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Findings on adiponectin, leptin and vitamin D in association with maternal & infant adiposity



Hamid Jan B. Jan Mohamed

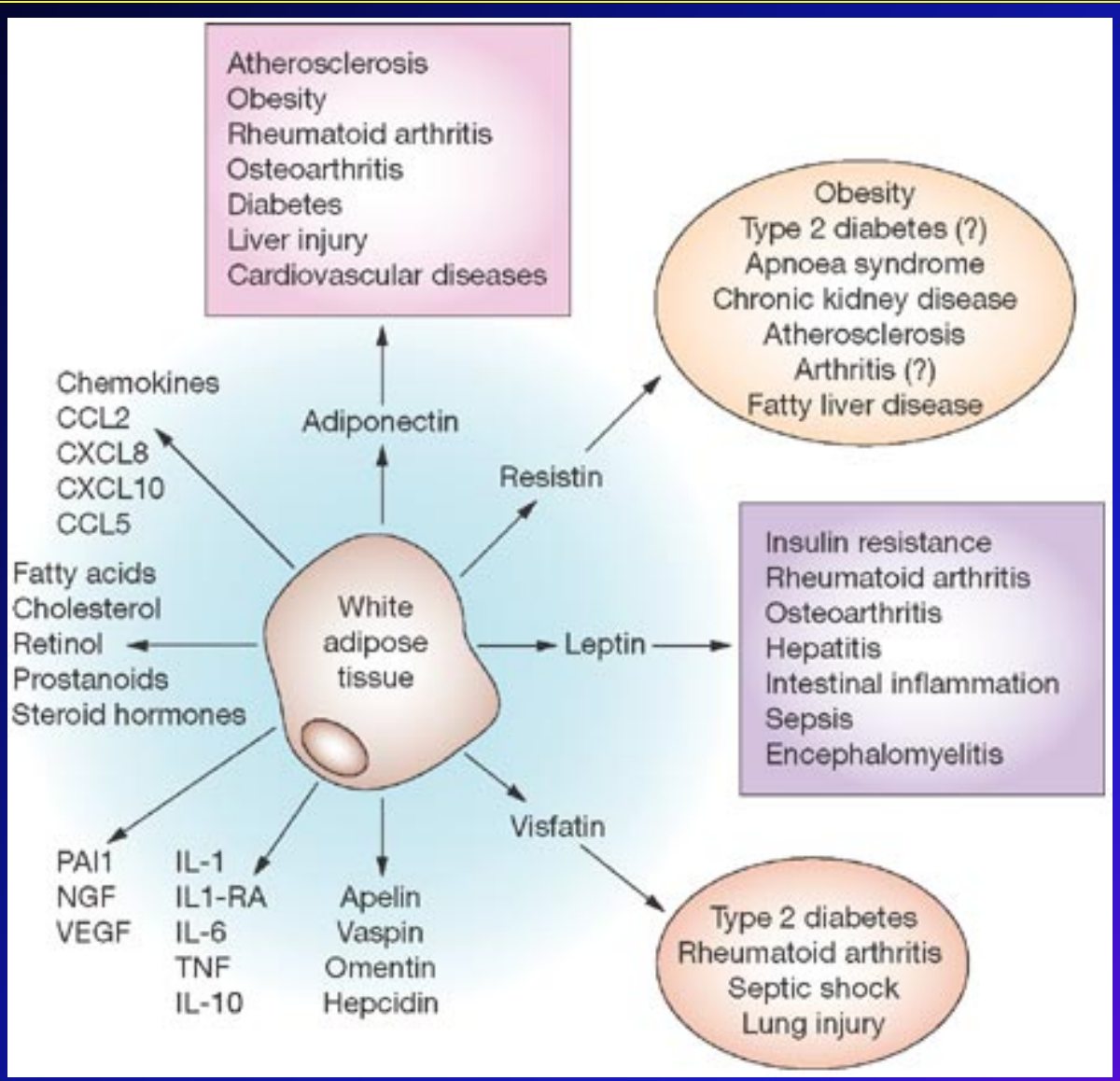
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OUTLINE

- Adipokines
- Adiponectin
- The USM Pregnancy Cohort Study findings
  - Adipokines
  - Vitamin D

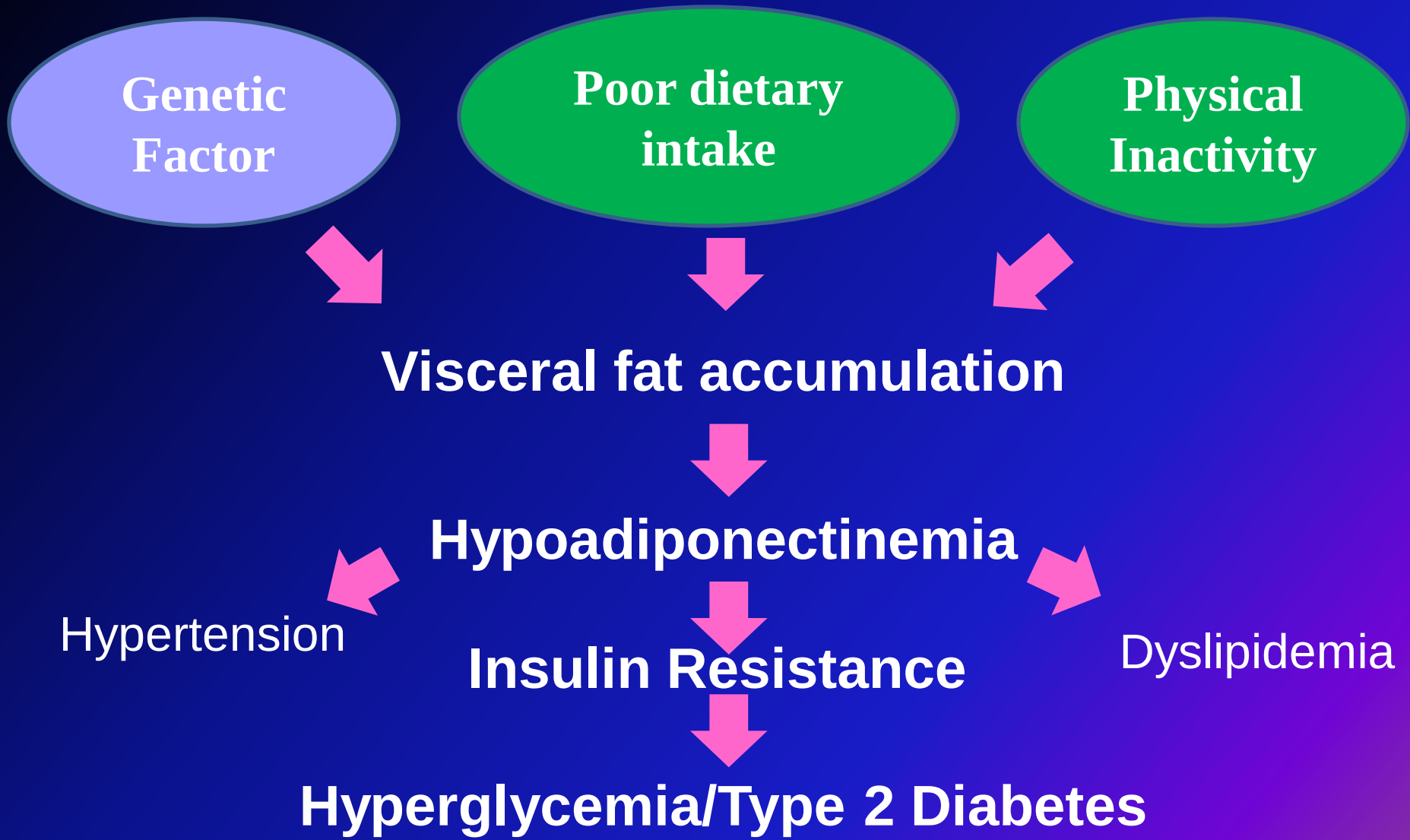
ADIPOKINES

The multiple functions of white adipose tissue include the synthesis and secretion of adipokines, and the uptake, storage and synthesis of lipids



Lago F *et al*. (2007) *Nat Clin Pract Rheumatol* **3:** 716–724.

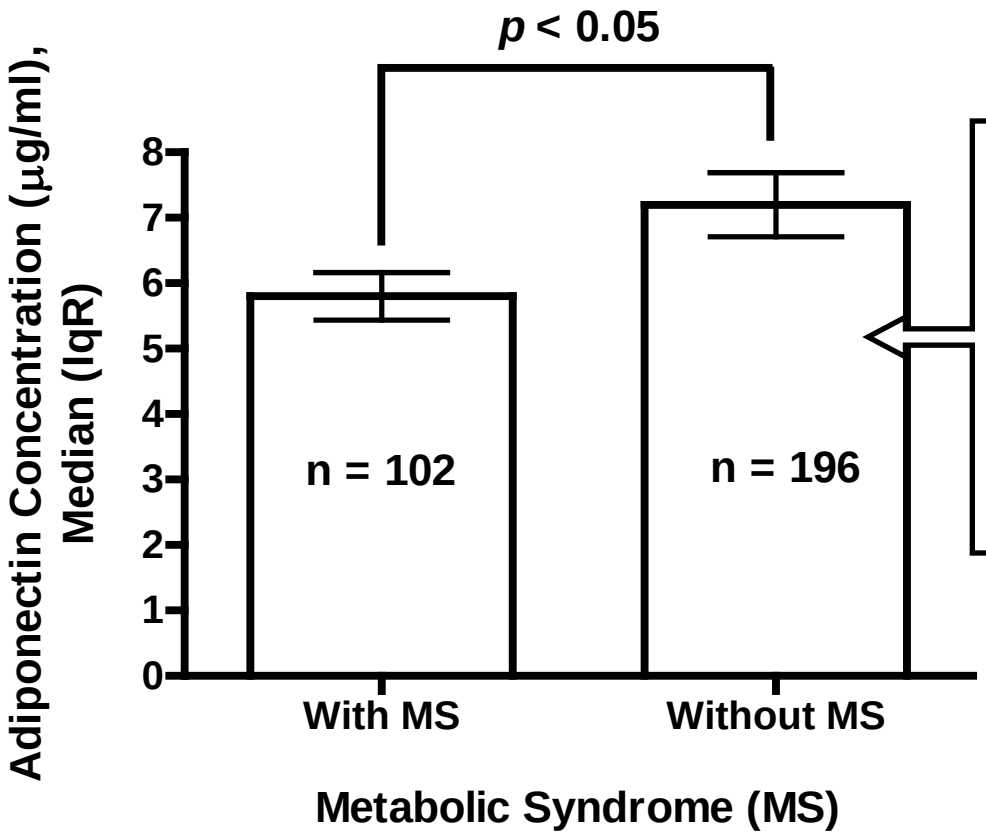
Adiponectin and Diabetes



(Ezenwaka et al. 2004)

Adiponectin: MetS vs. Healthy

The median (IqR) of adiponectin concentration among those with and without MetS (Mann-Whitney *U* test)



Finding:

- The median (IqR) of adiponectin concentration among those with and without MetS were 5.8 (3.7) µg/ml and 7.2 (6.8) µg/ml, respectively.

International Journal of Endocrinology and Metabolism. 2013 Summer; 11(3):167-174. DOI: 10.5812/ijem.8298

Published Online 2013 July 01. **Research Article**

Effect of Ethnicity, Dietary Intake and Physical Activity on Plasma Adiponectin Concentrations Among Malaysian Patients with Type 2 Diabetes Mellitus

Koo Hui Chin [1], Daniel Robert Sathyasurya [1], Hazizi Abu Saad [2], Hamid Jan B Jan Mohamed [1,*]

Table 5. Comparison of Adiponectin Concentration between Ethnicity with Relation to Their Dietary Intake and Physical Activity for Type 2 Diabetes Patients (n = 210)

	Adiponectin Concentration, µg/mL		
Groups	**Adj. Mean[a](95% CI)**	**F ratio [a]**	**P value [a]**
Ethnicity		9.32	0.003
Malay [b]	7.202 (6.298, 8.106)[b]		
Chinese	6.687 (5.799, 7.575)		
Indian [b]	5.597 (4.651, 6.544)[c]		

[a] Total MET score, fat, protein, carbohydrate and fiber adjusted.
[b] Test shows: Malay vs. Indian $P < 0.05$

Diet, PA and Adiponectin

Table 3. Pearson's Correlation Coefficients Between Plasma Adiponectin Concentrationwith Anthropometric Measurements, Biochemical Results, Dietary Intake and Physical Activity (n = 210)

Variables	Adiponectin Concentration	
	R	P value
Dietary Intake		
Calorie, mjoule	-0.14	0.054
Adjusted dietary carbohydrate, g	-0.12	0.056
Adjusted dietary protein, g	-0.05	0.458
Adjusted dietary fat, g	-0.11	0.102
Adjusted dietary fiber, g	-0.03	0.671
Physical Activity		
MET score	-0.18	0.007 [b]

Original Article

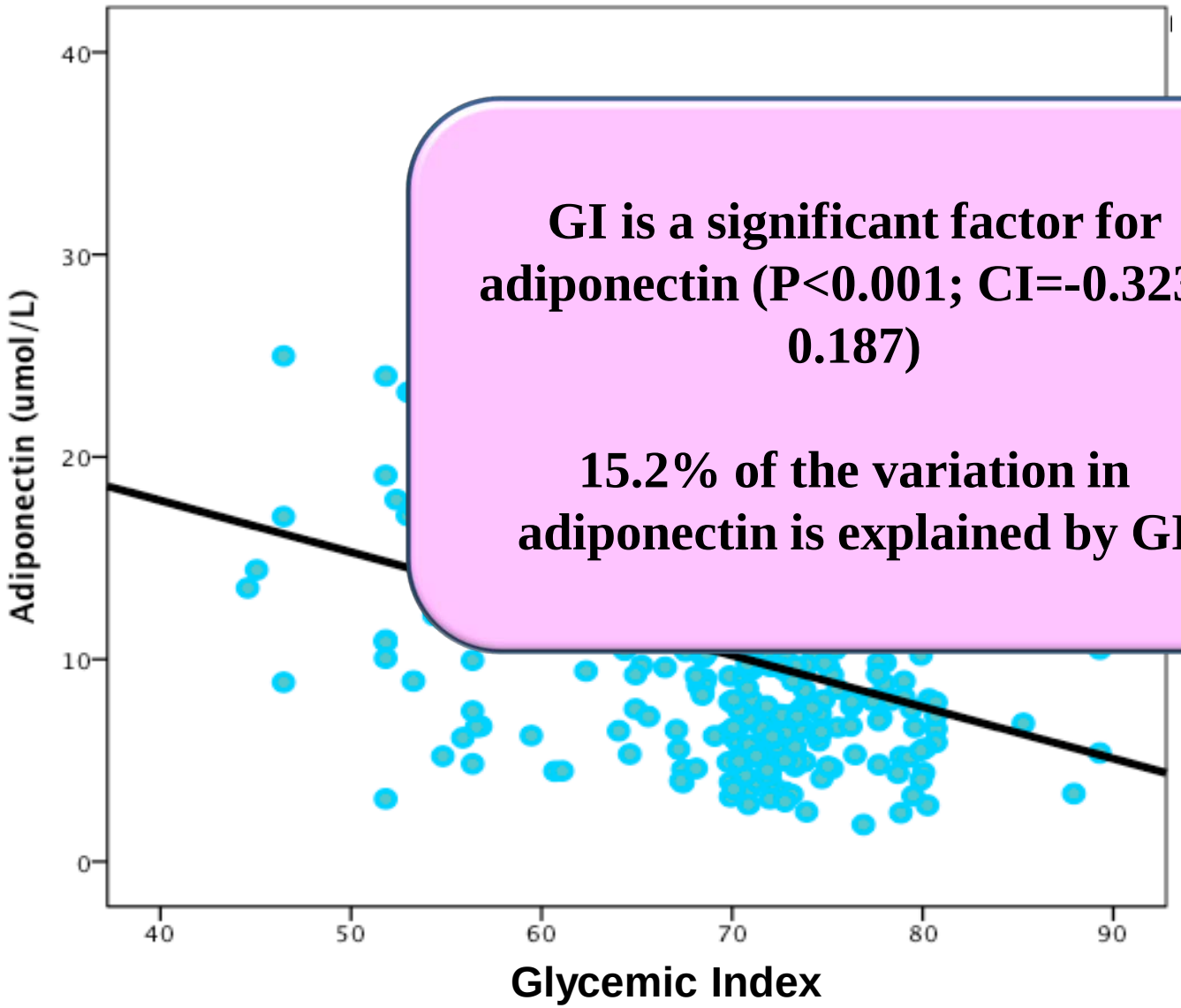
Plasma adiponectin concentrations are associated with dietary glycemic index in Malaysian patients with type 2 diabetes

Beng-In Loh BSc[1,3], Daniel Robert Sathyasurya MSc[2], Hamid Jan Jan Mohamed PhD[1]

[1]*Program in Nutrition, School of Health Sciences, Universiti Sains Malaysia, Health Campus, Kelantan, Malaysia*
[2]*Program in Dietetics, School of Health Sciences, Universiti Sains Malaysia, Health Campus, Kelantan, Malaysia*
[3]*Department of Dietetics and Dietary, Penang General Hospital, Ministry of Health, Malaysia*

Results

Simple Linear Regression Analysis



GI is a significant factor for adiponectin (P<0.001; CI=-0.323,-0.187)

15.2% of the variation in adiponectin is explained by GI

Results

Associated factors of adiponectin amongst individuals with T2DM (n=305)

Variables	Multiple Linear Regression	
	p-value	β (95% CI)
Glycemic index	<0.001**	- 0.272 (-0.262, -0.094)
Fiber	<0.001**	0.415 (0.155, 0.478)
Magnesium	<0.001**	- 0.408 (-0.035, -0.012)
Age	0.002*	0.162 (0.041, 0.181)
Sex	0.087	0.095 (-0.139, 2.054)
Race	0.294	- 0.052 (-1.060, 0.322)
BMI	0.267	0.091 (-0.071, 0.257)
WC	0.440	- 0.066 (-0.104, 0.045)
Smoking status	0.313	0.052 (-0.675, -2.100)
TG	<0.001**	- 0.238 (-1.883, -0.777)
HDL-C	0.072	0.092 (-0.088, 2.083)

Dependent variable: plasma adiponectin concentrations; β is

** Significant at the 0.001 level

One unit increase of GI will lead to a reduction of 0.3 µmol of adiponectin

Effects of prenatal adipokines levels on infant adiposity development during the first year of life

Objectives

To examine the association between maternal **serum adipokines** levels in the 2nd & 3rd trimesters and **breast milk adipokines** levels at birth & 2 months postpartum.

To investigate the effects of maternal serum & breast milk adipokines levels on **infant adiposity** development at birth, 2, 6 and 12 months of age.

Methods

- **Sample** : 152 mothers at 18 & 34 weeks' gestation
- **Serum adiponectin analysis**
  - Human Adiponectin Immunoassay Kit, Cat# 31010
  - Antibody and Immunoassay Services Center, the University of Hong Kong
- **Milk adiponectin analysis**
  - High Sensitive human Adiponectin Immunoassay Kit for Analysis of Milk Sample, Cat# 31013
  - Antibody and Immunoassay Services Center, the University of Hong Kong
- **Serum leptin analysis**
  - ALPCO Leptin ELISA, Cat# 11-LEPHU-E01
  - American Laboratory Products Company (ALPCO), USA

Statistical analysis

Test: **multiple linear regression**

Exposure variables:

- maternal adipokines levels at 2nd and 3rd trimesters
- Breast milk adiponectin levels at birth and 2 months postpartum

Outcome variables:

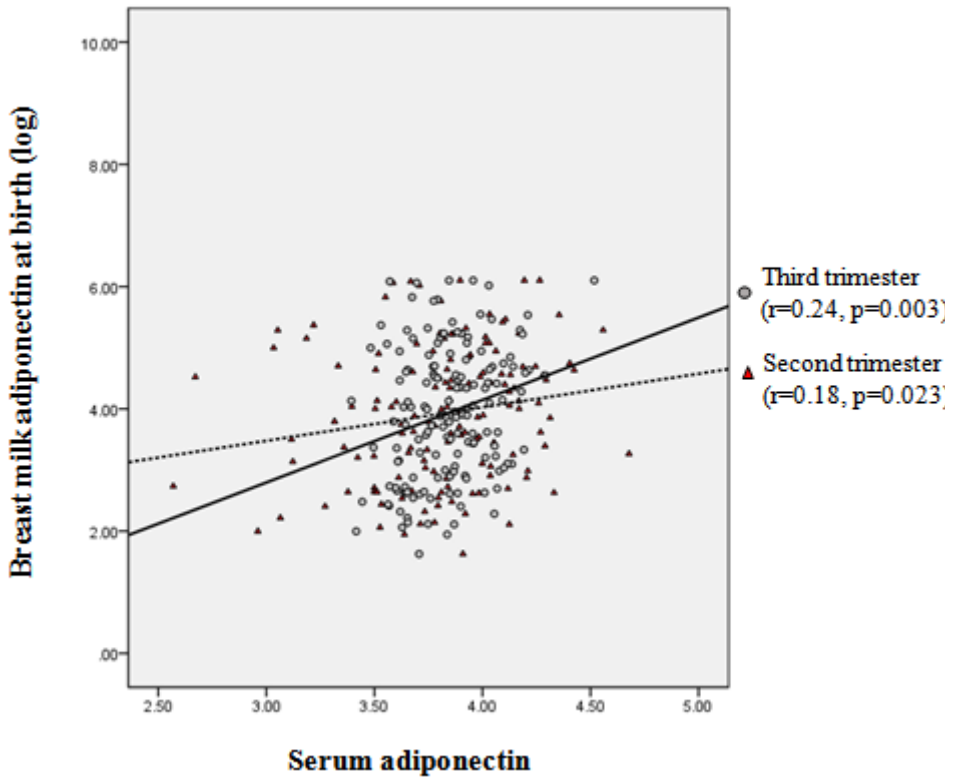
- Infant weight, BMI-for-age at birth, 2, 6, and 12 months of age; triceps skinfold at 6 and 12 months of age

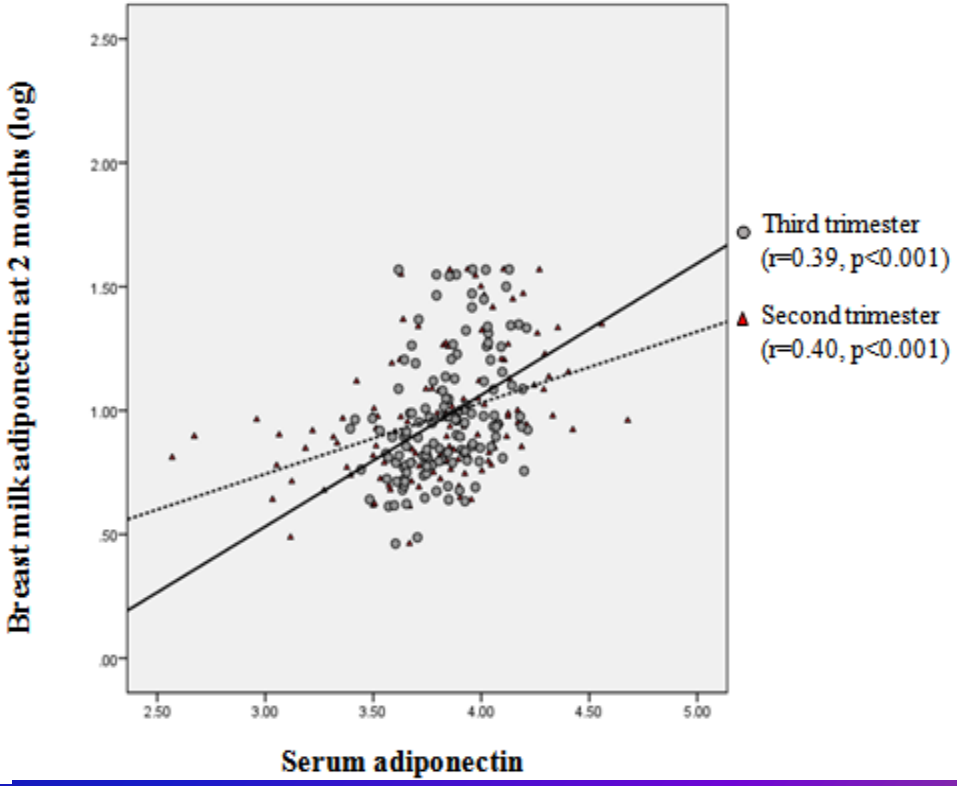
Maternal serum and breast milk adipokines at 2nd & 3rd trimesters of pregnancy

	Serum		P[c]
	Second trimester	Third trimester	
Adiponectin, µmol/L (n=151)	7.06 (4.35-10.91)	6.98 (4.78-9.12)	0.040
Leptin, nmol/L (n=130)	32.02 (22.02-51.92)	41.53 (28.88-55.62)	0.033
	Breast milk		
	0 month	2 month	
Adiponectin, nmol/L (n=135)	16.01 (9.63-23.07)	8.61 (6.29-13.11)	<0.001

Values presented as median (interquartile range).
p-value based on Student's paired t-test.

Correlation between maternal serum adiponectin levels at 2nd & 3rd trimesters of pregnancy and breast milk adiponectin levels at birth & 2 months postpartum





Regression coefficients (*p*-values) of maternal serum adiponectin levels at 2nd & 3rd trimesters of pregnancy on breast milk adiponectin level

	Breast milk adiponectin (nmol/L)			
Serum adiponectin (µmol/L)	At birth (n=149)		2 months (n=134)	
	Simple regression	Multiple regression[a]	Simple regression	Multiple regression[a]
Second trimester	0.58 (0.023)	-	0.31 (<0.001)	0.16 (0.034)
Third trimester	1.35 (0.003)	1.13 (0.009)	0.53 (<0.001)	0.40 (0.005)
R^2, %	-	18.3	-	21.1

[a] Adjusted for maternal age and duration of milk

Data were log-transformed before performing linear regression analysis

Regression coefficients (*p*-value) of maternal serum and breast milk adipokines on infant **body weight**

Adipokines	Infant body weight (kg)							
	At birth (n=149)		2 months (n=136)		6 months (n=146)		12 months (n=142)	
	Simple regression	Multiple regression[a]	Simple regression	Multiple regression[b]	Simple regression	Multiple regression[c]	Simple regression	Multiple regression[c]
Serum								
Second trimester								
Adiponectin, µmol/L	-0.22 (0.023)	-	-0.29 (0.047)	-	-0.61 (0.001)	-0.59 (0.002)	-0.59 (0.010)	-
Leptin, nmol/L	0.01 (0.487)	-	0.02 (0.513)	-	0.02 (0.612)	-	0.07 (0.129)	-
Third trimester								
Adiponectin, µmol/L	-0.54 (0.002)	-0.47 (0.004)	-0.44 (0.097)	-	-1.05 (0.002)	-	-1.18 (0.005)	-1.02 (0.009)
Leptin, nmol/L	-0.03 (0.216)	-	-0.05 (0.081)	-	-0.04 (0.320)	-	-0.03 (0.578)	-
Breast milk								
At birth								
Adiponectin, nmol/L	-	-	-0.00 (0.985)	-	0.00 (0.947)	-	0.03 (0.741)	-
2 months								
Adiponectin, nmol/L	-	-	-0.61 (0.002)	-0.54 (0.003)	-0.30 (0.273)	-	0.02 (0.956)	-
R^2, %	-	18.1	-	30.1	-	23.7	-	23.8

[a] Adjusted for gestational weight gain, gestational age, infant sex and maternal age

[b] Adjusted for gestational weight gain, gestational age, infant sex and prepregnancy Body Mass Index

[c] Adjusted for gestational weight gain, gestational age, infant sex, prepregnancy Body Mass Index and breastfeeding practice

Data were log-transformed before performing analysis

Regression coefficients (*p*-value) of maternal serum and breast milk adipokines on infant **body mass index-for-age**

Adipokines	Infant body mass index-for-age (Z-scores)							
	At birth (n=152)		2 months (n=135)		6 months (n=145)		12 months (n=142)	
	Simple regression	Multiple regression[a]	Simple regression	Multiple regression[b]	Simple regression	Multiple regression[b]	Simple regression	Multiple regression[c]
Serum								
Second trimester								
Adiponectin, µmol/L	-0.82 (0.009)	-0.87 (0.006)	-0.43 (0.040)	-	-0.58 (0.012)	-0.62 (0.009)	-0.48 (0.038)	-
Leptin, nmol/L	0.06 (0.316)	-	-0.79 (0.006)	-	0.01 (0.846)	-	0.05 (0.335)	-
Third trimester								
Adiponectin, µmol/L	-1.64 (0.003)	-	-0.43 (0.258)	-	-0.76 (0.067)	-	-0.99 (0.021)	-1.00 (0.018)
Leptin, nmol/L	-0.09 (0.178)	-	-0.07 (0.115)	-	-0.03 (0.486)	-	-0.05 (0.329)	-
Breast milk								
At birth								
Adiponectin, nmol/L	-	-	0.06 (0.364)	-	0.04 (0.585)	-	0.06 (0.453)	-
2 months								
Adiponectin, nmol/L	-	-	-0.79 (0.006)	-0.79 (0.008)	-0.06 (0.861)	-	-0.02 (0.946)	-
R^2, %	-	9.4	-	6.3	-	6.0	-	9.1

[a] Adjusted for gestational weight gain, gestational age, infant sex and maternal age
[b] Adjusted for gestational weight gain and infant sex
[c] Adjusted for gestational weight gain, infant sex and breastfeeding practice
Data were log-transformed before performing analysis

Regression coefficients (*p*-value) of maternal serum and breast milk adipokines on infant **triceps skinfold**

Adipokines	Infant triceps skinfold (cm)			
	6 months (n=149)		12 months (n=131)	
	Simple regression	Multiple regression[a]	Simple regression	Multiple regression
Serum				
Second trimester				
Adiponectin, µmol/L	-0.86 (0.033)	-1.00 (0.017)	0.01 (0.988)	-
Leptin, nmol/L	-0.09 (0.278)	-	-0.05 (0.466)	-
Third trimester				
Adiponectin, µmol/L	-0.99 (0.177)	-	0.19 (0.781)	-
Leptin, nmol/L	-0.03 (0.773)	-	-0.11 (0.165)	-
Breast milk				
At birth				
Adiponectin, nmol/L	-0.14 (0.302)	-	-0.11 (0.344)	-
2 months				
Adiponectin, nmol/L	0.12 (0.840)	-	0.62 (0.223)	-
R^2, %	-	4.1	-	-

[a] Adjusted for prepregnancy Body Mass Index

Data were log-transformed before performing linear regression analysis

Conclusion

- Serum adiponectin was correlated with breast milk adiponectin
- Adiponectin level decreases overtime during pregnancy and lactation
- Maternal serum and milk adiponectin was associated with infant growth

Effects of Prenatal Adipokines on First year Postpartum Weight Retention

Objective

To examine the associations of **prenatal adipokine levels** in the 2nd and 3rd trimesters with **maternal weight retention** at 2 months, 6 months and 12 months postpartum

Methods

- **Sample** : 140 mothers at 18 & 34 weeks' gestation

- **Serum adiponectin analysis**
  - Human Adiponectin Immunoassay Kit, Cat# 31010
  - Antibody and Immunoassay Services Center, the University of Hong Kong

- **Serum leptin analysis**
  - ALPCO Leptin ELISA, Cat# 11-LEPHU-E01
  - American Laboratory Products Company (ALPCO), USA

Statistical analysis

Test: **multiple linear regression**

Exposure variables: maternal adiponectin and leptin levels at 18 & 34 weeks' gestation

Outcome variables: weight retention at 2 months, 6 months and 12 months postpartum

Associations between prenatal adipokines levels and postpartum weight retention

Prenatal factors	Postpartum weight retention (kg)					
	2 months (n=140)		6 months (n=136)		12 months (n=134)	
	Simple regression	Multiple regression[b]	Simple regression	Multiple regression[c]	Simple regression	Multiple regression[c]
Second trimester						
Serum adiponectin, μmol/L	2.58 (0.015)	-	0.96 (0.312)	-	0.61 (0.488)	-
Serum leptin, nmol/L	-0.59 (0.005)	-0.43 (<0.001)	-0.36 (0.052)	-0.44 (0.013)	-0.13 (0.462)	-
Third trimester						
Serum adiponectin, μmol/L	-0.37 (0.848)	-	-0.80 (0.645)	-	-0.94 (0.555)	-
Serum leptin, nmol/L	0.48 (0.033)	-	0.12 (0.573)	-	0.07 (0.718)	-

Adjusted for maternal age, parity, breastfeeding pattern, prepregnancy BMI, gestational weight gain rate, physical activity and calorie intake

Conclusion

- Maternal adiponectin levels during pregnancy were not associated with first year postpartum weight retention.
- Reduced maternal leptin level at second trimester was associated with increased weight retention at 2 months and 6 months postpartum.
- In comparison to adiponectin, leptin at mid pregnancy has a more pronounce effect on postpartum weight retention.

Maternal Serum and Breast Milk Vitamin D Levels

OPEN ACCESS Freely available online

PLOS ONE

Maternal Serum and Breast Milk Vitamin D Levels: Findings from the Universiti Sains Malaysia Pregnancy Cohort Study

Hamid Jan Jan Mohamed[1]*, Angela Rowan[2], Bertram Fong[3], See-Ling Loy[1]

1 Nutrition Program, School of Health Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia, **2** Fonterra Co-operative Group Ltd, Palmerston North, New Zealand, **3** Fonterra Research and Development Centre, Palmerston North, New Zealand

Objectives

- To assess the **adequacy** of maternal vitamin D status by measuring maternal serum and breast milk 25-hydroxyvitamin D [25(OH)D] levels.
- To determine the association between maternal **serum** and **breast milk** 25(OH)D levels.

Methods

- **Sample size:** 102 pregnant women, aged 19-40 years
- **25(OH)D analysis:**
  - Blood samples were drawn at 18 & 34 weeks' gestation
  - Breast milk samples were collected at delivery, 2, 6 and 12 months postpartum were collected to analyze for 25(OH)D levels
  - Performed by High Performance Liquid Chromatography (HPLC)
  - Depending on maternal serum 25(OH)D levels, the women were categorized as severe vitamin D deficiency (<25 nmol/L), mild vitamin D deficiency (25 to <50 nmol/L), vitamin D insufficiency (50 to <75 nmol/L) and vitamin D sufficiency (≥75 nmol/L)

Statistical analysis

Data was analyzed using IBM SPSS statistics, Version 19.0 (USA). Finding at $p<0.05$ for a two-sided test was considered statistically significant.

Paired t-test

- To compare differences in serum 25(OH)D between 2nd & 3rd trimesters of pregnancy

One-Way ANOVA

- To compare differences in serum 25(OH)D levels according to maternal factors

Repeated measures ANOVA

- To compare differences in breast milk 25(OH)D levels during the first year lactation

Statistical analysis

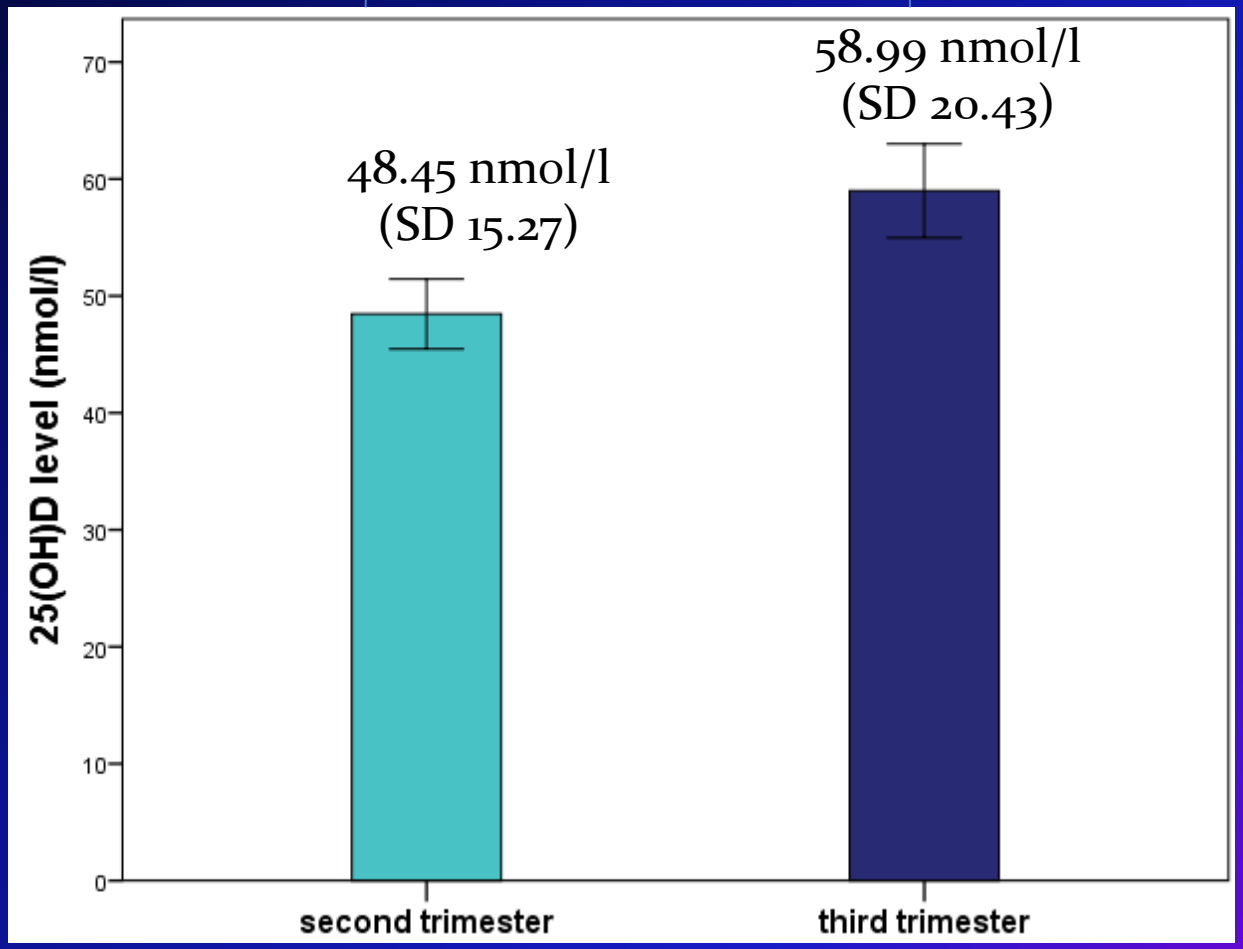
Multiple linear regression

- To examine the association between **maternal factors** (independent variable) and **serum 25(OH)D levels** (dependent variables)

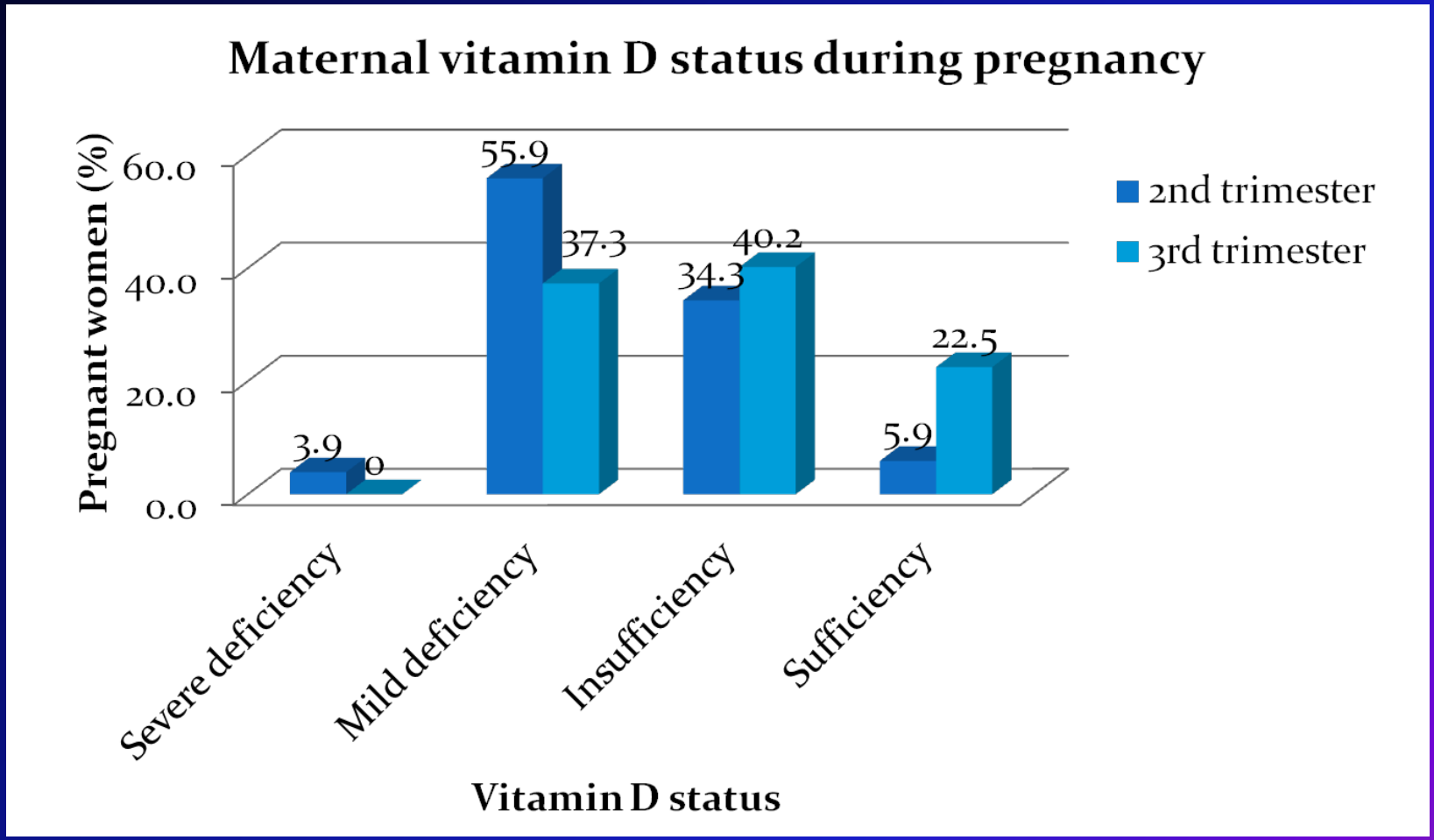
- To examine the association between maternal **serum** (independent variable) and **breast milk 25(OH)D levels** (dependent variable).

Maternal 25(OH)D levels in the 2nd & 3rd trimesters of pregnancy

p<0.001



Results


Maternal vitamin D status during pregnancy
Pregnant women (%)
60.0
40.0
20.0
0.0
3.9
0
55.9
37.3
34.3
40.2
5.9
22.5
2nd trimester
3rd trimester
Severe deficiency
Mild deficiency
Insufficiency
Sufficiency
Vitamin D status

Associations between maternal factors during pregnancy and serum 25(OH)D levels

Maternal factors	Serum 25(OH)D in the second trimester, nmol/L[a]		Serum 25(OH)D in the third trimester, nmol/L[a]	
	β (95% CI)	p	β (95% CI)	p
Prepregnancy BMI, kgm^{-2}	−0.06 (−0.74,0.62)	0.855	−0.40 (−1.37,0.57)	0.413
Maternal BMI, kgm^{-2}	−0.20 (−0.90,0.49)	0.562	−0.68 (−1.69,0.33)	0.186
Multivitamin intake	9.16 (2.79,15.53)	**0.005**	13.65 (4.73,22.57)	**0.003**
Dietary calcium, mg/day	0.002 (−0.01,0.01)	0.706	−0.01 (−0.02,0.01)	0.281
Activity score, Mets (log unit)	−1.95 (−4.60,0.71)	0.148	2.18 (−2.20,6.55)	0.326

BMI = body mass index, Mets = metabolic equivalents. Bold print shows significant $p<0.05$.
[a]Adjusted for maternal age and gestational age.

Adjusted for maternal age and gestational age.

The 25(OH)D levels of breast milk

Postnatal age	n	25(OH)D levels of breast milk, mean (95% CI)	
		nmol/L	IU/L
At delivery[a]	101	1.26 (1.09, 1.42)	20.16 (17.51, 22.81)
2 months	90	1.18 (1.09, 1.27)	19.21 (17.70, 20.73)
6 months	69	1.01 (0.99, 1.04)	16.39 (15.93, 16.86)
12 months	49	1.16 (1.02, 1.31)	18.80 (16.41, 21.19)

Comparison of breast milk 25(OH)D levels at different stages during the first year of lactation

Comparison	25(OH)D levels of breast milk (nmol/L), mean difference (95% CI)	p
At delivery – 2 months	0.17 (−0.29, 0.63)	>0.95
At delivery – 6 months	0.31 (−0.09, 0.72)	0.228
At delivery – 12 months	0.19 (−0.27, 0.64)	>0.95
2 months – 6 months	0.15 (−0.06, 0.35)	0.307
2 months – 12 months	0.02 (−0.27, 0.31)	>0.95
6 months – 12 months	−0.13 (−0.34, 0.09)	0.657

Associations between maternal serum and breast milk 25(OH)D levels

Maternal serum 25(OH)D levels, nmol/L	25(OH)D levels of human milk, nmol/l (log)							
	At delivery		2 months		6 months		12 months	
	β	p	β	p	β	p	β	p
Second trimester	0.002 (0,0.003)	**0.026**	0 (-0.001,0.001)	0.591	0 (-0.001,0.001)	0.639	-0.001 (-0.002,0.001)	0.389
Third trimester	0.001 (0,0.002)	0.098	0 (-0.001,0.001)	0.622	0 (-0.001,0.001	0.241	0.001 (-0.001,0.002)	0.424

Adjusted for maternal age and prenatal multivitamin intake

Conclusion

- Prevalence of vitamin D insufficiency was high among the pregnant women.
- Maternal vitamin D status during mid gestation is potentially affecting vitamin D level in breast milk at delivery and thereby, may influence vitamin D status of the breastfed infants in their early life.



Arigatou gozaimashita （ありがとうございました）

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