsaturated fatty acids

[50:02] There was about 70% of them had impaired glucose tolerance.

[50:06] As the intake of poly unsaturated fatty acids were enough, the incidence dropped.

[50:13] Suggesting that the intake of poly unsaturated fatty acids maybe beneficial.

[50:20] So how do poly unsaturated fatty acids influence insulin function?

[50:26] Well, the short answer to that question is, we don't know.

[50:30] But we can speculate, it appears that unsaturated fatty acids can affect cell membrane

[50:38] Fatty acid composition and function that improves the translocation of glucose transporters,

[50:46] Influences cell membrane fluidity and ion permeability

[50:50] And therefore may have an impact on binding and affinity of the insulin receptor.

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[50:57] Other possible actions of poly unsaturated fatty acids are that they may inhibit hepatic lipogenesis

[51:05] Stimulate fatty acid oxidation which could improve insulin sensitivity,

[51:11] They may also reduce inflammation, which could reduce, ah… could improve insulin sensitivity.

[51:22] So now I want to go back a little bit to how much weight an overweight or obese women should gain during pregnancy.

[51:32] I put this slide here at the very end to give you the brand new data that have just been released by the Institute of Medicine

[51:41] about appropriate weight gain during pregnancy.

[51:44] And you see, that it's recommended that the obese women with a BMI greater than 30

[51:52] Should gain somewhere between 5 to 9 kilograms total

[51:57] Whereas a normal weight women is recommended to gain between an 11 and a half to 16

[52:02] The underweight women between 12 and a half and 18.

[52:06] So this predicted that obese women really do need to gain don't need to gain as much weight as normal weight women.

[52:16] Thus it's still a question as to whether or not they need to gain weight at all.

[52:23] If, and hopefully our study would be about to provide an answer to that particular question.

[52:29] So, let me conclude.

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[52:31] Maternal overweight or obesity is associated with increased of metabolic complications

[52:38] And possible fetal programming for obesity and diabetes later in life.

[52:43] It may be related to higher levels of circulating cytokines that influence insulin resistance

[52:51] And excessive amounts of fetal fuel and fat gain.

[52:57] And an increased intake of complex carbohydrates and possibly also polyunsaturated fatty acids

[53:06] May reduce the risk of maternal metabolic complications and excessive fat gain during pregnancy.

[53:14] So it's our hope that someday we will start advising obese women when they come in for prenatal care

[53:22] To increase the intakes of complex carbohydrates, increase their intake of polyunsaturated fatty acids,

[53:28] And go for a nice walk every day. Thank you very much.

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