UNIVERSITI PUTRA MALAYSIA

FACTORS ASSOCIATED WITH VITAMIN D AND GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN IN SELECTED MATERNAL AND CHILD HEALTH CLINICS IN SEREMBAN, NEGERI SEMBILAN, MALAYSIA

LALITHA PALANIVELOO

FPSK(m) 2021 1

FACTORS ASSOCIATED WITH VITAMIN D AND GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN IN SELECTED MATERNAL AND CHILD HEALTH CLINICS IN SEREMBAN, NEGERI SEMBILAN, MALAYSIA

By

LALITHA PALANIVELOO

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

February 2021

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

FACTORS ASSOCIATED WITH VITAMIN D AND GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN IN SELECTED MATERNAL AND CHILD HEALTH CLINICS IN SEREMBAN, NEGERI SEMBILAN, MALAYSIA

By

LALITHA PALANIVELOO

February 2021

Chairman : Professor Zalilah Mohd Shariff, PhD
Faculty : Medicine and Health Sciences

The prevalence of Vitamin D deficiency (VDD) is high among pregnant women in Malaysia despite abundance of sunlight all year round. VDD had been associated with many adverse effects in pregnancy and one of them is gestational diabetes mellitus (GDM). Thus, this study aimed to investigate the association between Vitamin D status in first trimester with GDM among pregnant women in selected maternal and child health clinics in Seremban, Negeri Sembilan.

This study was a part of the 'Seremban Cohort Study (SECOST): A prospective study of determinants and pregnancy outcomes of maternal glycemia in Malaysia'. In this study, 170 pregnant women were recruited using purposive sampling method from Senawang and Ampangan Maternal and Child Health Clinics in Seremban, Negeri Sembilan between 2014 - 2015 and followed-up until 2016. A set of pre-tested Malay language interviewer-administered questionnaire was used to obtain information on demographic, socio-economic, dietary intake and physical activity. Obstetrical data were obtained from the antenatal cards of the women. Height and weight of the women were measured in the clinics at the study enrollment (<10 weeks), during Visit 1 (10-14 weeks of gestation) and Visit 2 (24-30 weeks of gestation).

Blood samples were obtained during Visit 1 to quantify serum 25-Hydroxy Vitamin D [25(OH)D] and during Visit 2 for a standard 75g Oral Glucose Tolerance Test (OGTT). VDD is defined as serum 25(OH)D <50nmol/L. GDM is diagnosed if fasting plasma glucose ≥ 5.6 nmol/L or 2-hours post prandial plasma glucose ≥ 7.8 nmol/L. All data were analysed using SPSS version 22 and significant level was set at $p<0.05$. Logistic regression was performed to determine the association between serum Vitamin D status in first trimester and GDM.

The prevalence of VDD in first trimester and GDM in the present study was 93% and 14.1% respectively. Pregnant women who had pre-pregnancy BMI of overweight/ obese were 6 times more likely to have mild VDD compared to pregnant women with normal BMI while pregnant women with a family history of Type 2 Diabetes Mellitus (T2DM) were 3 times more likely to have GDM compared to pregnant women who do not have any family history of T2DM. In this study, pregnant women with GDM had a significantly higher mean Vitamin D level compared to non-GDM pregnant women in bivariate analysis. However, serum Vitamin D status was not significantly associated with GDM in the multivariate analysis. In the study, pregnant women with GDM had a higher mean pre-pregnancy BMI and age compared to non-GDM pregnant women. These two factors could have contributed to the onset of GDM regardless of Vitamin D level. A more comprehensive study with a bigger sample size is suggested to obtain concrete evidence on the association between VDD in pregnancy and GDM as only 24 women were diagnosed with GDM in this study.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

FAKTOR BERKAITAN DI ANTARA VITAMIN D DAN 'GESTATIONAL DIABETES MELLITUS' DI KALANGAN IBU HAMIL DI KLINIK KESIHATAN IBU DAN ANAK TERPILIH DI SEREMBAN, NEGERI SEMBILAN, MALAYSIA

Oleh

LALITHA PALANIVELOO

Februari 2021

Pengerusi : Profesor Zalilah Mohd Shariff, PhD
Fakulti : Perubatan dan Sains Kesihatan

Prevalens kekurangan Vitamin D dalam kalangan ibu hamil di Malaysia adalah tinggi walaupun terdapat pancaran matahari sepanjang tahun di negara ini. Kekurangan Vitamin D dikaitkan dengan pelbagai masalah kesihatan dalam kehamilan, di antaranya adalah 'gestational diabetes mellitus' (GDM). Oleh itu, kajian ini dijalankan untuk mengkaji perkaitan di antara status Vitamin D pada trimester pertama kehamilan dan GDM dalam kalangan ibu hamil di klinik kesihatan yang terpilih di Seremban, Negeri Sembilan.

Kajian ini adalah sebahagian daripada 'Seremban Cohort Study (SECOST)' Kajian Kohort Perspektif Faktor Penentu dan Kesan Status Glukosa Darah Ibu Hamil Terhadap Kehamilan di Malaysia. Kajian ini melibatkan 170 ibu hamil yang dipilih menggunakan kaedah persampelan bertujuan dari Klinik Kesihatan Ibu dan Anak Senawang dan Ampangan sepanjang tahun 2014 – 2015 dan mereka disusuli sehingga tahun 2016. Borang soal selidik yang telah dibuat pra uji dalam bahasa Melayu digunakan untuk mendapat maklumat sosio-demografi, pemakanan dan aktiviti fizikal menggunakan borong soal-selidik dalam Bahasa Melayu yang telah dipra-uji manakala data obstetrik diperolehi melalui kad antenatal. Pengukuran berat dan tinggi diambil untuk kali pertama semasa responden mula menyertai kajian (<10 minggu kehamilan), temujanji 1 (minggu ke-10 hingga ke-14) dan seterusnya pada temujanji 2 (minggu ke-24 hingga ke-30 kehamilan).

Sampel darah diambil semasa temujanji pertama untuk analisis tahap serum 25-Hydroxy Vitamin D [25(OH)D] manakala ujian standard 75g oral glukos tolerans (OGTT) dibuat semsa temujanji kedua. Kekurangan Vitamin D ditakrifkan sebagai tahap serum 25(OH)D <50nmol/L manakala GDM ditakrifkan apabila tahap glukosa darah berpuasa

ibu hamil ≥ 5.6 nmol/L atau tahap glukosa darah selepas 2 jam pengambilan glukos ≥ 7.8 nmol/L. Kesemua data dianalisis menggunakan perisian statistik SPSS versi 22 dan tahap signifikan ditetapkan pada $p<0.05$. Regresi logistik dijalankan untuk menentukan perkaitan antara serum Vitamin D di trisemester pertama dan GDM.

Prevalens kekurangan Vitamin D dalam trimester pertama dan GDM yang diperolehi melalui kajian ini adalah 93% dan 14.1%. Ibu hamil yang berlebihan berat badan /obes sebelum mengandung mempunyai 6 kali lebih tinggi risiko untuk mengalami kekurangan Vitamin D yang sederhana berbanding ibu hamil yang mempunyai berat badan normal manakala ibu hamil yang mempunyai sejarah keluarga diabetes melitus jenis 2 (T2DM) mempunyai 3 kali lebih tinggi risiko mengalami GDM berbanding ibu hamil yang tidak mempunyai sejarah keluarga T2DM. Hasil analisis dalam model bivariat menunjukkan ibu hamil yang mengalami GDM mempunyai purata aras Vitamin D yang lebih tinggi berbanding ibu hamil yang tidak mengalami GDM, dan perkaitan ini adalah signifikan. Walaubagaimanapun, aras serum Vitamin D tidak menunjukkan perkaitan yang signifikan di antara ibu hamil yang mengalami GDM dan yang tidak dalam model analisis multivariat. Ibu hamil yang mengalami GDM didapati mempunyai purata Indeks Jisim Tubuh (IJT) sebelum hamil yang tinggi dan lebih berumur berbanding ibu hamil yang tidak mengalami GDM dalam kajian ini. Oleh itu, kemungkinan dua faktor ini menjadi factor penyebab kepada masalah GDM di kalangan ibu hamil tanpa mengambil kira aras serum Vitamin D. Adalah disarankan agar satu kajian yang berskala besar yang melibatkan lebih ramai ibu hamil dapat dijalankan bagi membuktikan perkaitan antara kekurangan Vitamin D dalam trimester pertama kehamilan dan GDM, memandangkan hanya 24 ibu hamil yang mengalami GDM dalam kajian ini.

ACKNOWLEDGEMENTS

Firstly, I would like to thank my supervisor, Professor Dr. Zalilah Mohd Shariff for her continuous support, funding and overall insights in this study which have made this an inspiring experience for me. Her patience and perseverance in guiding me to complete this project were greatly appreciated.

My sincere gratitude to my co-supervisor, Assoc. Prof. Dr Loh Su Peng for her expertise and suggestions to improve this study. My utmost gratitude to medical staffs from Senawang and Ampangan Maternal and Child Health Clinics in Seremban, Negeri Sembilan for assisting me throughout my data collection in their premises. Many thanks to all pregnant women who voluntarily participated in my study.

My heartfelt gratitude to my superiors in the Nutrition Division, Ministry of Health Malaysia for providing me with the opportunity and financial assistance to further my study. A special mention to Dr Yong Heng Yaw, who had been a good friend and a pillar of strength throughout my journey in UPM. Your knowledge, kind understandings and encouragements were invaluable.

Finally, I must express my very profound gratitude to my husband, mother-in-law and my two children for their sacrifices and unfailing support throughout my years of study and through the process of writing this thesis. Not forgetting my family members, friends and my officemates who had been providing me continuous encouragement in this journey. This accomplishment would not have been possible without all of them. Thank you.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Zalilah Mohd Shariff, PhD
Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Chairman**)**

Loh Su Peng, PhD
Associate Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 9 September 2021

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____ Date: _____

Name and Matric No: Lalitha Palaniveloo, GS40669

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

Signature: _____

Name of Chairman of Supervisory Committee: Professor Dr. Zalilah Mohd Shariff

Signature: _____

Name of Member of Supervisory Committee: Associate Professor Dr. Loh Su Peng

TABLE OF CONTENTS

		Page
ABSTRACT		i
ABSTRAK		iii
ACKNOWLEDGEMENTS		v
APPROVAL		vi
DECLARATION		viii
LIST OF TABLES		xiii
LIST OF FIGURES		xv
LIST OF ABBREVIATIONS		xvi
CHAPTER		
1	**INTRODUCTION**	1
	1.1 Background	1
	1.2 Problem Statement	3
	1.3 Research Objectives	5
	1.4 Research Framework	6
	1.5 Significance of Study	7
	1.6 Operational Definition	8
2	**LITERATURE REVIEW**	9
	2.1 Vitamin D	9
	2.1.1 Physiology	9
	2.1.2 Functions	10
	2.1.3 Classification of Vitamin D Status	11
	2.1.4 Prevalence of VDD in Pregnancy	11
	2.1.4.1 Worldwide	11
	2.1.4.2 Malaysia	12
	2.1.5 Effects of VDD in Pregnancy	12
	2.1.6 Factors associated with VDD	13
	2.1.6.1 Demographic and Socioeconomic factors	13
	2.1.6.2 Gravidity and Parity	14
	2.1.6.3 Pre-pregnancy BMI	15
	2.2 Gestational Diabetes Mellitus	16
	2.2.1 Definition	16
	2.2.2 Screening	16
	2.2.3 Diagnosis	17
	2.2.4 Prevalence	19
	2.2.4.1 Worldwide	19
	2.2.4.2 Malaysia	20
	2.2.5 Health consequences of GDM	20
	2.2.6 Factors associated with GDM	21
	2.2.6.1 Demographic and Socioeconomic factors	21

2.2.6.2 Obstetrical factors 22
2.2.6.3 Anthropometric Factors 24
2.2.6.4 Lifestyle Factors 26
2.3 Vitamin D status and GDM 28

3 METHODOLOGY 30
3.1 Study Design 30
3.2 Study Location 30
3.3 Study Approval 31
3.4 Respondents 31
3.5 Sample Size 32
3.6 Sampling Procedure 34
3.7 Measurements 34
3.7.1 Demographic and Socio-economic Information 34
3.7.2 Obstetrical information 36
3.7.3 Dietary Intake 36
3.7.4 Physical Activity 37
3.7.5 Anthropometric measurements 38
3.7.5.1 Screening BMI 38
3.7.5.2 Rate of Gestational Weight Gain (GWG) 39
3.7.6 Biochemical Parameters 39
3.7.6.1 Oral Glucose Tolerance Test (OGTT) 39
3.7.6.2 Serum Vitamin D 40
3.8 Data Collection 41
3.9 Statistical Analysis 42

4 RESULTS 43
4.1 Socio-demographic characteristics 43
4.2 Obstetric characteristics 43
4.3 Anthropometric measurements 45
4.4 Physical activity at 24-28 weeks of gestation 45
4.5 Energy and nutrient intakes 46
4.6 Serum Vitamin D status and prevalence of VDD among pregnant women 48
4.7 Maternal glycemic status and prevalence of GDM 48
4.8 Associations between socio-demographic factors and serum Vitamin D status 49
4.9 Associations between obstetrical factors and serum Vitamin D status 49
4.10 Associations between anthropometric measurements and serum Vitamin D status 52
4.11 Determinants of serum Vitamin D status of pregnant women 54
4.12 Associations between socio-demographic factors and GDM 58
4.13 Associations between obstetrical factors and GDM 58
4.14 Associations between anthropometric factors with GDM 61
4.15 Associations between physical activity level and GDM 63
4.16 Associations between energy and nutrient intakes with GDM 63

4.17 Determinants of GDM among pregnant women 66
4.18 Association between Vitamin D status with GDM 72

5 DISCUSSION 74
5.1 Prevalence of VDD 74
5.2 Determinants of serum Vitamin D status 76
5.3 Prevalence of GDM 77
5.4 Determinants of GDM 78
5.5 Vitamin D status and risk of GDM 81

6 CONCLUSION AND RECOMMENDATIONS 83
6.1 Conclusion 83
6.2 Recommendations 84
6.3 Limitations of Study 85

REFERENCES 86
APPENDICES 123
BIODATA OF STUDENT 132
PUBLICATION 133

LIST OF TABLES

Table		Page
2.1	Diagnostic criteria used for GDM diagnosis worldwide	18
2.2	Plasma glucose cut-off for GDM diagnosis in Malaysia	19
3.1	Sample size calculation	33
3.2	Recommended energy and nutrient intake for pregnant women at 2nd trimester	37
3.3	Classification of physical activity level in accordance to time spent on moderate-intensity aerobic activity	38
3.4	Screening BMI classification	38
3.5	Rate of GWG recommendations during pregnancy	39
3.6	Perinatal Care Manual, MOH criteria for diagnosis of GDM	40
3.7	Classification of serum 25(OH)D	40
4.1	Socio-demographic characteristics of pregnant women (N=170)	44
4.2	Obstetric characteristics of pregnant women (N=170)	44
4.3	Anthropometric measurements of pregnant women (N=170)	45
4.4	Physical activity level of pregnant women at 24-28 weeks of gestation (N=170)	46
4.5	Energy and nutrient intakes of pregnant women at 24th – 28th week of gestation (N=170)	47
4.6	Serum Vitamin D status and prevalence of VDD among pregnant women (N=170)	48
4.7	Maternal glycemic status and prevalence of GDM (N=170)	48
4.8	Association between socio-demographic factors and serum Vitamin D status of pregnant women (N=170)	50
4.9	Associations between obstetrical factors and serum Vitamin D status of pregnant women (N=170)	51

4.10	Associations between anthropometric measurements and serum Vitamin D status of pregnant women (N=170)	53
4.11	Crude odds ratio and 95% confidence intervals for factors associated with serum Vitamin D status of pregnant women (N=170)	55
4.12	Adjusted odds ratio and 95% confidence intervals for factors associated with serum Vitamin D status of pregnant women (N=170)	57
4.13	Associations between socio-demographic factors and GDM among pregnant women (N=170)	59
4.14	Associations between obstetrical factors and GDM among pregnant women (N=170)	60
4.15	Associations between anthropometric factors with GDM among pregnant women (N=170)	62
4.16	Associations between physical activity level and GDM among pregnant women (N=170)	64
4.17	Associations between energy and nutrient intakes with GDM among pregnant women (N=170)	65
4.18	Crude odds ratio and 95% confidence intervals for factors associated with GDM among pregnant women (N=170)	67
4.19	Adjusted odds ratio and 95% confidence intervals for factors associated with GDM among pregnant women (N=170)	70
4.20	Associations between Vitamin D level with GDM among pregnant women (N=170)	73
4.21	Crude odds ratio and 95% confidence intervals for association between Vitamin D status with GDM among pregnant women (N=170)	73
4.22	Adjusted odds ratio and 95% confidence intervals for association between Vitamin D status with GDM among pregnant women (N=170)	73

LIST OF FIGURES

Figure		Page
1.1	Research framework	6
3.1	Sampling procedure	35
3.2	Flow chart of data collection procedure	41

LIST OF ABBREVIATIONS

ACOG	American College of Obstetrics and Gynaecology
ADA	American Diabetes Association
BMI	Body Mass Index
BIGCS	Born in Guangzhou Cohort Study
CMIA	Chemiluminescent Microparticle Immuno Assay
DIP	Diabetes in Pregnancy
DM	Diabetes Mellitus
DPSG	Diabetes Pregnancy Study Group
DRI	Dietary Reference Intake
EI	Energy Intake
ER	Energy Requirement
EVITA	The Epidemiology of Vitamin D Study
GDM	Gestational Diabetes Mellitus
GWG	Gestational Weight Gain
IADPSG	International Association of Diabetes and Pregnancy Study Groups
IOM	Institute of Medicine
IPH	Institute for Public Health
MCH	Maternal and Child Health
MET	Metabolic Equivalent
MOH	Ministry of Health
MREC	Medical Research Ethics Committee
NCCFN	National Coordinating Committee on Food and Nutrition

NDDG	National Diabetes Data Group
NOR	National Obstetric Registry
OGTT	Oral Glucose Tolerance Test
PA	Physical Activity
PED	Pre-Existing Diabetes
PIH	Pregnancy Induced Hypertension
PIN	Pregnancy, Infection, and Nutrition
PPAQ	Pregnancy Physical Activity Questionnaire
RAS	Renin-Angiotensin System
RNI	Recommended Nutrient Intake
ROS	Reactive Oxygen Species
SECOST	Seremban Cohort Study
SGA	Small-For-Gestational Age
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
UPM	Universiti Putra Malaysia
UVB	Ultraviolet B
VDD	Vitamin D Deficiency
WINGS	Women in India with GDM Strategy
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

Vitamin D deficiency (VDD) (serum 25(OH)D level <50 nmol/L) is a global public health problem that cuts across all age and ethnic groups (Institute of Medicine, 2011). It has been estimated that nearly 1 billion of the world population are affected by VDD, which include countries in lower latitude with abundance of ultraviolet B (UVB) radiation and industrialized nations where Vitamin D fortification of food and beverages has been implemented for years (Palacios & Gonzalez, 2014; Aguiar at al., 2017). The prevalence of VDD among European adults age 18 – 65 years old was 40 – 75% (Larose et al., 2014; Hoge et al., 2015; Bettencourt et al., 2018; Deplanque et al., 2017) while in Middle Eastern countries, the prevalence was 64 – 83% (Al-Dabhani et al., 2017, Al-Alyani et al., 2018; Zhang et al., 2016). In the United States and Australia, the prevalence of VDD among adults age 18 – 65 years was 39 – 40% (Liu et al, 2018; Mitchell et al., 2012; Parva et al., 2018) and 23 – 31% (Malacova et al., 2019; Gill et al., 2014) respectively. In Asia, the prevalence of VDD ranged between 41 – 57% among adults of 18 – 65 years old (Akter et al., 2016; Bi et al., 2016; Mechenro et al., 2018; Yu et al., 2015, Choi, 2013).

In healthy women of reproductive age, the prevalence of VDD ranged between 32 – 73% (Contreras-Manzano, Villalpando & Robledo-Pérez, 2017; Junaid et al., 2015; Lopes et al., 2017). VDD is also common during pregnancy with a prevalence of 21 – 91% in developed and developing countries (Noble, Markenson & Chasan-Taber, 2015; Ekeroma, Camargo & Scragg, 2015; Ravinder et al., 2015; Ates et al., 2016; Pirdehghan et al., 2016; Richard et al., 2017). Among children and adolescents, the prevalence of VDD ranged between 40 – 50% (El Maataoui et al., 2016; Cairncross et al., 2017; Vierucci et al., 2014; Wang et al., 2016). Among the elderly aged 65 years and above, the prevalence of VDD was 37 – 45% (Carrillo-Vega et al., 2017; Cheng et al., 2017; Brouwer-Brolsma et al., 2016).

Vitamin D is an essential fat-soluble vitamin that has two major forms, Ergocalciferol (Vitamin D2) and Cholecalciferol (Vitamin D3). Ergocalciferol is found mainly in plants and some fish while Cholecalciferol is synthesized in the skin by UVB rays from the sunlight. The synthesized Vitamin D3 is transported to the liver by Vitamin D binding proteins to undergo hydroxylation where it is converted to 25(OH)D, which is the inactive form of Vitamin D. The 25(OH)D is then transported to the kidneys where it is hydroxylated further by the enzyme 1-αhydroxylase to the active form, 1,25(OH)D (Pludowski et al., 2018). As a fat-soluble vitamin, 25(OH)D is mostly stored in adipose tissues in the body (Holick et al., 2011). The receptors for 25(OH)D are found on cells throughout the body, mainly in skin, parathyroid gland, intestine, bone, kidney, pituitary gland, ovary, lymphocytes, liver, brain, heart and skeletal muscles (McAree et al., 2013). The main sources of Vitamin D are exposure to sunlight (endogenous synthesis) and

dietary intake. Endogenously synthesized Vitamin D accounts for nearly 80% of Vitamin D for humans while the remaining 20% is derived from dietary intake. However, due to limited food sources of Vitamin D (fatty fish, fortified dairy products, butter, margarines and egg yolk), exposure to sunlight is regarded as the main source (Saraff & Shaw, 2015; Holick, 2017; Moulas & Vaiou, 2018). Endogenous synthesis of Vitamin D is reduced when there is a limited exposure to sunlight due to clothing covering most of the skin surface while outdoors, usage of sunscreen lotion and frequent indoor or limited outdoor activities (Al-Wassia & Abo-Ouf, 2016). High presence of melanin in darker skin and limited sunshine due to geographical location and winter season also affect endogenous synthesis of Vitamin D (Dawodu & Akinbi, 2013).

Although the role of vitamin D in musculoskeletal health and bone mineralization is well established (Kumar et al., 2016), there is increasing evidence associating VDD with cardiovascular disease, cancer, autoimmune diseases and diabetes (Pludowski et al., 2018; Wang et al., 2017). The beneficial effects of vitamin D on reducing the risk of cardiovascular disease are through its role in the regulation of blood pressure, weakening the actions of the renin-angiotensin-aldosterone system and suppressing cellular inflammation of cardiac cells (Wimalawansa, 2016). In autoimmune diseases, Vitamin D acts as an anti-inflammatory agent and assists in maintaining the equilibrium between pro- and anti-inflammatory situations (Dankers et al., 2017). Furthermore, vitamin D and its metabolites reduce the incidence of cancer by inhibiting cell proliferation, stimulating apoptosis, suppressing inflammation, as well as inhibiting tumor angiogenesis, invasion and metastasis (Krishnan et al., 2012). The role of vitamin D in glucose tolerance is established by its ability to affect insulin secretion through the β-cells in the pancreas and insulin sensitivity (Martin & Campbell, 2011).

VDD in pregnancy has been associated with adverse pregnancy outcomes, including gestational diabetes mellitus (GDM), preeclampsia, bacterial vaginosis, a shorter gestation period, increase in cesarean section births and post-partum depression (Christesen et al., 2012; Charatcharoenwitthaya et al., 2013; Arnold et al., 2015). Adverse effects of VDD on newborns include higher incidence of small-for-gestational age (SGA), reduced infant bone mineral density and rickets (Hogler, 2015; Mulligan et al., 2010; Uday et al., 2018). Infants born to women with VDD are also at risk for developing respiratory infections, asthma, type 1, diabetes and schizophrenia later in life (Mulligan et al., 2010; Hart et al., 2015).

Hyperglycemia detected in pregnancy can be classified into pre-existing diabetes (PED) and gestational diabetes mellitus (GDM). PED comprises of Type 1 Diabetes Mellitus (T1DM) and Type 2 Diabetes Mellitus (T2DM) while GDM is defined as any degree of glucose intolerance with onset or first recognition during pregnancy at 24-28 weeks of gestation (IADPSG, 2010; Dirar and Doupis, 2017). Prevalence of GDM in Europe and United States were 5.4% (Eades, Cameron & Evans, 2017) and 7.6% (Casagrande, Linder & Cowie, 2018) respectively. In Asia, the prevalence was 11.5% (Lee at al., 2018). The prevalence of GDM varies between 14-28% In Malaysia (Institute for Public Health, 2016; Logakodie et al., 2016; Hasbullah et al., 2019). Women with GDM are at risk of developing gestational hypertension, preeclampsia and having higher rate of

caesarean section while women with a history of GDM are significantly at higher risk of developing type 2 diabetes mellitus (T2DM) and cardiovascular diseases later in life (Benhalima et al., 2014; Nyugen et al., 2018; Lee et al, 2018). Infants born to GDM mothers have a higher risk of being macrosomic, having neonatal hypoglycemia and developing T2DM later in life (Lee et al., 2018; Begum, Dey & Fatima, 2018).

1.2 Problem Statement

Despite Malaysia being a tropical country with abundance of sunlight all year round, high prevalence of VDD has been reported in all age groups. The prevalence of VDD in adults aged 25-55 years old was 67% (Shafinaz and Moy, 2016) while among the elderly aged 55 years old and above, the prevalence was 41% (Mat et al., 2018). In children and adolescents, the prevalence ranged between 33-93% (Khor et al., 2011; Quah et al., 2019; Al-Sadat et al., 2016). Prevalence of VDD among females aged between 18-60 years was 91% (Jamil et al., 2019) while the prevalence in healthy women of reproductive age was 60% (Green et al., 2008). Correspondingly, studies reported a high prevalence of VDD, ranging between 60 – 90%, among pregnant women (Jan Mohamed et al., 2014; Bukhary et al., 2016). This is an indication that further investigations are needed to identify the factors contributing to the high prevalence of VDD among Malaysians, particularly among vulnerable groups such as pregnant women, besides establishing prevalence data of VDD for the country.

Studies have indicated that pregnant women in the country had an inadequate dietary intake of Vitamin D (<15µg/day) (Lee et al., 2020; Woon et al., 2019; Bukhary et al., 2016). A study by Lee et al. (2020) among 217 pregnant women in Selangor showed that nearly 68% of the pregnant women had an inadequate dietary intake of Vitamin D. Another study conducted among pregnant women in Kuala Lumpur and Selangor indicated that nearly 74% of the women had an inadequate dietary intake of Vitamin D (Woon et al., 2019). As the previous studies were all conducted among pregnant women in the locality of Kuala Lumpur/ Selangor, this research would provide an opportunity to study on dietary intake of Vitamin D among pregnant women in a locality in Negeri Sembilan besides contributing to the existing database of dietary intake of Vitamin D among pregnant women in the country.

Findings from the National Health and Morbidity Survey 2019 (NHMS 2019) showed that 50.1% of adults in Malaysia were overweight/ obese. The report also indicated an overweight and obesity prevalence of 30% and 25% respectively among the women population (Institute for Public Health, 2019). These findings indicate that nearly 25-30% of women in Malaysia will be entering pregnancy either in the state of overweight or obese. In line with NHMS 2019 findings, a study by Muthupalaniappen and Danasamy (2018) among 315 pregnant women who were in their first trimester of pregnancy found that nearly 61% of them had overweight/obese pre-pregnancy BMI. Another local study conducted among pregnant women in the first trimester of pregnancy in Kelantan reported a prevalence of pre-pregnancy overweight/obese BMI of 44% (Farhan, Rohana and Alina, 2015). As body weight and pre-pregnancy BMI are regarded as important risk factors for VDD and diagnosis of GDM among pregnant

women, findings from this study could strengthen the association between BMI status of the women and risk of VDD and GDM.

Pregnant women with normal pregnancy were recommended of at least 150 minutes/ week of moderate-intensity exercise by The American College of Obstetricians and Gynaecologists (ACOG, 2017). In a study conducted in Kelantan, Jan Mohamed et al. (2014) reported that nearly 58% of pregnant women in the second trimester and 63% in the third trimester of pregnancy recorded a low physical activity level. Anjana et al. (2016) found that only 10.7% of pregnant women met the recommended ACOG 2017 guideline for physical activity in pregnancy from a study conducted among 795 pregnant women in India. Meanwhile, a study in Singapore found that pregnant women diagnosed with GDM had a higher percentage of insufficient level of physical activity compared to non-GDM women (Padmapriya et al. (2017). Physical activity is a modifiable risk factor associated with GDM (Gilbert et al., 2019). The establishment of the association between physical activity levels and the onset of GDM is crucial for an effective intervention among women with a high risk of GDM as existing data shows pregnant women generally has a low physical activity level.

The prevalence of GDM in Malaysia, ranged between 14-28%, is very much higher compared the to the prevalence of 5.4% in Europe, 7.6% in the United States and 14.6% in China (Institute for Public Health, 2016; Logakodie et al., 2016; Hasbullah et al., 2019; Eades, Cameroon and Evans, 2017; Casagrande, Linder & Cowie, 2018; Song et al., 2017). The relatively high prevalence of GDM among pregnant women in Malaysia warrants a more comprehensive study to identify risk factors of GDM in addition to updating the prevalence data of GDM in the country.

There have been numerous studies aimed to establish a link between serum Vitamin D with T2DM (Nakashima et al., 2016; Wimalawansa, 2016; Berridge, 2017; Lips et al., 2017; Lee et al., 2018). These studies have been extended to GDM since the pathophysiology of T2DM and GDM are similar (Zajdenverg and Negrato, 2017; Xu, Ma and Wang, 2018; Xia et al., 2019; Al-Ajlan et al., 2018; Dwarkanath et al., 2019). Despite a high prevalence of GDM reported among Malaysian pregnant women (Institute for Public Health, 2016; Logakodie et al., 2016; Hasbullah et al., 2019), limited information is available on the association between serum Vitamin D and GDM among Malaysian pregnant women (Woon et al., 2019). Thus, this study was conducted to investigate the association between serum Vitamin D in first trimester with GDM among Malaysian pregnant women. This study attempted to address the following questions:

a) What is the Vitamin D status of Malaysian pregnant women in first trimester?
b) What is the GDM status of Malaysian pregnant women?
c) What are the factors associated with serum Vitamin D in first trimester among Malaysian pregnant women?
d) What are the factors associated with GDM among Malaysian pregnant women?

e) Is there any association between serum Vitamin D in first trimester with GDM among Malaysian pregnant women?

1.3 Research Objectives

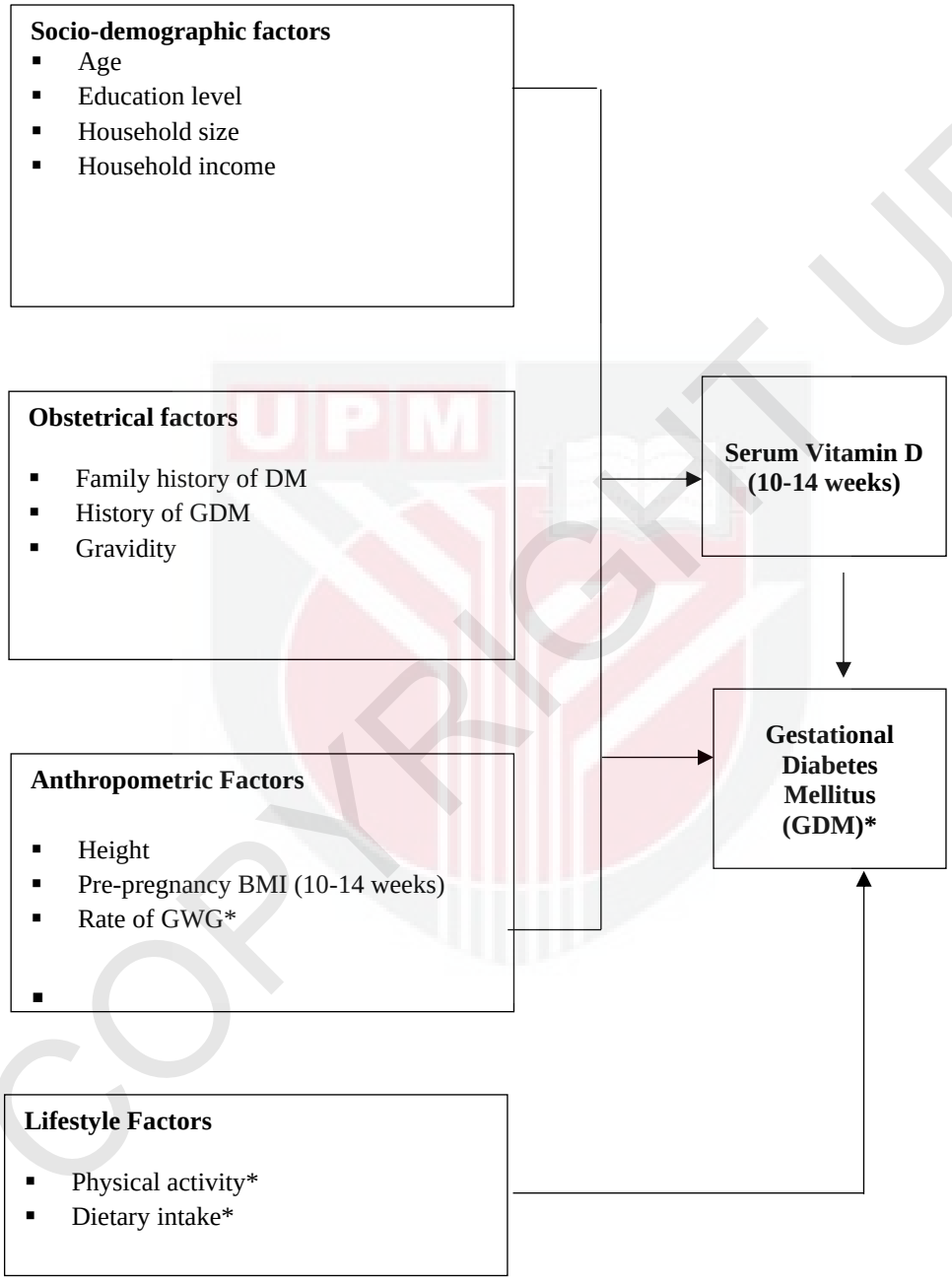
General Objective:

To determine the factors associated with Vitamin D status in first trimester and GDM, and its association among pregnant women in Seremban, Negeri Sembilan.

Specific Objective:

1. To assess
   a. socio-demographic characteristics
   b. obstetrical characteristics
   c. anthropometric characteristics
   d. lifestyle characteristics (dietary intake and physical activity status) of pregnant women
2. To identify
   a. serum Vitamin D status in first trimester
   b. Gestational Diabetes Mellitus (GDM) among pregnant women
3. To determine the contributing factors for VDD among pregnant women.
4. To determine the contributing factors for GDM among pregnant women.
5. To determine the association between Vitamin D status in first trimester with GDM among pregnant women.

1.4 Research Framework



**24 – 28 weeks – Second trimester*

Figure 1.1 : Research framework

The research framework for this study is presented in Figure 1.1. The present study examined socio-demographic, obstetrical and anthropometric factors in relation to Vitamin D status and GDM. Lifestyle factors at 24-28 weeks of gestation were also included as risk factors for GDM.

Vitamin D status in pregnancy is associated with maternal age, education level and economic status (Bener et al., 2013; Van Den Berg et al., 2013; Ustuner et al., 2011). There is a growing evidence to suggest gravidity as a risk factor for VDD in pregnancy (Andersen et al., 2013; Al-Musharaf et al., 2018). Studies also found pre-pregnancy BMI is significantly associated with lower serum Vitamin D in pregnancy (Agarwal S, Kovilam & Agrawal DK, 2018; Karlsson et al., 2015; Vandevijvere et al., 2012). While history of GDM and family history of T2DM are known risk factors for GDM, numerous studies supported that maternal obesity is an important risk factor for GDM (Pleskacova et al., 2015; Logakodie et al., 2017; Padmanabhan, McLean and Cheung, 2014; Duman, 2015; Leng et al., 2015). Additionally, lifestyle factors that include dietary intake and physical activity levels during pregnancy have been associated with GDM (Meinila et al., 2015; Zhang et al., 2014; Anjana et al., 2016; Liu et al., 2014). Several studies showed that VDD in pregnancy is significantly associated with GDM (Bener et al., 2013; Aghajafari et al., 2013; El Lithy et al., 2014). Low serum Vitamin D is shown to be associated with increased insulin resistance and decreased beta cell function among pregnant women (Mutlu et al., 2015; Yeow et al., 2015).

1.5 Significance of Study

Vitamin D deficiency (VDD) is associated with musculoskeletal, cardiovascular, inflammatory and autoimmune diseases and also cancers. Low Vitamin D level is also associated with adverse effects in pregnancies for both mother and child. Though the prevalence of VDD is high among all age groups in Malaysia, little is known on prevalence of VDD specifically in pregnancy and its risk factors associated among pregnant women in Malaysia. Findings from this study will contribute to the existing limited prevalence data on VDD in pregnancy and its risk factors among pregnant women in the country.

The prevalence of diabetes mellitus (DM) is gradually increasing worldwide but markedly in middle-income countries, with an estimated of 1.6 million from deaths yearly caused by DM (WHO, 2020). In Malaysia, the national prevalence of T2DM among Malaysian adults has been rising steadily from 11.2% in 2011 to 18.3% (2019) (Institute for Public Health, 2011 & 2019). With research findings indicating a 7-fold increased risk of T2DM later in life among women with a history of GDM and the high prevalence of GDM among pregnant women in Malaysia, effective preventive actions should be taken to ensure a safe pregnancy for all the pregnant women. Besides contributing to the existing literature on maternal glycemia, this study will also establish the risk factors for GDM among Malaysian women. Related government and health agencies could use these findings to improvise current health policies and programmes in the country.

Numerous studies have established the effect of VDD in pregnancy and its link to onset of GDM. However, studies on VDD in pregnancy and its association to GDM in Malaysia is limited and the findings have been inconsistent. Thus, the findings from this study could contribute to the existing studies on VDD in pregnancy and ascertain the association between Vitamin D and GDM.

Findings from this study could contribute in development of simple yet effective preventive measures in curbing incidence of VDD and also GDM among pregnant women in Malaysia. This will enable pregnant women to have a healthy pregnancy and less complications in delivery.

1.6 Operational Definition

1.6.1 Gestational diabetes mellitus (GDM) - any degree of glucose intolerance diagnosed in the second or third trimester of pregnancy that is clearly not overt diabetes (American Diabetes Association, 2014).

1.6.2 Vitamin D deficiency (VDD) – Serum Vitamin D level < 50 nmol/L (Institute of Medicine, 2011).

1.6.3 Body Mass Index (BMI) – calculated as weight (kg)/ height (m^2).

1.6.4 Pre-pregnancy BMI – BMI calculated from weight and height recorded at the study enrolment (<10 weeks of gestation).

1.6.5 Rate of gestational weight gain – the difference of weight measured in the clinic between the last and current antenatal visit and dividing it with the corresponding difference of gestational weeks (Huang et al., 2016).

1.6.6 Physical activity – household, caregiving, occupational, sports or exercise activities (Ainsworth et al., 2011).

REFERENCES

Abualhamael, S., Mosli, H., Baig, M., Noor, A. M., & Alshehri, F. M. (2019). Prevalence and associated risk factors of gestational diabetes mellitus at a university hospital in Saudi Arabia. Pakistan Journal of Medical Sciences, 35(2), 325–329. https://doi.org/10.12669/pjms.35.2.498

Abu-Heija, A. T., Al-Bash, M. R., & Al-Kalbani, M. A. (2017). Effects of maternal age, parity and pre-pregnancy body mass index on the glucose challenge test and gestational diabetes mellitus. Journal of Taibah University Medical Sciences, 12(4), 338–342. https://doi.org/10.1016/j.jtumed.2017.01.005

Agarwal, S., Chaudhary, M., Chauhan, J., & Vacchani, A. (2016). Assessment of Vitamin D Deficiency in Pregnant Females Attending Antenatal Care Clinic at Tertiary Care Hospital. International Journal of Scientific Study, 4(5), 99–101. https://doi.org/10.17354/ijss/2016/437

Agarwal, S., Kovilam, O., & Agrawal, D. K. (2018). Vitamin D and its impact on maternal-fetal outcomes in pregnancy: A critical review. Critical Reviews in Food Science and Nutrition, 58(5), 755–769. https://doi.org/10.1080/10408398.2016.1220915

Aghajafari, F., Nagulesapillai, T., Ronksley, P. E., Tough, S. C., O'Beirne, M., & Rabi, D. M. (2013). Association between maternal serum 25-hydroxyvitamin D level and pregnancy and neonatal outcomes: Systematic review and meta-analysis of observational Studies. BMJ (Online), 346(7902), 1–14. https://doi.org/10.1136/bmj.f1169

Aguiar, M., Andronis, L., Pallan, M., Högler, W., & Frew, E. (2017). Preventing Vitamin D deficiency (VDD): A systematic review of economic evaluations. European Journal of Public Health, 27(2), 292–301. https://doi.org/10.1093/eurpub/ckw270

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Tudor-Locke, C., Greer, J. L., Vezina, J., Whitt-Glover, M. C., & Leon, A. S. (2011). 2011 Compendium of Physical Activities. The Compendium of Physical Activities Tracking Guide. Healthy Lifestyles Research Center, College of Nursing & Health Innovation, Arizona State University., 17. https://doi.org/10.1249/MSS.0b013e31821ece12

Aji, A. S., Erwinda, E., Yusrawati, Y., Malik, S. G., & Lipoeto, N. I. (2019). Vitamin D deficiency status and its related risk factors during early pregnancy: A cross-sectional study of pregnant Minangkabau women, Indonesia. BMC Pregnancy and Childbirth, 19(1), 1–10. https://doi.org/10.1186/s12884-019-2341-4

Akter, S., Eguchi, M., Kurotani, K., Kochi, T., Kashino, I., Ito, R., Kuwahara, K., Tsuruoka, H., Kabe, I., & Mizoue, T. (2017). Serum 25-hydroxyvitamin D and metabolic syndrome in a Japanese working population: The Furukawa Nutrition and Health Study. In Nutrition (Vol. 36). Elsevier Ltd. https://doi.org/10.1016/j.nut.2016.02.024

Al-Ajlan, A., Al-Musharaf, S., Fouda, M. A., Krishnaswamy, S., Wani, K., Aljohani, N. J., Al-Serehi, A., Sheshah, E., Alshingetti, N. M., Turkistani, I. Z., Afrah Alharbi, A., Alraqebah, B. A., Ali, A. M., Al-Saeed, G., & Al-Daghri, N. M. (2018). Lower vitamin D levels in Saudi pregnant women are associated with higher risk of developing GDM. BMC Pregnancy and Childbirth, 18(1), 1–7. https://doi.org/10.1186/s12884-018-1723-3

Al-Alyani, H., Al-Turki, H. A., Al-Essa, O. N., Alani, F. M., & Sadat-Ali, M. (2018). Vitamin D deficiency in Saudi Arabians: A reality or simply hype: A meta-analysis (2008-2015). Journal of family & community medicine, 25(1), 1–4. https://doi.org/10.4103/jfcm.JFCM_73_17

Al-Dabhani, K., Tsilidis, K. K., Murphy, N., Ward, H. A., Elliott, P., Riboli, E., Gunter, M., & Tzoulaki, I. (2017). Prevalence of Vitamin D deficiency and association with metabolic syndrome in a Qatari population. Nutrition and Diabetes, 7(4), e263-6. https://doi.org/10.1038/nutd.2017.14

Al-Faris, N. A. (2016). High prevalence of vitamin D deficiency among pregnant saudi women. Nutrients, 8(2), 6–15. https://doi.org/10.3390/nu8020077

Al-Musharaf, S., Fouda, M. A., Turkestani, I. Z., Al-Ajlan, A., Sabico, S., Alnaami, A. M., Wani, K., Danish Hussain, S., Alraqebah, B., Al-Serehi, A., Alshingetti, N. M., Al-Daghri, N., McTernan, P. G., Wimalawansa, S. J., & Saravanan, P. (2018). Vitamin D Deficiency Prevalence and Predictors in Early Pregnancy among Arab Women. Nutrients, 10, 1–12. https://doi.org/10.3390/nu10040489

Al-Sadat, N., Majid, H. A., Sim, P. Y., Su, T. T., Dahlui, M., Bakar, M. F. A., Dzaki, N., Norbaya, S., Murray, L., Cantwell, M. M., Jalaludin, M. Y., Abu Bakar, M. F., Dzaki, N., Norbaya, S., Murray, L., Cantwell, M. M., & Jalaludin, M. Y. (2016). Vitamin D deficiency in Malaysian adolescents aged 13 years: Findings from the Malaysian Health and Adolescents Longitudinal Research Team study (MyHeARTs). BMJ Open, 6(8), 1–9. https://doi.org/10.1136/bmjopen-2015-010689

Al-Shoumer, K. A. (2015). Is there a relationship between vitamin D with insulin resistance and diabetes mellitus? World Journal of Diabetes, 6(8), 1057. https://doi.org/10.4239/wjd.v6.i8.1057

Alvarez-Silvares, E., Vilouta-Romero, M., Borrajo-Hernandez, E., Morales-Serrano, ML., & Alves-Pérez, MT. (2016). Maternal serum 25-hydroxy vitamin D levels in the first trimester and adverse gestational outcomes. Ginecologia y obstetricia de Mexico, 84(3):150-63.

Al-Wassia, H., & Abo-Ouf, N. (2016). Prevalence of vitamin D deficiency in mother–infant pairs in a tertiary hospital in the west coast of Saudi Arabia. Journal of Clinical Neonatology, 5(4), 243. https://doi.org/10.4103/2249-4847.194164

Alzaim, M., & Wood, R. J. (2013). Vitamin D and gestational diabetes mellitus. Nutrition Reviews, 71(3), 158–167. https://doi.org/10.1111/nure.12018

American Diabetes Association (ADA). (2014). Diagnosis and classification of diabetes mellitus. Diabetes Care, 37(1), 81–90. https://doi.org/10.2337/dc14-S081

Amraei, M., Mohamadpour, S., Sayehmiri, K., Mousavi, S. F., Shirzadpour, E., & Moayeri, A. (2018). Effects of vitamin D deficiency on incidence risk of gestational diabetes mellitus: a systematic review and meta-analysis. Frontiers in endocrinology, 9, 7.

Andersen, L. B., Abrahamsen, B., Dalgård, C., Kyhl, H. B., Beck-Nielsen, S. S., Frost-Nielsen, M., Jørgensen, J. S., Barington, T., & Christesen, H. T. (2013). Parity and tanned white skin as novel predictors of vitamin D status in early pregnancy: A population-based cohort study. Clinical Endocrinology, 79(3), 333–341. https://doi.org/10.1111/cen.12147

Anjana, R. M., Sudha, V., Lakshmipriya, N., Anitha, C., Unnikrishnan, R., Bhavadharini, B., Mahalakshmi, M. M., Maheswari, K., Kayal, A., Ram, U., Ranjani, H., Ninov, L., Deepa, M., Pradeepa, R., Pastakia, S. D., Malanda, B., Belton, A., & Mohan, V. (2016). Physical activity patterns and gestational diabetes outcomes - The wings project. Diabetes Research and Clinical Practice, 116, 253–262. https://doi.org/10.1016/j.diabres.2016.04.041

Arnold, D. L., Enquobahrie, D. A., Qiu, C., Huang, J., Grote, N., VanderStoep, A., & Williams, M. A. (2015). Early Pregnancy Maternal Vitamin D Concentrations and Risk of Gestational Diabetes Mellitus. Paediatric and Perinatal Epidemiology, 200–210. https://doi.org/10.1111/ppe.12182

Ates, S., Sevket, O., Ozcan, P., Ozkal, F., Kaya, M. O., & Dane, B. (2016). Vitamin D status in the first-trimester: Effects of vitamin D deficiency on pregnancy outcomes. African Health Sciences, 16(1), 36–43. https://doi.org/10.4314/ahs.v16i1.5

Aviram, A., Guy, L., Ashwal, E., Hiersch, L., Yogev, Y., & Hadar, E. (2016). Pregnancy outcome in pregnancies complicated with gestational diabetes mellitus and late preterm birth. Diabetes Research and Clinical Practice, 113, 198–203. https://doi.org/10.1016/j.diabres.2015.12.018

Azrielant, S., & Shoenfeld, Y. (2017). Vitamin D and the Immune System. The Israel Medical Association journal : IMAJ, 19(8), 510–511.

Bakacak, M., Serin, S., Ercan, O., Köstü, B., Avci, F., Kılınç, M., Kıran, H., & Kiran, G. (2015). Comparison of Vitamin D levels in cases with preeclampsia, eclampsia and healthy pregnant women. International Journal of Clinical and Experimental Medicine, 8(9), 16280–16286.

Baker, A. M., Haeri, S., Camargo, C. A., Stuebe, A. M., & Boggess, K. A. (2012). First-trimester maternal vitamin D status and risk for gestational diabetes (GDM) a nested case-control study. Diabetes/Metabolism Research and Reviews, 28(2), 164–168. https://doi.org/10.1002/dmrr.1282

Bao, W., Bowers, K., Tobias, D. K., Olsen, S. F., Chavarro, J., Vaag, A., Kiely, M., & Zhang, C. (2014). Prepregnancy low-carbohydrate dietary pattern and risk of gestational diabetes mellitus: A prospective cohort study. American Journal of Clinical Nutrition, 99(6), 1378–1384. https://doi.org/10.3945/ajcn.113.082966

Bawah, A. T., Ngala, R. A., Alidu, H., Seini, M. M., Wumbee, J. D. K., & Yeboah, F. A. (2019). Gestational diabetes mellitus and obstetric outcomes in a Ghanaian community. Pan African Medical Journal, 32, 1–7. https://doi.org/10.11604/pamj.2019.32.94.17334

Begum, P., Shaha, D. R., & Walid, K. M. (2017). Gestational Diabetes Mellitus and Associated Risk Factors in Patients Attending Diabetic Association Medical College Hospital in Faridpur. Journal of Enam Medical College, 7(3), 126–133. https://doi.org/10.3329/jemc.v7i3.34071

Begum, S., Dey, S. K., & Fatema, K. (2018). Neonatal Glycemic Status of Infants of Diabetic Mothers in a Tertiary Care Hospital. Indian journal of endocrinology and metabolism, 22(5), 621–626. https://doi.org/10.4103/ijem.IJEM_689_17

Beharier, O., Shoham-Vardi, I., Pariente, G., Sergienko, R., Kessous, R., Baumfeld, Y., Szaingurten-Solodkin, I., & Sheiner, E. (2015). Gestational diabetes mellitus is a significant risk factor for long-term maternal renal disease. Journal of Clinical Endocrinology and Metabolism, 100(4), 1412–1416. https://doi.org/10.1210/jc.2014-4474

Bener, A., Al-Hamaq, A. O., & Saleh, N. M. (2013). Association between vitamin d insufficiency and adverse pregnancy outcome: Global comparisons. International Journal of Women's Health, 5(1), 523–531. https://doi.org/10.2147/IJWH.S51403

Benhalima, K., Devlieger, R., & Van Assche, A. (2014). Screening and management of gestational diabetes. Best Practice & Research. Clinical Obstetrics & Gynaecology, 29(2015), 1–11. https://doi.org/10.1016/j.bpobgyn.2014.07.026

Berridge, M. J. (2017). Vitamin D deficiency and diabetes. Biochemical Journal, 474(8), 1321–1332. https://doi.org/10.1042/BCJ20170042

Bettencourt, A., Boleixa, D., Reis, J., Oliveira, J. C., Mendonça, D., Costa, P. P., Silva, B. M. da, Marinho, A., & Silva, A. M. da. (2018). Serum 25-hydroxyvitamin D levels in a healthy population from the North of Portugal. Journal of Steroid Biochemistry and Molecular Biology, 175, 97–101. https://doi.org/10.1016/j.jsbmb.2016.11.005

Bi, X., Tey, S. L., Leong, C., Quek, R., & Henry, C. J. (2016). Prevalence of Vitamin D deficiency in Singapore: Its implications to cardiovascular risk factors. PLoS ONE, 11(1), 1–12. https://doi.org/10.1371/journal.pone.0147616

Bjorn Jensen, C., Thorne-Lyman, A. L., Vadgård Hansen, L., Strøm, M., Odgaard Nielsen, N., Cohen, A., & Olsen, S. F. (2013). Development and Validation of a Vitamin D Status Prediction Model in Danish Pregnant Women: A Study of the Danish National Birth Cohort. PLoS ONE, 8(1). https://doi.org/10.1371/journal.pone.0053059

Bo, S., Menato, G., Lezo, A., Signorile, A., Bardelli, C., De Michieli, F., & Pagano, G. (2001). Dietary fat and gestational hyperglycaemia. Diabetologia, 44(8), 972-978.

Bodnar, L. M., Catov, J. M., Roberts, J. M., & Simhan, H. N. (2007). Prepregnancy obesity predicts poor vitamin D status in mothers and their neonates. Journal of Nutrition, 137(11), 2437–2442. https://doi.org/10.1093/jn/137.11.2437

Bodnar, L. M., Platt, R. W., & Simhan, H. N. (2015). Early-Pregnancy Vitamin D Deficiency and Risk of Preterm Birth Subtypes HHS Public Access Author manuscript. Obstet Gynecol, 125(2), 439–447. https://doi.org/10.1097/AOG.0000000000000621

Bokharee, N., Khan, Y. H., Wasim, T., Mallhi, T. H., Alotaibi, N. H., Iqbal, M. S., Rehman, K., Alzarea, A. I., & Khokhar, A. (2020). Daily versus stat vitamin D supplementation during pregnancy; A prospective cohort study. PloS one, 15(4), e0231590. https://doi.org/10.1371/journal.pone.0231590

Bouillon, R., Marcocci, C., Carmeliet, G., Bikle, D., White, J. H., Dawson-Hughes, B., Lips, P., Munns, C. F., Lazaretti-Castro, M., Giustina, A., & Bilezikian, J. (2019). Skeletal and Extraskeletal Actions of Vitamin D: Current Evidence and Outstanding Questions. In Endocrine Reviews (Vol. 40, Issue 4). https://doi.org/10.1210/er.2018-00126

Bouthoorn, S. H., Silva, L. M., Murray, S. E., Steegers, E. A. P., Jaddoe, V. W. V., Moll, H., Hofman, A., Mackenbach, J. P., & Raat, H. (2015). Low-educated women have an increased risk of gestational diabetes mellitus: the Generation R Study. Acta Diabetologica, 52(3), 445–452. https://doi.org/10.1007/s00592-014-0668-x

Boyle, V. T., Thorstensen, E. B., Mourath, D., Jones, M. B., McCowan, L. M. E., Kenny, L. C., & Baker, P. N. (2016). The relationship between 25-hydroxyvitamin D concentration in early pregnancy and pregnancy outcomes in a large, prospective cohort. British Journal of Nutrition, 116(8), 1409–1415. https://doi.org/10.1017/S0007114516003202

Brite, J., Shiroma, E. J., Bowers, K., Yeung, E., Laughon, S. K., Grewal, J. G., & Zhang, C. (2014). Height and the risk of gestational diabetes: Variations by race/ethnicity. Diabetic Medicine, 31(3), 332–340. https://doi.org/10.1111/dme.12355

Bromage, S., Enkhmaa, D., Baatar, T., Garmaa, G., Bradwin, G., Yondonsambuu, B., Sengee, T., Jamts, E., Suldsuren, N., McElrath, T. F., Cantonwine, D. E., Hoover, R. N., Troisi, R., & Ganmaa, D. (2019). Comparison of seasonal serum 25-hydroxyvitamin D concentrations among pregnant women in Mongolia and Boston. Journal of Steroid Biochemistry and Molecular Biology, 193(February), 105427. https://doi.org/10.1016/j.jsbmb.2019.105427

Brouwer-Brolsma, E. M., Vaes, A., van der Zwaluw, N. L., van Wijngaarden, J. P., Swart, K., Ham, A. C., van Dijk, S. C., Enneman, A. W., Sohl, E., van Schoor, N. M., van der Velde, N., Uitterlinden, A. G., Lips, P., Feskens, E., Dhonukshe-Rutten, R., & de Groot, L. (2016). Relative importance of summer sun exposure, vitamin D intake, and genes to vitamin D status in Dutch older adults: The B-PROOF study. The Journal of steroid biochemistry and molecular biology, 164, 168–176. https://doi.org/10.1016/j.jsbmb.2015.08.008

Bukhary, N., Md Isa, Z., Shamsuddin, K., Khor, G.L., Mahdy, Z.A., Hassan, H., & Yeop. N. S. H. (2016). Risk factors for antenatal hypovitaminosis D in an urban district in Malaysia. BMC Pregnancy and Childbirth, 16, 156. https://doi.org/10.1186/s12884-016-0939-3

Cabaset, S., Krieger, J. P., Richard, A., Elgizouli, M., Nieters, A., Rohrmann, S., & Quack Lötscher, K. C. (2019). Vitamin D status and its determinants in healthy pregnant women living in Switzerland in the first trimester of pregnancy 11 Medical and Health Sciences 1117 Public Health and Health Services. BMC Pregnancy and Childbirth, 19(1), 1–12. https://doi.org/10.1186/s12884-018-2150-1

Cairncross, C. T., Stonehouse, W., Conlon, C. A., Grant, C. C., McDonald, B., Houghton, L. A., Eyles, D., Camargo, C. A., Coad, J., & von Hurst, P. R. (2017). Predictors of vitamin D status in New Zealand preschool children. Maternal and Child Nutrition, 13(3), 1–12. https://doi.org/10.1111/mcn.12340

Camargo, C. A., Ingham, T., Wickens, K., Thadhani, R., Silvers, K. M., Epton, M. J., Town, G. I., Pattemore, P. K., Espinola, J. A., Crane, J., Crane, J., Dench, C., Duignan, M., Epton, M. J., Fishwick, D., Fitzharris, P., Ingham, T., Irvine, V., Kelly, R., … Withell, K. (2011). Cord-blood 25-hydroxyvitamin D levels and risk of respiratory infection, wheezing, and asthma. Pediatrics, 127(1). https://doi.org/10.1542/peds.2010-0442

Carrillo-Vega, M. F., García-Peña, C., Gutiérrez-Robledo, L. M., & Pérez-Zepeda, M. U. (2017). Vitamin D deficiency in older adults and its associated factors: a cross-sectional analysis of the Mexican Health and Aging Study. Archives of osteoporosis, 12(1),8. https://doi.org/10.1007/s11657-016-0297-9

Carroll, X., Liang, X., Zhang, W., Zhang, W., Liu, G., Turner, N., & Leeper-Woodford, S. (2018). Socioeconomic, environmental and lifestyle factors associated with gestational diabetes mellitus: A matched case-control study in Beijing, China. Scientific Reports, 8(1), 1–10. https://doi.org/10.1038/s41598-018-26412-6

Casagrande, S. S., Linder, B., & Cowie, C. C. (2018). Prevalence of gestational diabetes and subsequent Type 2 diabetes among U.S. women. Diabetes Research and Clinical Practice, 141, 200–208. https://doi.org/10.1016/j.diabres.2018.05.010

Catalano, P. M., Kirwan, J. P., Haugel-De Mouzon, S., & King, J. (2003). Gestational diabetes and insulin resistance: Role in short- and long-term implications for mother and fetus. Journal of Nutrition, 133(5 SUPPL. 1), 1674–1683. https://doi.org/10.1093/jn/133.5.1674s

Catalano, P. M., McIntyre, H. D., Cruickshank, J. K., McCance, D. R., Dyer, A. R., Metzger, B. E., Lowe, L. P., Trimble, E. R., Coustan, D. R., Hadden, D. R., Persson, B., Hod, M., & Oats, J. J. N. (2012). The hyperglycemia and adverse pregnancy outcome study: Associations of GDM and obesity with pregnancy outcomes. Diabetes Care, 35(4), 780–786. https://doi.org/10.2337/dc11-1790

Charatcharoenwitthaya, N., Nanthakomon, T., Somprasit, C., Chanthasenanont, A., Chailurkit, L. O., Pattaraarchachai, J., & Ongphiphadhanakul, B. (2013). Maternal vitamin D status, its associated factors and the course of pregnancy in Thai women. Clinical Endocrinology, 78(1), 126–133. https://doi.org/10.1111/j.1365-2265.2012.04470.x

Chen, X.L., Peng, Y.Y., & Xu, X.Q. (2018). Study on weight gain in different stages of pregnancy and pregnancy outcomes. Zhonghua yi xue za zhi, 98(19):1493-1497.

Chen, Y. H., Fu, L., Hao, J. H., Wang, H., Zhang, C., Tao, F. B., & Xu, D. X. (2018). Influent factors of gestational Vitamin D deficiency and its relation to an increased risk of preterm delivery in Chinese population. Scientific Reports, 8(1), 1–8. https://doi.org/10.1038/s41598-018-21944-3

Chen, Y., Zhu, B., Wu, X., Li, S., & Tao, F. (2017). Association between maternal vitamin D deficiency and small for gestational age: evidence from a meta-analysis of prospective cohort studies. BMJ Open, 7(8), e016404. https://doi.org/10.1136/bmjopen-2017-016404

Cheng, Q., Du, Y., Hong, W., Tang, W., Li, H., Chen, M., & Zheng, S. (2017). Factors associated to serum 25-hydroxyvitamin D levels among older adult populations in urban and suburban communities in Shanghai, China. BMC Geriatrics, 17(1), 246. https://doi.org/10.1186/s12877-017-0632-z

Chiefari, E., Arcidiacono, B., Foti, D., & Brunetti, A. (2017). Gestational diabetes mellitus: an updated overview. Journal of Endocrinological Investigation, 40(9), 899-909.

Cho, E.-H. H., Hur, J., & Lee, K.-J. J. (2015). Early Gestational Weight Gain Rate and Adverse Pregnancy Outcomes in Korean Women. PloS One, 10(10), e0140376. https://doi.org/10.1371/journal.pone.0140376

Choi, H. S. (2013). Vitamin d status in Korea. Endocrinol Metab (Seoul), 28(1), 12–16. https://doi.org/10.3803/EnM.2013.28.1.12

Choi, R., Kim, S., Yoo, H., Cho, Y. Y., Kim, S. W., Chung, J. H., Oh, S. Y., & Lee, S. Y. (2015). High prevalence of Vitamin D deficiency in pregnant Korean women: The first trimester and the winter season as risk factors for Vitamin D deficiency. Nutrients, 7(5), 3427–3448. https://doi.org/10.3390/nu7053427

Christesen, H. T., Falkenberg, T., Lamont, R. F., & Jørgensen, J. S. (2012). The impact of vitamin D on pregnancy: a systematic review. Acta obstetricia et gynecologica Scandinavica, 91(12), 1357–1367. https://doi.org/10.1111/aogs.12000

Chu, S. Y., Abe, K., Hall, L. R., Kim, S. Y., Njoroge, T., & Qin, C. (2009). Gestational diabetes mellitus: All Asians are not alike. Preventive Medicine, 49(2–3), 265–268. https://doi.org/10.1016/j.ypmed.2009.07.001

Chu, S. Y., Callaghan, W. M., Kim, S. Y., Schmid, C. H., Lau, J., England, L. J., & Dietz, P. M. (2007). Maternal obesity and risk of gestational diabetes mellitus. Diabetes care, 30(8), 2070-2076.

Cipriani, C., Pepe, J., Piemonte, S., Colangelo, L., Cilli, M., & Minisola, S. (2014). Vitamin D and its relationship with obesity and muscle. International Journal of Endocrinology, 2014. https://doi.org/10.1155/2014/841248

Colotta, F., Jansson, B., & Bonelli, F. (2017). Modulation of inflammatory and immune responses by vitamin D. Journal of Autoimmunity, 85, 78–97. https://doi.org/10.1016/j.jaut.2017.07.007

Contreras-Manzano, A., Villalpando, S., & Robledo-Pérez, R. (2017). Vitamin D status by sociodemographic factors and body mass index in Mexican women at reproductive age. Salud Publica de Mexico, 59(5), 518–525. https://doi.org/10.21149/8080

Cooray, S. D., Boyle, J. A., Soldatos, G., Wijeyaratne, L. A., & Teede, H. J. (2019). Prognostic prediction models for pregnancy complications in women with gestational diabetes: A protocol for systematic review, critical appraisal and meta-analysis. Systematic Reviews, 8(1), 1–10. https://doi.org/10.1186/s13643-019-1151-0

Cozzolino, M., Serena, C., Maggio, L., Rambaldi, M. P., Simeone, S., Mello, G., & Mecacci, F. (2017). Analysis of the main risk factors for gestational diabetes diagnosed with International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria in multiple pregnancies. Journal of endocrinological investigation, 40(9), 937-943.

Curtis, E. M., Moon, R. J., Harvey, N. C., & Cooper, C. (2018). Maternal Vitamin D supplementation during pregnancy. British Medical Bulletin, 126(1), 57–77. https://doi.org/10.1093/bmb/ldy010

Daglar, K., Tokmak, A., Kirbas, A., Guzel, A. I., Erkenekli, K., Yucel, A., & Uygur, D. (2016). Maternal serum Vitamin D levels in pregnancies complicated by neural tube defects. Journal of Maternal-Fetal and Neonatal Medicine, 29(2), 298–302. https://doi.org/10.3109/14767058.2014.999037

Dankers, W., Colin, E. M., van Hamburg, J. P., & Lubberts, E. (2017). Vitamin D in Autoimmunity: Molecular Mechanisms and Therapeutic Potential. Frontiers in immunology, 7, 697. https://doi.org/10.3389/fimmu.2016.00697

Dawodu, A., & Akinbi, H. (2013). IJWH-34032-vitamin-d-nutrition-in-pregnancy--current-opinion. International Journal of Women's Health, 5, 333–343. https://doi.org/10.2147/IJWH.S34032

de Seymour, J., Chia, A., Colega, M., Jones, B., McKenzie, E., Shirong, C., Godfrey, K., Kwek, K., Saw, S. M., Conlon, C., Chong, Y. S., Baker, P., & Chong, M. F. F. (2016). Maternal dietary patterns and gestational diabetes mellitus in a multi-ethnic Asian cohort: The GUSTO study. Nutrients, 8(9). https://doi.org/10.3390/nu8090574

Deplanque, X., Wullens, A., & Norberciak, L. (2017). Prévalence et facteurs de risque de l'insuffisance en vitamine D chez l'adulte sain entre 18 et 65 ans dans le Nord de la France. Revue de Medecine Interne, 38(6), 368–373. https://doi.org/10.1016/j.revmed.2016.12.013

Division of Family Health Development, Ministry of Health Malaysia. (2013). Perinatal Care Manual (3rd edition).

Domanski, G., Lange, A. E., Ittermann, T., Allenberg, H., Spoo, R. A., Zygmunt, M., & Heckmann, M. (2018). Evaluation of neonatal and maternal morbidity in mothers with gestational diabetes: a population-based study. BMC Pregnancy and Childbirth, 18(1), 367. https://doi.org/10.1186/s12884-018-2005-9

Du, H. Y., Jiang, H., O, K., Chen, B., Xu, L. J., Liu, S. P., Yi, J. P., He, G. S., & Qian, X. (2017). Association of Dietary Pattern during Pregnancy and Gestational Diabetes Mellitus: A Prospective Cohort Study in Northern China. Biomedical and environmental sciences: BES, 30(12), 887–897. https://doi.org/10.3967/bes2017.119

Dudhwadkar, A., & Fonseca, M. (2016). Maternal and fetal outcome in gestational diabetes mellitus. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 5(10), 3317-3321. doi: http://dx.doi.org/10.18203/2320-1770.ijrcog20163193

Duman, N. B. (2015). Frequency of gestational diabetes mellitus and the associated risk factors. Pakistan Journal of Medical Sciences, 31(1), 194–197. https://doi.org/10.12669/pjms.311.5617

Dwarkanath, P., Vinotha, P., Thomas, T., Joseph, S., Thomas, A., Shirley, G., Sheela, C. N., Mehta, S., & Kurpad, A. V. (2019). Relationship of Early Vitamin D Concentrations and Gestational Diabetes Mellitus in Indian Pregnant Women. Frontiers in Nutrition, 6(August), 1–8. https://doi.org/10.3389/fnut.2019.00116

Eades, C. E., Cameron, D. M., & Evans, J. M. M. (2017). Prevalence of gestational diabetes mellitus in Europe: A meta-analysis. In Diabetes Research and Clinical Practice (Vol. 129). https://doi.org/10.1016/j.diabres.2017.03.030

Ekeroma, A. J., Camargo, C. A., Scragg, R., Wall, C., Stewart, A., Mitchell, E., Crane, J., & Grant, C. C. (2015). Predictors of vitamin D status in pregnant women in New Zealand. The New Zealand Medical Journal, 128(1422), 24–34. http://www.ncbi.nlm.nih.gov/pubmed/26411844

El Lithy, A., Abdella, R. M., El-Faissal, Y. M., Sayed, A. M., & Samie, R. M. A. (2014). The relationship between low maternal serum vitamin D levels and glycemic control in gestational diabetes assessed by HbA1c levels: an observational cross-sectional study. BMC Pregnancy and Childbirth, 14(1), 362. https://doi.org/10.1186/1471-2393-14-362

El Maataoui, A., Biaz, A., El Machtani, S., Bouhsain, S., Dami, A., El Maghraoui, A., & Ouzzif, Z. (2016). Vitamin D status in healthy Moroccan men and women aged 50 years and older: a cross-sectional study. Archives of Osteoporosis, 11(1). https://doi.org/10.1007/s11657-016-0279-y

El Rifai, N. M., Abdel Moety, G. A. F., Gaafar, H. M., & Hamed, D. A. (2014). Vitamin D deficiency in Egyptian mothers and their neonates and possible related factors. The Journal of Maternal-Fetal & Neonatal Medicine, 27(10), 1064-1068.

El Sagheer, G. M., & Hamdi, L. (2018). Prevalence and risk factors for gestational diabetes mellitus according to the diabetes in pregnancy study group India in comparison to International Association of the Diabetes and Pregnancy Study Groups in El-Minya, Egypt. The Egyptian Journal of Internal Medicine, 30(3), 131.

Enkhmaa, D., Tanz, L., Ganmaa, D., Enkhtur, S., Oyun-Erdene, B., Stuart, J., Chen, G., Carr, A., Seely, E. W., Fitzmaurice, G., Buyandelger, Y., Sarantsetseg, B., Gantsetseg, G., & Rich-Edwards, J. (2019). Randomized trial of three doses of vitamin D to reduce deficiency in pregnant Mongolian women. EBioMedicine, 39, 510–519. https://doi.org/10.1016/j.ebiom.2018.11.060

Erem, C., Kuzu, U. B., Deger, O., & Can, G. (2015). Prevalence of gestational diabetes mellitus and associated risk factors in Turkish women: The Trabzon GDM Study. Archives of Medical Science, 11(4), 724–735. https://doi.org/10.5114/aoms.2015.53291

Fallatah, A. M., Bahrawi, A. J., Babatin, H. M., Nassibi, K. M., AlEdreesi, Y., & Abduljabbar, H. S. (2019). Pregnancy Outcomes among Obese Pregnant Women with Varying Levels of Vitamin D in King Abdulaziz University Hospital: A Single-center Retrospective Study. Cureus, 11(11). https://doi.org/10.7759/cureus.6220

Farhana, M. N., Rohana, A. J., & Alina, T. T. (2015). Excessive and inadequate gestational weight gain among Malaysian pregnant women in rural area: are there any associated factors?. Pakistan Journal of Nutrition, 14(12), 854.

Farrant, H. J., Krishnaveni, G. V., Hill, J. C., Boucher, B. J., Fisher, D. J., Noonan, K., Osmond, C., Veena, S. R., & Fall, C. H. (2009). Vitamin D insufficiency is common in Indian mothers but is not associated with gestational diabetes or variation in newborn size. European journal of clinical nutrition, 63(5), 646–652. https://doi.org/10.1038/ejcn.2008.14

Fenina, H., Chelli, D., Ben Fradj, M. K. ace., Feki, M., Sfar, E., & Kaabachi, N. (2016). Vitamin D Deficiency is Widespread in Tunisian Pregnant Women and Inversely Associated with the Level of Education. Clinical Laboratory, 62(5), 801–806. https://doi.org/10.7754/clin.lab.2015.150806

Fiscaletti, M., Stewart, P., & Munns, C. F. (2017). The importance of vitamin D in maternal and child health: A global perspective. Public Health Reviews, 38(1), 1–17. https://doi.org/10.1186/s40985-017-0066-3

Fong, A., Serra, A., Herrero, T., Pan, D., & Ogunyemi, D. (2014). Pre-gestational versus gestational diabetes: a population based study on clinical and demographic differences. Journal of diabetes and its complications, 28(1), 29–34. https://doi.org/10.1016/j.jdiacomp.2013.08.009

Fujimoto, W. Y., Bergstrom, R. W., Boyko, E. J., Leonetti, D. L., Newell-Morris, L. L., & Wahl, P. W. (1995). Susceptibility to development of central adiposity among populations. Obesity research, 3(S2), 179s-186s.

Ganeshan, M., Soelar, S. A., Karalasingam, S. D., Bujang, M. A., Jeganathan, R., & Suharjono, H. (2017). Effectiveness of selective risk based screening for Gestational Diabetes (GDM) in Malaysia: A retrospective cohort study based on the National Obstetric Registry (NOR) of Malaysia. Medical Journal of Malaysia, 72(1), 46–49.

Garrison, A. (2015). Screening, diagnosis, and management of gestational diabetes mellitus. American Family Physician, 91(7), 460–467.

Gbadegesin, A., Sobande, A., Adedeji, O., Disu, E., Korede, O., Dosunmu, A., & Shakunle, A. (2017). Maternal serum vitamin D levels and pregnancy outcomes: from Lagos, Nigeria. Journal of Obstetrics and Gynaecology, 37(1), 25–28. https://doi.org/10.1080/01443615.2016.1196483

Gibson, K. S., Waters, T. P., & Catalano, P. M. (2012). Maternal weight gain in women who develop gestational diabetes mellitus. Obstetrics and Gynecology, 119(3), 560–565. https://doi.org/10.1097/AOG.0b013e31824758e0

Gil, Á., Plaza-Diaz, J., & Mesa, M. D. (2018). Vitamin D: Classic and Novel Actions. Annals of Nutrition and Metabolism, 72(2), 87–95. https://doi.org/10.1159/000486536

Gilbert, L., Gross, J., Lanzi, S., Quansah, D. Y., Puder, J., & Horsch, A. (2019). How diet, physical activity and psychosocial well-being interact in women with gestational diabetes mellitus: an integrative review. BMC pregnancy and childbirth, 19(1), 1-16.

Gilder, M. E., Zin, T. W., Wai, N. S., Ner, M., Say, P. S., Htoo, M., Say, S., Htay, W. W., Simpson, J. A., Pukrittayakamee, S., Nosten, F., & McGready, R. (2014). Gestational diabetes mellitus prevalence in Maela refugee camp on the Thai-Myanmar border: A clinical report. Global Health Action, 7(1), 1–6. https://doi.org/10.3402/gha.v7.23887

Gill, T. K., Hill, C. L., Shanahan, E. M., Taylor, A. W., Appleton, S. L., Grant, J. F., Shi, Z., Dal Grande, E., Price, K., & Adams, R. J. (2014). Vitamin D levels in an Australian population. BMC Public Health, 14(1), 1001. https://doi.org/10.1186/1471-2458-14-1001

Gorman, S., Buckley, A. G., Ling, K. M., Berry, L. J., Fear, V. S., Stick, S. M., Larcombe, A. N., Kicic, A., & Hart, P. H. (2017). Vitamin D supplementation of initially vitamin D-deficient mice diminishes lung inflammation with limited effects on pulmonary epithelial integrity. Physiological Reports, 5(15), 1–12. https://doi.org/10.14814/phy2.13371

Green, T. J., Skeaff, C. M., Rockell, J. E. P., Venn, B. J., Lambert, a, Todd, J., Khor, G. L., Loh, S. P., Muslimatun, S., Agustina, R., & Whiting, S. J. (2008). Vitamin D status and its association with parathyroid hormone concentrations in women of child-bearing age living in Jakarta and Kuala Lumpur. European Journal of Clinical Nutrition, 62(3), 373–378. https://doi.org/10.1038/sj.ejcn.1602696

Griew, K., Nunn, R., Fairbrother, G., & Tewari, S. (2019). Early pregnancy vitamin D deficiency and gestational diabetes: Exploring the link. Australian Journal of General Practice, 48(11), 797–802. https://doi.org/10.31128/ajgp-09-18-469

Griffin, M. E., Coffey, M., Johnson, H., Scanlon, P., Foley, M., Stronge, J., O'Meara, N. M., & Firth, R. G. (2000). Universal vs. risk factor-based screening for gestational diabetes mellitus: Detection rates, gestation at diagnosis and outcome. Diabetic Medicine, 17(1), 26–32. https://doi.org/10.1046/j.1464-5491.2000.00214.x

Groof, Z., Garashi, G., Husain, H., Owayed, S., AlBader, S., Mouhsen, H., Mohammad, A., & Ziyab, A. H. (2019). Prevalence, risk factors, and fetomaternal outcomes of gestational diabetes mellitus in Kuwait: A cross-sectional study. Journal of Diabetes Research, 2019. https://doi.org/10.1155/2019/9136250

Guerrero-Hernandez, A., & Verkhratsky, A. (2014). Calcium signalling in diabetes. Cell Calcium, 56(5), 297–301. https://doi.org/10.1016/j.ceca.2014.08.009

Hajizadeh, S., Shary, J. R., Reed, S. G., & Wagner, C. L. (2019). The prevalence of hypovitaminosis D and its risk factors in pregnant women and their newborns in the Middle East: A systematic review. International Journal of Reproductive BioMedicine, 17(10), 685–708. https://doi.org/10.18502/ijrm.v17i10.5284

Hantoushzadeh, S., Sheikh, M., Bosaghzadeh, Z., Ghotbizadeh, F., Tarafdari, A., Panahi, Z., & Shariat, M. (2016). The impact of gestational weight gain in different trimesters of pregnancy on glucose challenge test and gestational diabetes. Postgraduate Medical Journal, 92(1091), 520–524. https://doi.org/10.1136/postgradmedj-2015-133816

Hardiman, G., Savage, S. J., Hazard, E. S., Wilson, R. C., Courtney, S. M., Smith, M. T., Hollis, B. W., Halbert, C. H., & Gattoni-Celli, S. (2016). Systems analysis of the prostate transcriptome in African-American men compared with European-American men. Pharmacogenomics, 17(10), 1129–1143. https://doi.org/10.2217/pgs-2016-0025

Hart, P. H., Lucas, R. M., Walsh, J. P., Zosky, G. R., Whitehouse, A. J. O., Zhu, K., Allen, K. L., Kusel, M. M., Anderson, D., & Mountain, J. A. (2015). Vitamin D in Fetal Development: Findings From a Birth Cohort Study. Pediatrics, 135(1), e167–e173. https://doi.org/10.1542/peds.2014-1860

Harvey, N. C., Holroyd, C., Ntani, G., Javaid, K., Cooper, P., Moon, R., Cole, Z., Tinati, T., Godfrey, K., Dennison, E., Bishop, N. J., Baird, J., & Cooper, C. (2014). Vitamin D supplementation in pregnancy: A systematic review. Health Technology Assessment, 18(45), 1–189. https://doi.org/10.3310/hta18450

Hasbullah, F., Yong, H., Mohd Shariff, Z., Rejali, Z., Adam, N., & Mohd Yusof, B. (2019). Dietary characteristics of women with gestational diabetes mellitus. Malaysian Journal of Medicine and Health Sciences, 15(SP1), 69–76.

Hashim, M., Radwan, H., Hasan, H., Obaid, R. S., Al Ghazal, H., Al Hilali, M., Rayess, R., Chehayber, N., Mohamed, H. J. J., & Naja, F. (2019). Gestational weight gain and gestational diabetes among Emirati and Arab women in the United Arab Emirates: Results from the MISC cohort. BMC Pregnancy and Childbirth, 19(1), 1–11. https://doi.org/10.1186/s12884-019-2621-z

Hayashi, A., Oguchi, H., Kozawa, Y., Ban, Y., Shinoda, J., & Suganuma, N. (2018). Daily walking is effective for the management of pregnant women with gestational diabetes mellitus. Journal of Obstetrics and Gynaecology Research, 44(9), 1731–1738. https://doi.org/10.1111/jog.13698

He, J. R., Yuan, M. Y., Chen, N. N., Lu, J. H., Hu, C. Y., Mai, W. B., Zhang, R. F., Pan, Y. H., Qiu, L., Wu, Y. F., Xiao, W. Q., Liu, Y., Xia, H. M., & Qiu, X. (2015). Maternal dietary patterns and gestational diabetes mellitus: A large prospective cohort study in China. British Journal of Nutrition, 113(8), 1292–1300. https://doi.org/10.1017/S0007114515000707

Hedderson, M. M., Gunderson, E. P., & Ferrara, A. (2010). Gestational weight gain and risk of gestational diabetes mellitus. Obstetrics and Gynecology, 115(3), 597–604. https://doi.org/10.1097/AOG.0b013e3181cfce4f

Helseth, R., Salvesen, O., Stafne, S. N., Morkved, S., Salvesen, K. A., & Carlsen, S. M. (2014). Gestational diabetes mellitus among Nordic Caucasian women: Prevalence and risk factors according to WHO and simplified IADPSG criteria. Scandinavian Journal of Clinical and Laboratory Investigation, 74(7), 620–628. https://doi.org/10.3109/00365513.2014.928942

Herring, S. J., Nelson, D. B., Pien, G. W., Homko, C., Goetzl, L. M., Davey, A., & Foster, G. D. (2014). Objectively measured sleep duration and hyperglycemia in pregnancy. Sleep medicine, 15(1), 51-55.

Herring, S. J., Oken, E., Rifas-Shiman, S. L., Rich-Edwards, J. W., Stuebe, A. M., Kleinman, K. P., & Gillman, M. W. (2009). Weight gain in pregnancy and risk of maternal hyperglycemia. American Journal of Obstetrics and Gynecology, 201(1), 61.e1-61.e7. https://doi.org/10.1016/j.ajog.2009.01.039

Hoge, A., Donneau, A. F., Streel, S., Kolh, P., Chapelle, J. P., Albert, A., Cavalier, E., & Guillaume, M. (2015). Vitamin D deficiency is common among adults in Wallonia (Belgium, 51°30' North): Findings from the Nutrition, Environment and Cardio-Vascular Health study. Nutrition Research, 35(8), 716–725. https://doi.org/10.1016/j.nutres.2015.06.005

Högler, W. (2015). Complications of vitamin D deficiency from the foetus to the infant: One cause, one prevention, but who's responsibility? Best Practice and Research: Clinical Endocrinology and Metabolism, 29(3), 385–398. https://doi.org/10.1016/j.beem.2015.03.003

Holick M. F. (2017). The vitamin D deficiency pandemic: Approaches for diagnosis, treatment and prevention. Reviews in endocrine & metabolic disorders, 18(2), 153–165. https://doi.org/10.1007/s11154-017-9424-1

Holick, M. F., Binkley, N. C., Bischoff-Ferrari, H. A., Gordon, C. M., Hanley, D. A., Heaney, R. P., Murad, M. H., & Weaver, C. M. (2011). Evaluation, treatment, and prevention of vitamin D deficiency: An endocrine society clinical practice guideline. Journal of Clinical Endocrinology and Metabolism, 96(7), 1911–1930. https://doi.org/10.1210/jc.2011-0385

Hong-Bi, S., Yin, X., Xiaowu, Y., Ying, W., Yang, X., Ting, C., & Na, W. (2018). High prevalence of vitamin D deficiency in pregnant women and its relationship with adverse pregnancy outcomes in Guizhou, China. Journal of International Medical Research, 46(11), 4500–4505. https://doi.org/10.1177/0300060518781477

Horvath, K., Koch, K., Jeitler, K., Matyas, E., Bender, R., Bastian, H., Lange, S., & Siebenhofer, A. (2010). Effects of treatment in women with gestational diabetes mellitus: Systematic review and meta-analysis. BMJ (Online), 340(7750), 796. https://doi.org/10.1136/bmj.c1395

Hossein-nezhad, A., & Holick, M. F. (2013). Vitamin D for health: a global perspective. Mayo Clinic proceedings,88(7),720-755. https://doi.org/10.1016/j.mayocp.2013.05.011

Hrolfsdottir, L., Gunnarsdottir, I., Birgisdottir, B. E., Hreidarsdottir, I. T., Smarason, A. K., Hardardottir, H., & Halldorsson, T. I. (2019). Can a simple dietary screening in early pregnancy identify dietary habits associated with gestational diabetes? Nutrients, 11(8), 1–12. https://doi.org/10.3390/nu11081868

Hu, J., Oken, E., Aris, I. M., Lin, P. I. D., Ma, Y., Ding, N., Gao, M., Wei, X., & Wen, D. (2019). Dietary patterns during pregnancy are associated with the risk of gestational diabetes mellitus: Evidence from a chinese prospective birth cohort study. Nutrients, 11(2), 1–15. https://doi.org/10.3390/nu11020405

Huang, A., Ji, Z., Zhao, W., Hu, H., Yang, Q., & Chen, D. (2016). Rate of gestational weight gain and preterm birth in relation to prepregnancy body mass indices and trimester: a follow-up study in China. Reproductive Health, 13(1), 1–7. https://doi.org/10.1186/s12978-016-0204-2

Huang, T. T. K., Roberts, S. B., Howarth, N. C., & McCrory, M. A. (2005). Effect of screening out implausible energy intake reports on relationships between diet and BMI. Obesity research, 13(7), 1205-1217.

Hulley, S. B., Cummings, S. R., Newman, T. B., Browner, W. S., & Grady, D. G. (2013). Designing cross-sectional and cohort studies. Designing clinical research, 85.

Huxley, R., James, W. P. T., Barzi, F., Patel, J. V., Lear, S. A., Suriyawongpaisal, P., & Reddy, S. (2008). Ethnic comparisons of the cross-sectional relationships between measures of body size with diabetes and hypertension. Obesity Reviews, 9, 53-61.

Illescas-Montes, R., Melguizo-Rodríguez, L., Ruiz, C., & Costela-Ruiz, V. J. (2019). Vitamin D and autoimmune diseases. Life Sciences, 233(July), 116744. https://doi.org/10.1016/j.lfs.2019.116744

Ilmiawati, C., Oviana, A., Friadi, A., & Reza, M. (2020). Sunlight exposed body surface area is associated with serum 25-hydroxyvitamin D (25 (OH) D) level in pregnant Minangkabau women, Indonesia. BMC nutrition, 6(1), 1-7.

Institute for Public Health (IPH), Ministry of Health Malaysia. (2011). National Health and Morbidity Survey (NHMS) 2011. Vol. II: Non-Communicable Diseases.

Institute for Public Health (IPH), Ministry of Health Malaysia. (2020). National Health and Morbidity Survey (NHMS) 2019: Non-communicable diseases, healthcare demand, and health literacy-Key Findings.

Institute for Public Health (IPH), Ministry of Health Malaysia. (2016). National Health and Morbidity Survey (NHMS) 2016: Maternal and Child Health. Vol. II: Findings.

Institute of Medicine (IOM). (2009). Weight gain during pregnancy: reexamining the guidelines. Washington, DC: The National Academies Press.

Institute of Medicine (IOM). (2011). Dietary reference intakes for calcium and vitamin D. Washington, DC: The National Academies Press.

International Association of Diabetes and Pregnancy Study Groups (IADPSG) Consensus Panel. Metzger, B. E., Gabbe, S. G., Persson, B., Buchanan, T. A., Catalano, P. A., Damm, P., Dyer, A. R., Leiva, A. d., Hod, M., Kitzmiler, J. L., Lowe, L. P., McIntyre, H. D., Oats, J. J., Omori, Y., & Schmidt, M. I. (2010). International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes care, 33(3), 676–682. https://doi.org/10.2337/dc09-1848

Jain, M., Kapry, S., Jain, S., Singh, S. K., & Singh, T. B. (2015). Maternal vitamin D deficiency: a risk factor for gestational diabetes mellitus in North India. Gynecol Obstet (Sunnyvale), 5(264), 2161-0932.

Jamil, N. A., Shahudin, N. N., Aziz, N. S. A., Qi, C. J., Aminuddin, W. A. A. W., Ludin, A. F. M., Chin, K. Y., Manaf, Z. A., & Daud, N. M. (2019). Knowledge, attitude and practice related to vitamin D and its relationship with vitamin d status among malay female office workers. International Journal of Environmental Research and Public Health, 16(23), 1–11. https://doi.org/10.3390/ijerph16234735

Jan Mohamed, H. J., Rowan, A., Fong, B., & Loy, S. L. (2014). Maternal serum and breast milk vitamin D levels: findings from the Universiti Sains Malaysia Pregnancy Cohort Study. PloS One, 9(7), e100705. https://doi.org/10.1371/journal.pone.0100705

Jang, H. C., Min, H. K., Lee, H. K., Cho, N. H., & Metzger, B. E. (1998). Short stature in Korean women: A contribution to the multifactorial predisposition to gestational diabetes mellitus. Diabetologia, 41(7), 778–783. https://doi.org/10.1007/s001250050987

Japelt, R. B., & Jakobsen, J. (2013). Vitamin D in plants: a review of occurrence , analysis , and biosynthesis. 4(May), 1–20. https://doi.org/10.3389/fpls.2013.00136

Jesmin, S., Akter, S., Akashi, H., Al-Mamun, A., Rahman, M. A., Islam, M. M., Sohael, F., Okazaki, O., Moroi, M., Kawano, S., & Mizutani, T. (2014). Screening for gestational diabetes mellitus and its prevalence in Bangladesh. Diabetes Research and Clinical Practice, 103(1), 57–62. https://doi.org/10.1016/j.diabres.2013.11.024

Ji, S. K., Jang, H. C., & Choi, H. M. (2008). A case-control study of food habits and diet intakes of women with gestational diabetes mellitus. Journal of Nutrition and Health, 41(1), 41-53.

Johnson, D. D., Wagner, C. L., Hulsey, T. C., McNeil, R. B., Ebeling, M., & Hollis, B. W. (2011). Vitamin D deficiency and insufficiency is common during pregnancy. American Journal of Perinatology, 28(1), 7–12. https://doi.org/10.1055/s-0030-1262505

Joseph, M., Das Gupta, R., Shetty, S., Ramachandran, R., Antony, G., Mathews, J., Benjamin, S., Anoop, S., Rani, J. V., & Thomas, N. (2018). How Adequate are Macro- and Micronutrient Intake in Pregnant Women with Diabetes Mellitus? A Study from South India. Journal of Obstetrics and Gynecology of India, 68(5), 400–407. https://doi.org/10.1007/s13224-017-1069-1

Judistiani, R. T. D., Nirmala, S. A., Rahmawati, M., Ghrahani, R., Natalia, Y. A., Sugianli, A. K., Indrati, A. R., Suwarsa, O., & Setiabudiawan, B. (2019). Optimizing ultraviolet B radiation exposure to prevent vitamin D deficiency among pregnant women in the tropical zone: Report from cohort study on vitamin D status and its impact during pregnancy in Indonesia. BMC Pregnancy and Childbirth, 19(1), 1–9. https://doi.org/10.1186/s12884-019-2306-7

Junaid, K., Rehman, A., Jolliffe, D. A., Wood, K., & Martineau, A. R. (2015). High prevalence of vitamin D deficiency among women of child-bearing age in Lahore Pakistan, associating with lack of sun exposure and illiteracy. BMC Women's Health, 15(1), 1–8. https://doi.org/10.1186/s12905-015-0242-x

Kahn, S. E., Hull, R. L., & Utzschneider, K. M. (2006). Mechanisms linking obesity to insulin resistance and type 2 diabetes. Nature, 444(7121), 840–846. https://doi.org/10.1038/nature05482

Kalyani, K., Jajoo, S., Hariharan, C., & Samal, S. (2014). Prevalence of gestational diabetes mellitus, its associated risk factors and pregnancy outcomes at a rural setup in Central India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 3(1), 219–224. https://doi.org/10.5455/2320-1770.ijrcog20140344

Kanan, R. M., Al Saleh, Y. M., Fakhoury, H. M., Adham, M., Aljaser, S., & Tamimi, W. (2013). Year-round vitamin D deficiency among Saudi female out-patients. Public Health Nutrition, 16(3), 544–548. https://doi.org/10.1017/S1368980012002947

Karlsson, T., Andersson, L., Hussain, A., Bosaeus, M., Jansson, N., Osmancevic, A., Hulthén, L., Holmäng, A., & Larsson, I. (2015). Lower vitamin D status in obese compared with normal-weight women despite higher vitamin D intake in early pregnancy. Clinical Nutrition, 34(5), 892–898. https://doi.org/10.1016/j.clnu.2014.09.012

Karras, S. N., Anagnostis, P., Paschou, S. A., Kandaraki, E., & Goulis, D. G. (2015). Vitamin D status during pregnancy: Time for a more unified approach beyond borders? European Journal of Clinical Nutrition, 69(8), 874–877. https://doi.org/10.1038/ejcn.2015.33

Kershaw, E. E., & Flier, J. S. (2004). Adipose tissue as an endocrine organ. Journal of Clinical Endocrinology and Metabolism, 89(6), 2548–2556. https://doi.org/10.1210/jc.2004-0395

Khan, R., Ali, K., & Khan, Z. (2013). Socio-demographic risk factors of gestational diabetes mellitus. Pakistan Journal of Medical Sciences, 29(3), 843–846. https://doi.org/10.12669/pjms.293.3629

Khan, S. (2018). Evaluation of the diabetes in pregnancy study group of India criteria and Carpenter-Coustan criteria in the diagnosis of gestational diabetes mellitus Gestasyonel diabetes mellitus tanısında Hindistan kriterleri. 75–79. https://doi.org/10.4274/tjod.57255

Khor, G. L., Chee, W. S. S., Shariff, Z. M., Poh, B. K., Arumugam, M., Rahman, J. A., & Theobald, H. E. (2011). High prevalence of vitamin D insufficiency and its association with BMI-for-age among primary school children in Kuala Lumpur, Malaysia. BMC Public Health, 11(Idd), 95. https://doi.org/10.1186/1471-2458-11-95

Kim, S. Y., Saraiva, C., Curtis, M., Wilson, H. G., Troyan, J., England, L., & Sharma, A. J. (2013). Fraction of gestational diabetes mellitus attributable to overweight and obesity by race/ethnicity, California, 2007-2009. American Journal of Public Health, 103(10), 2007–2009. https://doi.org/10.2105/AJPH.2013.301469

Kota, S., Jammula, S., Panda, S., Modi, K., Kota, S., Meher, L., & Tripathy, P. (2011). Renin-angiotensin system activity in vitamin D deficient, obese individuals with hypertension: An urban Indian study. Indian Journal of Endocrinology and Metabolism, 15(8), 395. https://doi.org/10.4103/2230-8210.86985

Kramer, C. K., Campbell, S., & Retnakaran, R. (2019). Gestational diabetes and the risk of cardiovascular disease in women: a systematic review and meta-analysis. Diabetologia, 62(6), 905–914. https://doi.org/10.1007/s00125-019-4840-2

Kramer, C. K., Swaminathan, B., Hanley, A. J., Connelly, P. W., Sermer, M., Zinman, B., & Retnakaran, R. (2014). Prospective associations of vitamin D status with β-cell function, insulin sensitivity, and glycemia: the impact of parathyroid hormone status. Diabetes, 63(11), 3868-3879.

Krishnan, A. V, Trump, D. L., Johnson, C. S., & Feldman, D. (2012). The Role of Vitamin D in Cancer Prevention and Treatment. Rheumatic Disease Clinics of North America, 38, 161–178. https://doi.org/10.1016/j.rdc.2012.03.014

Kumar, K. V. Sh., Kumar, S., Dhillon, A., Mansingh, S., & Sood, S. (2016). High prevalence of Vitamin D deficiency during pregnancy: A social health problem in India. Journal of Social Health and Diabetes, 4(1), 36. https://doi.org/10.4103/2321-0656.164793

Lacroix, M., Battista, M. C., Doyon, M., Houde, G., Ménard, J., Ardilouze, J. L., Hivert, M. F., & Perron, P. (2014). Lower vitamin D levels at first trimester are associated with higher risk of developing gestational diabetes mellitus. Acta Diabetologica, 51(4), 609–616. https://doi.org/10.1007/s00592-014-0564-4

Lacroix, M., Battista, M. C., Doyon, M., Moreau, J., Patenaude, J., Guillemette, L., Ménard, J., Ardilouze, J. L., Perron, P., & Hivert, M. F. (2016). Higher maternal leptin levels at second trimester are associated with subsequent greater gestational weight gain in late pregnancy. BMC Pregnancy and Childbirth, 16(1), 1–9. https://doi.org/10.1186/s12884-016-0842-y

Lamb, A. R., Lutenbacher, M., Wallston, K. A., Pepkowitz, S. H., Holmquist, B., & Hobel, C. J. (2018). Vitamin D deficiency and depressive symptoms in the perinatal period. Archives of Women's Mental Health, 21(6), 745–755. https://doi.org/10.1007/s00737-018-0852-z

Larose, T. L., Chen, Y., Camargo, C. A., Langhammer, A., Romundstad, P., & Mai, X. M. (2014). Factors associated with vitamin D deficiency in a Norwegian population: The HUNT Study. Journal of Epidemiology and Community Health, 68(2), 165–170. https://doi.org/10.1136/jech-2013-202587

Larrabure-Torrealva, G. T., Martinez, S., Luque-Fernandez, M. A., Sanchez, S. E., Mascaro, P. A., Ingar, H., Castillo, W., Zumaeta, R., Grande, M., Motta, V., Pacora, P., Gelaye, B., & Williams, M. A. (2018). Prevalence and risk factors of gestational diabetes mellitus: Findings from a universal screening feasibility program in Lima, Peru. BMC Pregnancy and Childbirth, 18(1), 1–9. https://doi.org/10.1186/s12884-018-1904-0

Lawrence, R. L., Wall, C. R., & Bloomfield, F. H. (2019). Prevalence of gestational diabetes according to commonly used data sources: An observational study. BMC Pregnancy and Childbirth, 19(1), 1–9. https://doi.org/10.1186/s12884-019-2521-2

Lee, C. L., Ng, B. K., Wu, L. L., Cheah, F. C., Othman, H., & Ismail, N. A. M. (2017). Vitamin D deficiency in pregnancy at term: Risk factors and pregnancy outcomes. Hormone Molecular Biology and Clinical Investigation, 31(3), 1–8. https://doi.org/10.1515/hmbci-2017-0005

Lee, K. W., Ching, S. M., Ramachandran, V., Yee, A., Hoo, F. K., Chia, Y. C., Wan Sulaiman, W. A., Suppiah, S., Mohamed, M. H., & Veettil, S. K. (2018). Prevalence and risk factors of gestational diabetes mellitus in Asia: A systematic review and meta-analysis. BMC Pregnancy and Childbirth, 18(1), 1–20. https://doi.org/10.1186/s12884-018-2131-4

Lee, S. S., Subramaniam, R., Tusimin, M., Ling, K. H., Rahim, K. F., & Loh, S. P. (2020). Inadequate vitamin D intake among pregnant women in Malaysia based on revised recommended nutrient intakes value and potential dietary strategies to tackle the inadequacy. Nutrition Research and Practice, 14.

Leelavathi, M., & Danasamy, R. S. (2018). Knowledge of obesity related pregnancy risks among expectant mothers and its associated factors. The Medical journal of Malaysia, 73(4), 239-243.

Leng, J., Liu, G., Zhang, C., Xin, S., Chen, F., Li, B., Tian, H., Yu, Z., Tuomilehto, J., Hu, G., & Yang, X. (2016). Physical activity, sedentary behaviors and risk of gestational diabetes mellitus: A population-based cross-sectional study in Tianjin, China. European Journal of Endocrinology, 174(6), 763–773. https://doi.org/10.1530/EJE-15-1103

Leng, J., Shao, P., Zhang, C., Tian, H., Zhang, F., Zhang, S., Dong, L., Li, L., Yu, Z., Chan, J. C. N., Hu, G., & Yang, X. (2015). Prevalence of gestational diabetes mellitus and its risk factors in Chinese pregnant women: A prospective population-based study in Tianjin, China. PLoS ONE, 10(3), 1–12. https://doi.org/10.1371/journal.pone.0121029

Ley, S. H., Hanley, A. J., Retnakaran, R., Sermer, M., Zinman, B., & O'Connor, D. L. (2011). Effect of macronutrient intake during the second trimester on glucose metabolism later in pregnancy. American Journal of Clinical Nutrition, 94(5), 1232–1240. https://doi.org/10.3945/ajcn.111.018861

Li, G., Kong, L., Zhang, L., Fan, L., Su, Y., Rose, J. C., & Zhang, W. (2015). Early Pregnancy Maternal Lipid Profiles and the Risk of Gestational Diabetes Mellitus Stratified for Body Mass Index. Reproductive Sciences, 22(6), 712–717. https://doi.org/10.1177/1933719114557896

Li, H., Shen, L., Song, L., Liu, B., Zheng, X., Xu, S., & Wang, Y. (2017). Early age at menarche and gestational diabetes mellitus risk: Results from the Healthy Baby Cohort study. Diabetes and Metabolism, 43(3), 248–252. https://doi.org/10.1016/j.diabet.2017.01.002

Li, J., Song, C., Li, C., Liu, P., Sun, Z., & Yang, X. (2018). Increased risk of cardiovascular disease in women with prior gestational diabetes: A systematic review and meta-analysis. Diabetes Research and Clinical Practice, 140, 324–338. https://doi.org/10.1016/j.diabres.2018.03.054

Li, Z., Cheng, Y., Wang, D., Chen, H., Chen, H., Ming, W. K., & Wang, Z. (2020). Incidence Rate of Type 2 Diabetes Mellitus after Gestational Diabetes Mellitus: A Systematic Review and Meta-Analysis of 170,139 Women. Journal of Diabetes Research, 2020(1). https://doi.org/10.1155/2020/3076463

Liang, Y., Gong, Y., Zhang, X., Yang, D., Zhao, D., Quan, L., Zhou, R., Bao, W., & Cheng, G. (2018). Dietary protein intake, meat consumption, and dairy consumption in the year preceding pregnancy and during pregnancy and their associations with the risk of Gestational diabetes mellitus: A prospective cohort study in southwest China. Frontiers in Endocrinology, 9(OCT), 1–9. https://doi.org/10.3389/fendo.2018.00596

Lichtenstein, A. H., & Schwab, U. S. (2000). Relationship of dietary fat to glucose metabolism. Atherosclerosis, 150(2), 227–243. https://doi.org/10.1016/s0021-9150(99)00504-3

Lim, S.-Y., Yoo, H.-J., Kim, A.-L., Oh, J.-A., Kim, H.-S., Choi, Y.-H., Cho, J.-H., Lee, J.-H., & Yoon, K.-H. (2013). Nutritional Intake of Pregnant Women with Gestational Diabetes or Type 2 Diabetes Mellitus. Clinical Nutrition Research, 2(2), 81. https://doi.org/10.7762/cnr.2013.2.2.81

Lin, P. C., Hung, C. H., Chan, T. F., Lin, K. C., Hsu, Y. Y., & Ya-Ling Tzeng. (2016). The risk factors for gestational diabetes mellitus: A retrospective study. Midwifery, 42, 16–20. https://doi.org/10.1016/j.midw.2016.09.008

Lindsay, K. L., Brennan, L., Kennelly, M. A., Maguire, O. C., Smith, T., Curran, S., & McAuliffe, F. M. (2015). Impact of probiotics in women with gestational diabetes mellitus on metabolic health: a randomized controlled trial. American journal of obstetrics and gynecology, 212(4), 496-e1.

Lips, P., Eekhoff, M., van Schoor, N., Oosterwerff, M., de Jongh, R., Krul-Poel, Y., & Simsek, S. (2017). Vitamin D and type 2 diabetes. Journal of Steroid Biochemistry and Molecular Biology, 173, 280–285. https://doi.org/10.1016/j.jsbmb.2016.11.021

Liu, X., Baylin, A., & Levy, P. D. (2018). Vitamin D deficiency and insufficiency among US adults: Prevalence, predictors and clinical implications. British Journal of Nutrition, 119(8), 928–936. https://doi.org/10.1017/S0007114518000491

Liu, Z., Ao, D., Yang, H. X., & Wang, Y. (2014). Gestational weight gain and risk of gestational diabetes mellitus among Chinese women. Chinese Medical Journal, 127(7), 1255–1260. https://doi.org/10.3760/cma.j.issn.0366-6999.20132772

Logakodie, S., Azahadi, O., Fuziah, P., Norizzati, B., Tan, S. F., Zienna, Z., Norliza, M., Noraini, J., Hazlin, M., Noraliza, M. Z., Sazidah, M. K., & Mimi, O. (2017). Gestational diabetes mellitus: The prevalence, associated factors and foeto-maternal outcome of women attending antenatal care. Malaysian Family Physician : The Official Journal of the Academy of Family Physicians of Malaysia, 12(2), 9–17.

Londero, A. P., Rossetti, E., Pittini, C., Cagnacci, A., & Driul, L. (2019). Maternal age and the risk of adverse pregnancy outcomes: A retrospective cohort study. BMC Pregnancy and Childbirth, 19(1), 1–10. https://doi.org/10.1186/s12884-019-2400-x

Lopes, V. M., Lopes, J. R. C., Brasileiro, J. P. B., Oliveira, I. de, Lacerda, R. P., Andrade, M. R. D., Tierno, N. I. Z., Souza, R. C. C. de, & Motta, L. A. C. R. da. (2017). Highly prevalence of vitamin D deficiency among Brazilian women of reproductive age. Archives of Endocrinology and Metabolism, 61(1), 21–27. https://doi.org/10.1590/2359-3997000000216

Louie, J. C. Y., Markovic, T. P., Ross, G. P., Foote, D., & Brand-Miller, J. C. (2013). Higher glycemic load diet is associated with poorer nutrient intake in women with gestational diabetes mellitus. Nutrition Research, 33(4), 259–265. https://doi.org/10.1016/j.nutres.2013.02.008

Loy, S. L., Lek, N., Yap, F., Soh, S. E., Padmapriya, N., Tan, K. H., Biswas, A., Yeo, G. S. H., Kwek, K., Gluckman, P. D., Godfrey, K. M., Saw, S. M., Muller-Riemenschneider, F., Chong, Y. S., Chong, M. F. F., Chan, J. K. Y., Sheppard, A., Chinnadurai, A., Goh, A. E. N., Lee, Y. S. (2015). Association of maternal Vitamin D status with glucose tolerance and caesarean section in a multi-ethnic Asian cohort: The growing up in Singapore towards healthy outcomes study. PLoS ONE, 10(11), 1–16. https://doi.org/10.1371/journal.pone.0142239

Lu, M., Xu, Y., Lv, L., & Zhang, M. (2016). Association between vitamin D status and the risk of gestational diabetes mellitus: a meta-analysis. Archives of Gynecology and Obstetrics, 293(5), 959–966. https://doi.org/10.1007/s00404-016-4010-4

Lundqvist, A., Sandström, H., Stenlund, H., Johansson, I., & Hultdin, J. (2016). Vitamin D status during pregnancy: A longitudinal study in Swedish women from early pregnancy to seven months postpartum. PLoS ONE, 11(3), 1–12. https://doi.org/10.1371/journal.pone.0150385

Macaulay, S., Dunger, D. B., & Norris, S. A. (2014). Gestational diabetes mellitus in Africa: A systematic review. PLoS ONE, 9(6). https://doi.org/10.1371/journal.pone.0097871

Macaulay, S., Ngobeni, M., Dunger, D. B., & Norris, S. A. (2018). The prevalence of gestational diabetes mellitus amongst black South African women is a public health concern. Diabetes Research and Clinical Practice, 139, 278–287. https://doi.org/10.1016/j.diabres.2018.03.012

Maestro, B., Molero, S., Bajo, S., N.DaÂvila, & Calle, C. (2002). Transcriptional activation of the human insulin receptor gene. Cell Biochemistry and Function, 20(April 2001), 227–232.

Maghbooli, Z., Hossein-nezhad, A., Karimi, F., Shafaei, A. R., & Larijani, B. (2008). Correlation between vitamin D3 deficiency and insulin resistance in pregnancy. Diabetes/metabolism research and reviews, 24(1), 27-32.

Mahtab, H., & Bhowmik, B. (2016). Gestational Diabetes Mellitus–Global and Bangladesh Perspectives. J Endocrinol, 3(2), 1041

Mak, J. K. L., Pham, N. M., Lee, A. H., Tang, L., Pan, X. F., Binns, C. W., & Sun, X. (2018). Dietary patterns during pregnancy and risk of gestational diabetes: A prospective cohort study in Western China 11 Medical and Health Sciences 1111 Nutrition and Dietetics 11 Medical and Health Sciences 1114 Paediatrics and Reproductive Medicine. Nutrition Journal, 17(1), 1–11. https://doi.org/10.1186/s12937-018-0413-3

Makgoba, M., Nelson, S. M., Savvidou, M., Messow, C. M., Nicolaides, K., & Sattar, N. (2011). First-trimester circulating 25-hydroxyvitamin D levels and development of gestational diabetes mellitus. Diabetes Care, 34(5), 1091–1093. https://doi.org/10.2337/dc10-2264

Malacova, E., Cheang, P., Dunlop, E., Sherriff, J. L., Lucas, R. M., Daly, R. M., Nowson, C. A., & Black, L. J. (2019). Prevalence and predictors of Vitamin D deficiency in a nationally representative sample of adults participating in the 2011-2013 Australian Health Survey. British Journal of Nutrition, 121(8), 894–904. https://doi.org/10.1017/S0007114519000151

Mamat@Mohamad, Puteri Sulwani (2016) Validation of the Malay version of pregnancy physical activity questionaire (PPAQ) and the assessment of physical activity, dietary intake and gestational weight gain rate among pregnant women in Kota Bharu, Kelantan. Masters thesis, Universiti Sains Malaysia.

Mapira, H. T., Tumusiime, D. K., Yarasheski, K., Rujeni, N., Cade, T. W., & Mutimura, E. (2017). Strategy to improve the burden of gestational diabetes in African women: Rwandan perspective. Rwanda Journal, 4(1), 36. https://doi.org/10.4314/rj.v4i1.5f

Martin, T., & Campbell, R. K. (2011). Vitamin D and Diabetes. 113–118.

Masalin, S., Laine, M. K., Kautiainen, H., Gissler, M., Raina, M., Pennanen, P., & Eriksson, J. G. (2019). Impact of maternal height and gestational diabetes mellitus on offspring birthweight. Diabetes Research and Clinical Practice, 148, 110–118. https://doi.org/10.1016/j.diabres.2019.01.004

Mat, S., Jaafar, M. H., Sockalingam, S., Raja, J., Kamaruzzaman, S. B., Chin, A. V., Abbas, A. A., Chan, C. K., Hairi, N. N., Othman, S., Cumming, R., & Tan, M. P. (2018). Vitamin D deficiency is associated with ethnicity and knee pain in a multi-ethnic South-East Asian nation: Results from Malaysian Elders Longitudinal Research (MELoR). International Journal of Rheumatic Diseases, 21(5), 930–936. https://doi.org/10.1111/1756-185X.13279

Mcaree, T., Jacobs, B., Manickavasagar, T., Sivalokanathan, S., Brennan, L., Bassett, P., Rainbow, S., & Blair, M. (2013). Vitamin D deficiency in pregnancy - still a public health issue. Maternal and Child Nutrition, 9(1), 23–30. https://doi.org/10.1111/mcn.12014

Mechenro, J., Venugopal, G., Buvnesh Kumar, M., Balakrishnan, D., & Ramakrishna, B. S. (2018). Vitamin D status in Kancheepuram District, Tamil Nadu, India. BMC Public Health, 18(1), 1–8. https://doi.org/10.1186/s12889-018-6244-5

Meinila, J., Koivusalo, S. B., Valkama, A., Rono, K., Erkkola, M., Kautiainen, H., Stach-Lempinen, B., & Eriksson, J. G. (2015). Nutrient intake of pregnant women at high risk of gestational diabetes. Food & nutrition research, 59, 26676. https://doi.org/10.3402/fnr.v59.26676

Metzger, B. E. (2008). International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes Care, 33(3), 676–682. https://doi.org/10.2337/dc09-1848

Mijatovic-Vukas, J., Capling, L., Cheng, S., Stamatakis, E., Louie, J., Wah Cheung, N., Markovic, T., Ross, G., Senior, A., Brand-Miller, J. C., & Flood, V. M. (2018). Associations of diet and physical activity with risk for gestational diabetes mellitus: A Systematic review and meta-analysis. Nutrients, 10(6). https://doi.org/10.3390/nu10060698

Ming, W. K., Ding, W., Zhang, C. J. P., Zhong, L., Long, Y., Li, Z., Sun, C.,Wu, Y.,Chen, H.,Chen, H., & Wang, Z.(2018). The effect of exercise during pregnancy on gestational diabetes mellitus in normal-weight women:A systematic review and meta-analysis. BMC Pregnancy and Childbirth, 18(1),1–9.https://doi.org/10.1186/s12884-018-2068-7

Ministry of Health Malaysia. (2015). Clinical Practice Guidelines: Management of Type 2 Diabetes Mellitus (5th Edition).

Mirghani Dirar, A., & Doupis, J. (2017). Gestational diabetes from A to Z. World journal of diabetes, 8(12), 489–511. https://doi.org/10.4239/wjd.v8.i12.489

Mishra, S., & Kishore, S. (2018). Effect of physical activity during pregnancy on gestational diabetes mellitus. Indian Journal of Endocrinology and Metabolism, 22(5), 661.

Mitanchez, D., Yzydorczyk, C., & Simeoni, U. (2015). What neonatal complications should the pediatrician be aware of in case of maternal gestational diabetes? World Journal of Diabetes, 6(5), 734. https://doi.org/10.4239/wjd.v6.i5.734

Mitchell, D., Henao, M., Finkelstein, J., & Burnett-Bowie, S-A. (2012). Prevalence and predictors of vitamin D deficiency in healthy young adults. Endocrine Practice, 18(6), 914–923. https://doi.org/10.4158/EP12072.OR.PREVALENCE

Mohan, M. A., & Chandrakumar, A. (2016). Evaluation of prevalence and risk factors of gestational diabetes in a tertiary care hospital in Kerala. Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 10(2), 68–71. https://doi.org/10.1016/j.dsx.2015.09.002

Mohsin, F., Khan, S., Baki, M. A., Zabeen, B., & Azad, K. (2016). Neonatal management of pregnancy complicated by diabetes. JPMA. The Journal of the Pakistan Medical Association, 66(9), S81–S84.

Moon, R. J., Harvey, N. C., & Cooper, C. (2015). Influence of maternal vitamin D status on obstetric outcomes and the fetal skeleton. European Journal of Endocrinology, 173(2), R69–R83. https://doi.org/10.1530/EJE-14-0826

Moosazadeh, M., Asemi, Z., Lankarani, K. B., Tabrizi, R., Maharlouei, N., Naghibzadeh-Tahami, A., Yousefzadeh, G., Sadeghi, R., Khatibi, S. R., Afshari, M., Khodadost, M., & Akbari, M. (2017). Family history of diabetes and the risk of gestational diabetes mellitus in Iran: A systematic review and meta-analysis. Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 11(2), S99–S104. https://doi.org/10.1016/j.dsx.2016.12.016

Morisset, A. S., Tchernof, A., Dubé, M. C., Veillette, J., Weisnagel, S. J., & Robitaille, J. (2011). Weight gain measures in women with gestational diabetes mellitus. Journal of women's health, 20(3), 375-380.

Mottola, M. F., & Artal, R. (2016). Role of exercise in reducing gestational diabetes mellitus. Clinical Obstetrics and Gynecology, 59(3), 620–628. https://doi.org/10.1097/GRF.0000000000000211

Moulas, A. N., & Vaiou, M. (2018). Vitamin D fortification of foods and prospective health outcomes. Journal of Biotechnology, 285, 91–101. https://doi.org/10.1016/j.jbiotec.2018.08.010

Mousa, A., & Naqash, A. (2019). Macronutrient and Micronutrient Intake during Pregnancy: An Overview of Recent Evidence. 1–20. https://doi.org/10.3390/nu11020443

Mousa, A., Naderpoor, N., Johnson, J., Sourris, K., De Courten, M. P. J., Wilson, K., Scragg, R., Plebanski, M., & De Courten, B. (2017). Effect of Vitamin D supplementation on inflammation and nuclear factor kappa-B activity in overweight/obese adults: A randomized placebo-controlled trial. Scientific Reports, 7(1), 1–11. https://doi.org/10.1038/s41598-017-15264-1

Muche, A. A., Olayemi, O. O., & Gete, Y. K. (2019). Prevalence and determinants of gestational diabetes mellitus in Africa based on the updated international diagnostic criteria: A systematic review and meta-analysis. Archives of Public Health, 77(1), 1–20. https://doi.org/10.1186/s13690-019-0362-0

Mulligan, M. L., Felton, S. K., Riek, A. E., & Bernal-Mizrachi, C. (2010). Implications of vitamin D deficiency in pregnancy and lactation. American Journal of Obstetrics and Gynecology, 202(5), 429.e1-429.e9. https://doi.org/10.1016/j.ajog.2009.09.002

Murthi, P., Davies-Tuck, M., Lappas, M., Singh, H., Mockler, J., Rahman, R., Lim, R., Leaw, B., Doery, J., Wallace, E. M., & Ebeling, P. R. (2017). Maternal 25-hydroxyvitamin D is inversely correlated with foetal serotonin. Clinical Endocrinology, 86(3), 401–409. https://doi.org/10.1111/cen.13281

Muthukrishnan, J., & Dhruv, G. (2015). Vitamin D status and gestational diabetes mellitus. Indian Journal of Endocrinology and Metabolism, 19(5), 616–619. https://doi.org/10.4103/2230-8210.163175

Mutlu, N., Esra, H., Begum, A., Fatma, D., Arzu, Y., Yalcin, H., Fatih, K., & Selahattin, K. (2015). Relation of maternal vitamin D status with gestational diabetes mellitus and perinatal outcome. African Health Sciences, 15(2), 523–531. https://doi.org/10.4314/ahs.v15i2.27

Mwanri, A. W., Kinabo, J., Ramaiya, K., & Feskens, E. J. M. (2015). Gestational diabetes mellitus in sub-Saharan Africa: Systematic review and metaregression on prevalence and risk factors. Tropical Medicine and International Health, 20(8), 983–1002. https://doi.org/10.1111/tmi.12521

Nakashima, A., Yokoyama, K., Yokoo, T., & Urashima, M. (2016). Role of vitamin D in diabetes mellitus and chronic kidney disease. World Journal of Diabetes, 7(5), 89. https://doi.org/10.4239/wjd.v7.i5.89

Nasiri-Amiri, F., Bakhtiari, A., Faramarzi, M., Rad, H. A., & Pasha, H. (2016). The association between physical activity during pregnancy and gestational diabetes mellitus: A case-control study. International Journal of Endocrinology and Metabolism, 14(3). https://doi.org/10.5812/ijem.37123

Nassar, N., Halligan, G. H., Roberts, C. L., Morris, J. M., & Ashton, A. W. (2011). Systematic review of first-trimester vitamin D normative levels and outcomes of pregnancy. American Journal of Obstetrics and Gynecology, 205(3), 208.e1-208.e7. https://doi.org/10.1016/j.ajog.2011.03.058

National Coordinating Committee on Food and Nutrition (NCCFN), Ministry of Health Malaysia. (2017). Recommended Nutrient Intakes for Malaysia.

Nguyen, C. L., Pham, N. M., Binns, C. W., Duong, D. V., & Lee, A. H. (2018). Prevalence of Gestational Diabetes Mellitus in Eastern and Southeastern Asia: A Systematic Review and Meta-Analysis. Journal of diabetes research, 2018, 6536974. https://doi.org/10.1155/2018/6536974

Nobles, C. J., Markenson, G., & Chasan-Taber, L. (2015). Early pregnancy Vitamin D status and risk for adverse maternal and infant outcomes in a bi-ethnic cohort: The Behaviors Affecting Baby and You (B.A.B.Y.) Study. British Journal of Nutrition, 114(12), 2116–2128. https://doi.org/10.1017/S0007114515003980

Ogonowski, J., Miazgowski, T., Engel, K., & Celewicz, Z. (2014). Birth weight predicts the risk of gestational diabetes mellitus and pregravid obesity. Nutrition, 30(1), 39–43. https://doi.org/10.1016/j.nut.2013.05.021

Oppong, S. A., Ntumy, M. Y., Amoakoh-Coleman, M., Ogum-Alangea, D., & Modey-Amoah, E. (2015). Gestational diabetes mellitus among women attending prenatal care at Korle-Bu Teaching Hospital, Accra, Ghana. International Journal of Gynecology and Obstetrics, 131(3), 246–250. https://doi.org/10.1016/j.ijgo.2015.05.029

Padayachee, C., & Coombes J.S. (2015). Exercise guidelines for gestational diabetes mellitus. World Journal of Diabetes, 6(8), 1033.https://doi.org/10.4239/wjd.v6.i8.1033

Padmanabhan, S., McLean, M., & Cheung, N. W. (2014). Falling insulin requirements are associated with adverse obstetric outcomes in women with preexisting diabetes. Diabetes Care, 37(10), 2685–2692. https://doi.org/10.2337/dc14-0506

Padmapriya, N., Bernard, J. Y., Liang, S., Loy, S. L., Cai, S., Zhe, I. S., Kwek, K., Godfrey, K. M., Gluckman, P. D., Saw, S. M., Chong, Y. S., Chan, J. K. Y., Müller-Riemenschneider, F., Sheppard, A., Chinnadurai, A., Neo Goh, A. E., Rifkin-Graboi, A., Qiu, A., Biswas, A., Lee, Y. S. (2017). Associations of physical activity and sedentary behavior during pregnancy with gestational diabetes mellitus among Asian women in Singapore. BMC Pregnancy and Childbirth, 17(1), 1–10. https://doi.org/10.1186/s12884-017-1537-8

Palacios, C., & Gonzalez, L. (2015). Is vitamin D deficiency a major global public health problem? 787, 138–145. https://doi.org/10.1016/j.jsbmb.2013.11.003.Is

Palaniveloo, L., Yaw, Y. H., Shariff, Z. M., Peng, L. S., Bindels, J., Yee Siang Tee, Y., & van der Beek, E. M. (2020). Vitamin D status is associated with high BMI, working status and gravidity among pregnant Malaysian women. Malaysian Journal of Nutrition, 26(1).

Pang, W. W., Colega, M., Cai, S., Chan, Y. H., Padmapriya, N., Chen, L.-W., Soh, S.-E., Han, W. M., Tan, K. H., Lee, Y. S., Saw, S.-M., Gluckman, P. D., Godfrey, K. M., Chong, Y.-S., van Dam, R. M., & Chong, M. F. (2017). Higher Maternal Dietary Protein Intake Is Associated with a Higher Risk of Gestational Diabetes Mellitus in a Multiethnic Asian Cohort. The Journal of Nutrition, 147(4), 653–660. https://doi.org/10.3945/jn.116.243881

Park, S., Yoon, H.-K., Ryu, H.-M., Han,Y.J., Lee, S.W., Park, B.K., Park, S.-Y., Yim, C.-H., & Kim, S.-H. (2014). Maternal vitamin D deficiency in early pregnancy is not associated with gestational diabetes mellitus development or pregnancy outcomes in Korean pregnant women in a prospective study. Journal of Nutritional Science and Vitaminology, 60(4), 269–275. https://doi.org/10.3177/jnsv.60.269

Park, Y. W., Allison, D. B., Heymsfield, S. B., & Gallagher, D. (2001). Larger amounts of visceral adipose tissue in Asian Americans. Obesity research, 9(7), 381-387.

Parlak, M., Kalay, S., Kalay, Z., Kırecci, A., Guney, O., & Koklu, E. (2014). Severe vitamin D deficiency among pregnant women and their newborns in Turkey. The Journal Of Maternal-Fetal & Neonatal Medicine: The Official Journal Of The European Association Of Perinatal Medicine, The Federation Of Asia And Oceania Perinatal Societies, The International Society Of Perinatal Obstetricians, 7058(September), 1–12. https://doi.org/10.3109/14767058.2014.924103

Parlea, L., Bromberg, I. L., Feig, D. S., Vieth, R., Merman, E., & Lipscombe, L. L. (2012). Association between serum 25-hydroxyvitaminD in early pregnancy and risk of gestational diabetes mellitus. Diabetic Medicine, 29(7), 25–32. https://doi.org/10.1111/j.1464-5491.2011.03550.x

Parva, N. R., Tadepalli, S., Singh, P., Qian, A., Joshi, R., Kandala, H., Nookala, V. K., & Cheriyath, P. (2018). Prevalence of Vitamin D Deficiency and Associated Risk Factors in the US Population (2011-2012). Cureus, 10(6). https://doi.org/10.7759/cureus.2741

Pérez-López, F. R., Fernández-Alonso, A. M., Ferrando-Marco, P., González-Salmerón, M. D., Dionis-Sánchez, E. C., Fiol-Ruiz, G., & Chedraui, P. (2011). First trimester serum 25-hydroxyvitamin D status and factors related to lower levels in gravids living in the spanish mediterranean coast. Reproductive Sciences, 18(8), 730–736. https://doi.org/10.1177/1933719110396720

Pérez-López, F. R., Pasupuleti, V., Mezones-Holguin, E., Benites-Zapata, V. A., Thota, P., Deshpande, A., & Hernandez, A. V. (2015). Effect of vitamin D supplementation during pregnancy on maternal and neonatal outcomes: A systematic review and meta-analysis of randomized controlled trials. Fertility and Sterility, 103(5), 1278-1288.e4. https://doi.org/10.1016/j.fertnstert.2015.02.019

Peterson, K.F. and Shulman, G. I. (2010). Etiology of IR. 119, 1–13. https://doi.org/10.1016/j.amjmed.2006.01.009.Etiology

Phelan, S. (2017). Windows of Opportunity for Lifestyle Interventions to Prevent Gestational Diabetes Mellitus. American Journal of Perinatology, 33(13), 1291–1299. https://doi.org/10.1055/s-0036-1586504.Windows

Pirdehghan, A., Vakili, Mahmood., Dehghan, R., & Zare, F. (2016). High prevalence of Vitamin D deficiency and adverse pregnancy outcomes in Yazd, a central province of Iran. Journal of Reproduction and Infertility, 17(1), 34–38.

Pleskacova, A., Bartakova, V., Pacal, L., Kuricova, K., Bjlobradkova, J., Tomandl, J., & Kankova, K. (2015). Vitamin D status in women with gestational diabetes mellitus during pregnancy and postpartum. BioMed Research International, 2015. http://dx.doi.org/10.1155/2015/260624

Plows, J. F., Stanley, J. L., Baker, P. N., Reynolds, C. M., & Vickers, M. H. (2018). The pathophysiology of gestational diabetes mellitus. International Journal of Molecular Sciences, 19(11), 1–21. https://doi.org/10.3390/ijms19113342

Pludowski, P., Holick, M. F., Grant, W. B., Konstantynowicz, J., Mascarenhas, M. R., Haq, A., Povoroznyuk, V., Balatska, N., Barbosa, A. P., Karonova, T., Rudenka, E., Misiorowski, W., Zakharova, I., Rudenka, A., Łukaszkiewicz, J., Marcinowska-Suchowierska, E., Łaszcz, N., Abramowicz, P., Bhattoa, H. P., & Wimalawansa, S. J. (2018). Vitamin D supplementation guidelines. The Journal of steroid biochemistry and molecular biology, 175, 125–135. https://doi.org/10.1016/j.jsbmb.2017.01.021

Practice, C. (2014). Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy: A World Health Organization Guideline. Diabetes Research and Clinical Practice, 103(3), 341–363. https://doi.org/10.1016/j.diabres.2013.10.012

Pratumvinit, B., Wongkrajang, P., Wataganara, T., Hanyongyuth, S., Nimmannit, A., Chatsiricharoenkul, S., Manonukul, K., & Reesukumal, K. (2015). Maternal vitamin d status and its related factors in pregnant women in Bangkok, Thailand. PLoS ONE, 10(7), 1–14. https://doi.org/10.1371/journal.pone.0131126

Quah, S. W., Majid, H. A., Al-Sadat, N., Yahya, A., Su, T. T., & Jalaludin, M. Y. (2018). Risk factors of Vitamin D deficiency among 15-year-old adolescents participating in the Malaysian health and adolescents longitudinal research team study (MyHeARTs). PLoS ONE, 13(7), 1–17. https://doi.org/10.1371/journal.pone.0200736

Radesky, J. S., Oken, E., Rifas-Shiman, S. L., Kleinman, K. P., Rich-Edwards, J. W., & Gillman, M. W. (2008). Diet during early pregnancy and development of gestational diabetes. Paediatric and Perinatal Epidemiology, 22(1), 47–59. https://doi.org/10.1111/j.1365-3016.2007.00899.x

Rajput, R., Yadav, Y., Nanda, S., & Rajput, M. (2013). Prevalence of gestational diabetes mellitus & associated risk factors at a tertiary care hospital in Haryana. Indian Journal of Medical Research, 137(4), 728–733.

Ravinder. S., Deepika, C., Padmavathi, R., & Vijayaraghavan, J. (2015). Occurrence of Vitamin D deficiency in pregnant women in South India – A preliminary study. 3(2), 291–296.

Rawal, S., Olsen, S. F., Grunnet, L. G., Ma, R. C., Hinkle, S. N., Granström, C., Wu, J., Yeung, E., Mills, J. L., Zhu, Y., Bao, W., Ley, S. H., Hu, F. B., Damm, P., Vaag, A., Tsai, M. Y., & Zhang, C. (2018). Gestational diabetes mellitus and renal function: A prospective study with 9-to 16-year follow-up after pregnancy. Diabetes Care, 41(7), 1378–1384. https://doi.org/10.2337/dc17-2629

Reddi Rani, P., & Begum, J. (2016). Screening and diagnosis of gestational diabetes mellitus, where do we stand. Journal of Clinical and Diagnostic Research, 10(4), QE01–QE04. https://doi.org/10.7860/JCDR/2016/17588.7689

Riaz, M., Nawaz, A., Masood, S. N., Fawwad, A., Basit, A., & Shera, A. S. (2019). Frequency of gestational diabetes mellitus using DIPSI criteria, a study from Pakistan. Clinical Epidemiology and Global Health, 7(2), 218–221. https://doi.org/10.1016/j.cegh.2018.06.003

Richard, A., Rohrmann, S., & Quack Lötscher, K. C. (2017). Prevalence of vitamin D deficiency and its associations with skin color in pregnant women in the first trimester in a sample from Switzerland. Nutrients, 9(3). https://doi.org/10.3390/nu9030260

Rifas-Shiman, S. L., Fleisch, A., Hivert, M. F., Mantzoros, C., Gillman, M. W., & Oken, E. (2017). First and second trimester gestational weight gains are most strongly associated with cord blood levels of hormones at delivery important for glycemic control and somatic growth. Metabolism, 69, 112-119.

Rodriguez, A., Santa Marina, L., Jimenez, A. M., Esplugues, A., Ballester, F., Espada, M., Sunyer, J., & Morales, E. (2016). Vitamin D Status in Pregnancy and Determinants in a Southern European Cohort Study. Paediatric and Perinatal Epidemiology, 30(3), 217–228. https://doi.org/10.1111/ppe.12281

Rostami, M., Tehrani, F. R., Simbar, M., Panah, F. H., & Majd, S. H. A. (2015). Prevalence of vitamin d deficiency and related factors among pregnant women referred to masjed soleimam health centers in 2014. Iranian Journal of Obstetrics, Gynecology and Infertility, 18(164), 1–10. https://doi.org/10.22038/ijogi.2015.5614

Sahib, S. M., & Abdulwahid, H. S. (2020). Epidemiology of Gestational Diabetes among Pregnant Women at Primary Health Care Centres in Al Nasiriyah City/Iraq. Indian Journal of Public Health Research & Development, 11(4).

Sakamoto, R. R. (2019). Sunlight in Vitamin D Deficiency: Clinical Implications. The Journal for Nurse Practitioners. 15, 282–285. https://doi.org/10.1016/j.nurpra.2019.01.014

Saldana, T. M., Siega-Riz, A. M., & Adair, L. S. (2004). Effect of macronutrient intake on the development of glucose intolerance during pregnancy. American Journal of Clinical Nutrition, 79(3), 479–486. https://doi.org/10.1093/ajcn/79.3.479

Saltiel, A. R., & Kahn, C. R. (2001). Insulin signalling and the regulation of glucose and lipid metabolism. Nature, 414(6865), 799–806. https://doi.org/10.1038/414799a

Saraff, V., & Shaw, N. (2016). Sunshine and vitamin D. Archives of disease in childhood, 101(2), 190–192. https://doi.org/10.1136/archdischild-2014-307214

Savastio, S., Cadario, F., Genoni, G., Bellomo, G., Bagnati, M., Secco, G., Picchi, R., Giglione, E., & Bona, G. (2016). Vitamin D deficiency and glycemic status in children and adolescents with type 1 diabetes mellitus. PLoS ONE, 11(9), 1–13. https://doi.org/10.1371/journal.pone.0162554

Schoos, A.-M. M., Vinther, C., Nørgaard, S., Brustad, N., Stokholm, J., Bønnelykke, K., Bisgaard, H., & Chawes, B. L. (2019). Environmental and Genetic Determinants of Serum 25(OH)-Vitamin D Levels during Pregnancy and Early Childhood. Children, 6(10), 116. https://doi.org/10.3390/children6100116

Schwartz, N., Nachum, Z., & Green, M. S. (2015). The prevalence of gestational diabetes mellitus recurrence - Effect of ethnicity and parity: A metaanalysis. American Journal of Obstetrics and Gynecology, 213(3), 310–317. https://doi.org/10.1016/j.ajog.2015.03.011

Sepandi, M., Esmailzadeh, S., Hosseini, M. S., Hashemi, S. R., Abbaszadeh, S., Alimohamadi, Y., & Taghdir, M. (2020). Prevalence of Vitamin D Deficiency Among Iranian Pregnant Women. Nutrition and Dietary Supplements, 12, 97-102.

Shafinaz, I. S., & Moy, F. M. (2016). Vitamin D level and its association with adiposity among multi-ethnic adults in Kuala Lumpur, Malaysia: A cross sectional study. BMC Public Health, 16(1), 1–9. https://doi.org/10.1186/s12889-016-2924-1

Shahbazian, H., Nouhjah, S., Shahbazian, N., Jahanfar, S., Latifi, S. M., Aleali, A., Shahbazian, N., & Saadati, N. (2016). Gestational diabetes mellitus in an Iranian pregnant population using IADPSG criteria: Incidence, contributing factors and outcomes. Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 10(4), 242–246. https://doi.org/10.1016/j.dsx.2016.06.019

Shahbazian, H., Nouhjah, S., Shahbazian, N., Jahanfar, S., Latifi, S. M., Aleali, A., ... & Saadati, N. (2016). Gestational diabetes mellitus in an Iranian pregnant population using IADPSG criteria: incidence, contributing factors and outcomes. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 10(4), 242-246.

Shan, D., Qiu, P. Y., Wu, Y. X., Chen, Q., Li, A. L., Ramadoss, S., Wang, R. R., & Hu, Y. Y. (2018). Pregnancy Outcomes in Women of Advanced Maternal Age: a Retrospective Cohort Study from China. Scientific Reports, 8(1), 1–9. https://doi.org/10.1038/s41598-018-29889-3

Shariff, Z. M., Lin, K. G., Sariman, S., Lee, H. S., Siew, C. Y., Yusof, B. N. M. & Mohamad, M. (2015). The relationship between household income and dietary intakes of 1-10 year old urban Malaysian. Nutrition research and practice, 9(3), 278.

Sharma, S., Kumar, A., Prasad, S., & Sharma, S. (2016). Current Scenario of Vitamin D Status During Pregnancy in North Indian Population. Journal of Obstetrics and Gynecology of India, 66(2), 93–100. https://doi.org/10.1007/s13224-014-0658-5

Shimodaira, M., Yamasaki, T., & Nakayama, T. (2016). The association of maternal ABO blood group with gestational diabetes mellitus in Japanese pregnant women. Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 10(2), S102–S105. https://doi.org/10.1016/j.dsx.2016.03.003

Shin, D., & Song, W. O. (2015). Prepregnancy body mass index is an independent risk factor for gestational hypertension, gestational diabetes, preterm labor, and small- and large-for-gestational-age infants. Journal of Maternal-Fetal and Neonatal Medicine, 28(14), 1679–1686. https://doi.org/10.3109/14767058.2014.964675

Shin, J., & Yoon, K. (2010). The Effect of Parental Transmission of Diabetes on the Development of Gestational Diabetes Mellitus. 237–238. https://doi.org/10.3904/kjim.2010.25.3.237

Shostrom, D. C. V., Sun, Y., Oleson, J. J., Snetselaar, L. G., & Bao, W. (2017). History of gestational diabetes mellitus in relation to cardiovascular disease and cardiovascular risk factors in US women. Frontiers in Endocrinology, 8(JUN), 1–6. https://doi.org/10.3389/fendo.2017.00144

Shou, C., Wei, Y.-M., Wang, C., & Yang, H.-X. (2019). Updates in Long-term Maternal and Fetal Adverse Effects of Gestational Diabetes Mellitus. Maternal-Fetal Medicine, 1(2), 91–94. https://doi.org/10.1097/fm9.0000000000000019

Sicree, R. A., Zimmet, P. Z., Dunstan, D. W., Cameron, A. J., Welborn, T. A., & Shaw, J. E. (2008). Differences in height explain gender differences in the response to the oral glucose tolerance test - The AusDiab study. Diabetic Medicine, 25(3), 296–302. https://doi.org/10.1111/j.1464-5491.2007.02362.x

Siddiqui, S., Waghdhare, S., Panda, M., Sinha, S., Singh, P., Dubey, S., & Jha, S. (2019). Regional prevalence of gestational diabetes mellitus in North India. Journal of Diabetology, 10(1), 25. https://doi.org/10.4103/jod.jod_32_18

Soheilykhah, S., Mojibian, M., Rashidi, M., Rahimi-Saghand, S., & Jafari, F. (2010). Maternal vitamin D status in gestational diabetes mellitus. Nutrition in Clinical Practice, 25(5), 524-527.

Song, L., Shen, L., Li, H., Liu, B., Zheng, X., Zhang, L., Xu, S., & Wang, Y. (2017). Socio-economic status and risk of gestational diabetes mellitus among Chinese women. Diabetic Medicine, 34(10), 1421–1427. https://doi.org/10.1111/dme.13415

Song, S. J., Zhou, L., Si, S., Liu, J., Zhou, J., Feng, K., Wu, J., & Zhang, W. (2013). The high prevalence of vitamin D deficiency and its related maternal factors in pregnant women in Beijing. PLoS ONE, 8(12), 1–8. https://doi.org/10.1371/journal.pone.0085081

Sudasinghe, B. H., Wijeyaratne, C. N., & Ginige, P. S. (2018). Long and short-term outcomes of Gestational Diabetes Mellitus (GDM) among South Asian women – A community-based study. Diabetes Research and Clinical Practice, 145, 93–101. https://doi.org/10.1016/j.diabres.2018.04.013

Sung, C. C., Liao, M. T., Lu, K. C., & Wu, C. C. (2012). Role of vitamin D in insulin resistance. Journal of Biomedicine and Biotechnology, 2012. https://doi.org/10.1155/2012/634195

Suntorn, R. & Panichkul, P. (2015). Prevalence of Gestational Diabetes Mellitus Detected by International Association of the Diabetes and Pregnancy Study Groups (IADPSG) Criteria in Phramongkutklao Hospital. 23(3), 144–150.

Tan, H. L. E., Luu, J., Caswell, A., Holliday, E., Attia, J., & Acharya, S. (2017). Impact of new International Association of Diabetes and Pregnancy Study Groups (IADPSG) diagnostic criteria on perinatal outcomes in a regional tertiary hospital in New South Wales, Australia. Diabetes Research and Clinical Practice, 134, 191–198. https://doi.org/10.1016/j.diabres.2017.09.016

Teh, W. T., Teede, H. J., Paul, E., Harrison, C. L., Wallace, E. M., & Allan, C. (2011). Risk factors for gestational diabetes mellitus: Implications for the application of screening guidelines. Australian and New Zealand Journal of Obstetrics and Gynaecology, 51(1), 26–30. https://doi.org/10.1111/j.1479-828X.2011.01292.x

Terry, P., Hu, F. B., Hansen, H., & Wolk, A. (2001). Prospective study of major dietary patterns and colorectal cancer risk in women. American journal of epidemiology, 154(12), 1143-1149.

The American College of Obstetricians and Gynecologists (ACOG). (2017). Is it safe to exercise during pregnancy? Are there certain conditions that make exercise during pregnancy unsafe? Retrieved February 10, 2018, from https://www.acog.org/patient-resources/faqs/pregnancy/exercise-during-pregnancy

Tobias, D. K., Stuart, J. J., Li, S., Chavarro, J., Rimm, E. B., Rich-Edwards, J., Hu, F. B., Manson, J. E., & Zhang, C. (2017). Association of history of gestational diabetes with long-term cardiovascular disease risk in a large prospective cohort of US women. JAMA Internal Medicine, 177(12), 1735–1742. https://doi.org/10.1001/jamainternmed.2017.2790

Tomedi, L. E., Simhan, H. N., Chang, C. C. H., McTigue, K. M., & Bodnar, L. M. (2014). Gestational weight gain, early pregnancy maternal adiposity distribution, and maternal hyperglycemia. Maternal and Child Health Journal, 18(5), 1265–1270. https://doi.org/10.1007/s10995-013-1361-3

Ullah, M. I., Uwaifo, G. I., Nicholas, W. C., & Koch, C. A. (2010). Does vitamin D deficiency cause hypertension? Current evidence from clinical studies and potential mechanisms. International Journal of Endocrinology, 2010. https://doi.org/10.1155/2010/579640

Urrutia-Pereira, M., & Solé, D. (2015). Vitamin D deficiency in pregnancy and its impact on the fetus, the newborn and in childhood. Revista Paulista de Pediatria : Orgão Oficial Da Sociedade de Pediatria de São Paulo, 33(1), 104–113. https://doi.org/10.1016/j.rpped.2014.05.004

Ustuner, I., Keskin, H. L., Tas, E. E., Neselioglu, S., Sengul, O., & Filiz Avsar, A. (2011). Maternal serum 25(OH)D levels in the third trimester of pregnancy during the winter season. Journal of Maternal-Fetal and Neonatal Medicine, 24(12), 1421–1426. https://doi.org/10.3109/14767058.2011.566768

Vaidya A. (2013). Vitamin D and cardio-metabolic disease. Metabolism: clinical and experimental, 62(12), 1697–1699. https://doi.org/10.1016/j.metabol.2013.08.009

Van Den Berg, G., Van Eijsden, M., Vrijkotte, T. G. M., & Gemke, R. J. B. J. (2013). Suboptimal maternal vitamin D status and low education level as determinants of small-for-gestational-age birth weight. European Journal of Nutrition, 52(1), 273–279. https://doi.org/10.1007/s00394-012-0327-3

Vandevijvere, S., Amsalkhir, S., van Oyen, H., & Moreno-Reyes, R. (2012). High prevalence of vitamin D deficiency in pregnant women: A national cross-sectional survey. PLoS ONE, 7(8). https://doi.org/10.1371/journal.pone.0043868

Vangipurapu, J., Stancakova, A., Jauhiainen, R., Kuusisto, J., & Laakso, M. (2017). Short adult stature predicts impaired β-Cell function, insulin resistance, glycemia, and type 2 diabetes in finnish men. Journal of Clinical Endocrinology and Metabolism, 102(2), 443–450. https://doi.org/10.1210/jc.2016-2933

Vierucci, F., Del Pistoia, M., Fanos, M., Erba, P., & Saggese, G. (2014). Prevalence of hypovitaminosis D and predictors of vitamin D status in Italian healthy adolescents. Italian Journal of Pediatrics, 40(1), 1–9. https://doi.org/10.1186/1824-7288-40-54

Wagner, C. L., Taylor, S. N., Dawodu, A., Johnson, D. D., & Hollis, B. W. (2012). Vitamin D and its role during pregnancy in attaining optimal health of mother and fetus. Nutrients, 4(3), 208–230. https://doi.org/10.3390/nu4030208

Wahabi, H., Fayed, A., Esmaeil, S., Mamdouh, H., & Kotb, R. (2017). Prevalence and Complications of Pregestational and Gestational Diabetes in Saudi Women: Analysis from Riyadh Mother and Baby Cohort Study (RAHMA). BioMed Research International, 2017. https://doi.org/10.1155/2017/6878263

Wang, C., Wang, X. Y., & Yang, H. X. (2017). Effect of maternal age on pregnancy outcomes in Beijing. Zhonghua Fu Chan Ke Za Zhi, 52(8), 514–520. https://doi.org/10.3760/cma.j.issn.0529-567X.2017.08.003

Wang, J. W., Wang, Q., Wang, X. Q., Wang, M., Cao, S. S., & Wang, J. N. (2019). Association between maternal education level and gestational diabetes mellitus: a meta-analysis. Journal of Maternal-Fetal and Neonatal Medicine, October 2018, 1–5. https://doi.org/10.1080/14767058.2019.1611773

Wang, L., Wang, H., Wen, H., Tao, H., & Zhao, X. (2016). Vitamin D status among infants, children, and adolescents in southeastern China. Journal of Zhejiang University-SCIENCE B, 17(7), 545–552. https://doi.org/10.1631/jzus.B1500285

Wierzejska, R., Jarosz, M., Sawicki, W., Bachanek, M., & Siuba-Strzelińska, M. (2017). Vitamin D concentration in maternal and umbilical cord blood by season. International Journal of Environmental Research and Public Health, 14(10). https://doi.org/10.3390/ijerph14101121

Wimalawansa, S. J. (2016). Vitamin D Adequacy and Improvements of Comorbidities in Persons with Intellectual Developmental Disabilities. Journal of Childhood & Developmental Disorders, 2(3), 1–13. https://doi.org/10.4172/2472-1786.100030

Woolcott, C. G., Giguère, Y., Weiler, H. A., Spencer, A., Forest, J. C., Anthony Armson, B., & Dodds, L. (2016). Determinants of vitamin D status in pregnant women and neonates. Canadian Journal of Public Health, 107(4–5), e410–e416. https://doi.org/10.17269/CJPH.107.5629

Woon, F. C., Chin, Y. S., Ismail, I. H., Batterham, M., Latiff, A. H. A., Gan, W. Y., Appannah, G., Hussien, S. H. M., Edi, M., Tan, M. L., & Chan, Y. M. (2019). Vitamin D deficiency during pregnancy and its associated factors among third trimester Malaysian pregnant women. PLoS ONE, 14(6), 1–12. https://doi.org/10.1371/journal.pone.0216439

World Health Organization (WHO). (2020). Factsheet: Diabetes. Retrieved August 20, 2020, from https://www.who.int/news-room/fact-sheets/detail/diabetes

World Health Organization. (1995). Physical status: the use and interpretation of anthropometry. Report of a WHO expert committee. Technical report series no. 854. Geneva: (http://whqlibdoc.who.int/trs/WHO_TRS_854.pdf).

Wortsman, J., Matsuoka, L. Y., Chen, T. C., Lu, Z., & Holick, M. F. (2000). Decreased bioavailability of vitamin D in obesity. American Journal of Clinical Nutrition, 72(3), 690–693. https://doi.org/10.1093/ajcn/72.3.690

Wu, B., Zhang, S., Guo, Z., Wang, G., Zhang, G., Xie, L., Lou, J., Chen, X., Wu, D., Bergmeier, W., Zheng, J., & Wan, Y. Y. (2018). RAS P21 Protein Activator 3 (RASA3) Specifically Promotes Pathogenic T Helper 17 Cell Generation by Repressing T-Helper-2-Cell-Biased Programs. Immunity, 49(5), 886-898.e5. https://doi.org/10.1016/j.immuni.2018.09.004

Xia, J., Song, Y., Rawal, S., Wu, J., Hinkle, S. N., Tsai, M. Y., & Zhang, C. (2019). Vitamin D status during pregnancy and the risk of gestational diabetes mellitus: A longitudinal study in a multiracial cohort. Diabetes, Obesity and Metabolism, 21(8), 1895–1905. https://doi.org/10.1111/dom.13748

Xu, C., Ma, H., & Wang, Y. (2018). Maternal Early Pregnancy Plasma Concentration of 25-Hydroxyvitamin D and Risk of Gestational Diabetes Mellitus. Calcified Tissue International, 102(3), 280–286. https://doi.org/10.1007/s00223-017-0346-4

Xu, Q., Gao, Z. Y., Li, L. M., Wang, L., Zhang, Q., Teng, Y., Zhao, X., Ge, S., Jing, H. J., Yang, Y. T., Liu, X. J., Lyu, C. J., Mao, L., Yu, X. M., Liu, Y. H., Kong, A. J., Yang, X. Y., Liu, Z., Zhang, Y., Wang, J., & Lu, Y. P. (2016). The Association of Maternal Body Composition and Dietary Intake with the Risk of Gestational Diabetes Mellitus during the Second Trimester in a Cohort of Chinese Pregnant Women. Biomedical and environmental sciences: BES, 29(1), 1–11. https://doi.org/10.3967/bes2016.001

Yao, D., Chang, Q., Wu, Q. J., Gao, S. Y., Zhao, H., Liu, Y. S., & Zhao, Y. H. (2020). Relationship between Maternal Central Obesity and the Risk of Gestational Diabetes Mellitus: A Systematic Review and Meta-Analysis of Cohort Studies. Journal of Diabetes Research, 2020.

Yeow, T. P., Lim, S. L., Hor, C. P., Khir, A. S., Mohamud, W. N. W., & Pacini, G. (2015). Impact of vitamin D replacement on markers of glucose metabolism and cardio-metabolic risk in women with former gestational diabetes - A double-blind, randomized controlled trial. PLoS ONE, 10(6), 1–16. https://doi.org/10.1371/journal.pone.0129017

Yong, H. Y., Shariff, Z. M., Yusof, B. N. M., Rejali, Z., Appannah, G., Bindels, J., Tee, Y. Y. S., & Van Der Beek, E. M. (2020). The association between dietary patterns before and in early pregnancy and the risk of gestational diabetes mellitus (GDM): Data from the Malaysian SECOST cohort. PLoS ONE, 15(1), 1–16. https://doi.org/10.1371/journal.pone.0227246

Young, M., & Xiong, Y. (2018). Influence of vitamin D on cancer risk and treatment: Why the variability? Trends in cancer research, 13, 43–53.

Yu, L., Guo, Y., Ke, H. J., He, Y. si, Che, D., & Wu, J. L. (2019). Vitamin D status in pregnant women in southern China and risk of preterm birth: A large-scale retrospective cohort study. Medical Science Monitor, 25, 7755–7762. https://doi.org/10.12659/MSM.919307

Yu, S., Fang, H., Han, J., Cheng, X., Xia, L., Li, S., Liu, M., Tao, Z., Wang, L., Hou, L., Qin, X., Li, P., Zhang, R., Su, W., & Qiu, L. (2015). The high prevalence of hypovitaminosis D in China : A multicenter Vitamin D status survey. Medicine (United States), 94(8), e585. https://doi.org/10.1097/MD.0000000000000585

Zajdenverg, L., & Negrato, C. A. (2017). Gestational diabetes mellitus and type 2 diabetes: Same disease in a different moment of life? maybe not. Archives of Endocrinology and Metabolism, 61(3), 208–210. https://doi.org/10.1590/2359-3997000000276

Zamal, A., Manazir, A. S., Firdaus, U., Noor, N., & Ss, S. (2019). Neonatal and Pediatric Medicine Relationship between Maternal Vitamin D Levels and Risk of Low Birth Weight in Term Newborns : A Case Control Study. 5(1), 1–5. https://doi.org/10.4172/2572-4983.1000179

Zaman, F., Nouhjah, S., Shahbazian, H., Shahbazian, N., Latifi, S. M., & Jahanshahi, A. (2018). Risk factors of gestational diabetes mellitus using results of a prospective population-based study in Iranian pregnant women. Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 12(5), 721–725. https://doi.org/10.1016/j.dsx.2018.04.014

Zhang, C., Liu, S., Solomon, C. G., & Hu, F. B. (2006). Dietary fiber intake, dietary glycemic load, and the risk for gestational diabetes mellitus. Diabetes Care, 29(10), 2223–2230. https://doi.org/10.2337/dc06-0266

Zhang, C., Qiu, C., Hu, F. B., David, R. M., Van Dam, R. M., Bralley, A., & Williams, M. A. (2008). Maternal plasma 25-hydroxyvitamin D concentrations and the risk for gestational diabetes mellitus. PloS one, 3(11), e3753.

Zhang, C., Tobias, D. K., Chavarro, J. E., Bao, W., Wang, D., Ley, S. H., & Hu, F. B. (2014). Adherence to healthy lifestyle and risk of gestational diabetes mellitus: prospective cohort study. British Medical Journal, 349(September), g5450. https://doi.org/10.1136/bmj.g5450

Zhang, F. F., Al Hooti, S., Al Zenki, S., Alomirah, H., Jamil, K. M., Rao, A., Al Jahmah, N., Saltzman, E., & Ausman, L. M. (2016). Vitamin D deficiency is associated with high prevalence of diabetes in Kuwaiti adults: Results from a national survey Chronic Disease epidemiology. BMC Public Health, 16(1), 1–9. https://doi.org/10.1186/s12889-016-2758-x

Zhang, Q., Zhu, B., & Li, Y. (2017). Resolution of cancer-promoting inflammation: A new approach for anticancer therapy. Frontiers in Immunology, 8(February), 1–11. https://doi.org/10.3389/fimmu.2017.00071

Zhao, X., Fang, R., Yu, R., Chen, D., Zhao, J., & Xiao, J. (2017). Maternal vitamin D status in the late second trimester and the risk of severe preeclampsia in Southeastern China. Nutrients, 9(2). https://doi.org/10.3390/nu9020138

Zheng, M., Campbell, K. J., Scanlan, E., & McNaughton, S. A. (2020). Development and evaluation of a food frequency questionnaire for use among young children. PloS one, 15(3), e0230669.

Zhong, C., Li, X., Chen, R., Zhou, X., Liu, C., Wu, J., Xu, S., Wang, W., Xiao, M., Xiong, G., Wang, J., Yang, X., Hao, L., & Yang, N. (2017). Greater early and mid-pregnancy gestational weight gain are associated with increased risk of gestational diabetes mellitus: A prospective cohort study. Clinical Nutrition ESPEN, 22, 48–53. https://doi.org/10.1016/j.clnesp.2017.08.013

Zhou, J., Su, L., Liu, M., Liu, Y., Cao, X., Wang, Z., & Xiao, H. (2014). Associations between 25-hydroxyvitamin D levels and pregnancy outcomes: a prospective observational study in southern China. European journal of clinical nutrition, 68(8), 925-930.

Zhu, W. W., Yang, H. X., Wang, C., Su, R. N., Feng, H., & Kapur, A. (2017). High Prevalence of Gestational Diabetes Mellitus in Beijing : Effect of Maternal Birth Weight and Other Risk Factors. China Medical Journal, 130:1019-25. 130(9). https://doi.org/10.4103/0366-6999.204930

Zhu, Y., Hedderson, M. M., Quesenberry, C. P., Feng, J., & Ferrara, A. (2019). Central obesity increases the risk of gestational diabetes partially through increasing insulin resistance. Obesity, 27(1), 152-160.