Reasons for urgent termination of physical activity

Box 2 Reasons to stop physical activity and consult a healthcare provider

- Persistent excessive shortness of breath that does not resolve on rest.
- Severe chest pain.
- Regular and painful uterine contractions.
- Vaginal bleeding.
- Persistent loss of fluid from the vagina indicating rupture of the membranes.
- Persistent dizziness or faintness that does not resolve on rest.

Preventative Role of Prenatal Physical Activity on Common Health Conditions

Margie H. Davenport, PhD

Christenson Professorship in Active Healthy Living

Women and Children's Health Research Institute

Alberta Diabetes Institute

www.exerciseandpregnancy.ca

UNIVERSITY OF ALBERTA
FACULTY OF KINESIOLOGY, SPORT, AND RECREATION

PROGRAM FOR PREGNANCY & POSTPARTUM HEALTH

Overview

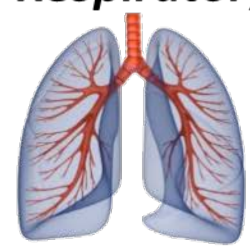
- Describe the risk factors and prevalence of common discomforts and health conditions in pregnancy.
- Explain the preventative role of prenatal physical activity in relation to common pregnancy complications.

Incredible adaptations to normal pregnancy

Metabolic

↑ Insulin Resistance
↓ Glucose Availability
↑ Resting VO_2

Respiratory



↑ Resting Ventilation (***+30-50%***)
↓ Arterial CO_2 (***-15-20 Torr***)
↓ Bicarbonate (***-5mEq/L***)
↑ Chemoreflex Sensitivity
(***HCVR +100%; HVR +100%***)

Cardiovascular

↑ Heart Rate (***+20%***)
↑Blood Volume (***+50%***)
↑ Stroke Volume (***+20-30%***)
↑ Cardiac Output (***+30%***)
↓ Vascular Resistance (***-20%***)
↔↓ Blood pressure

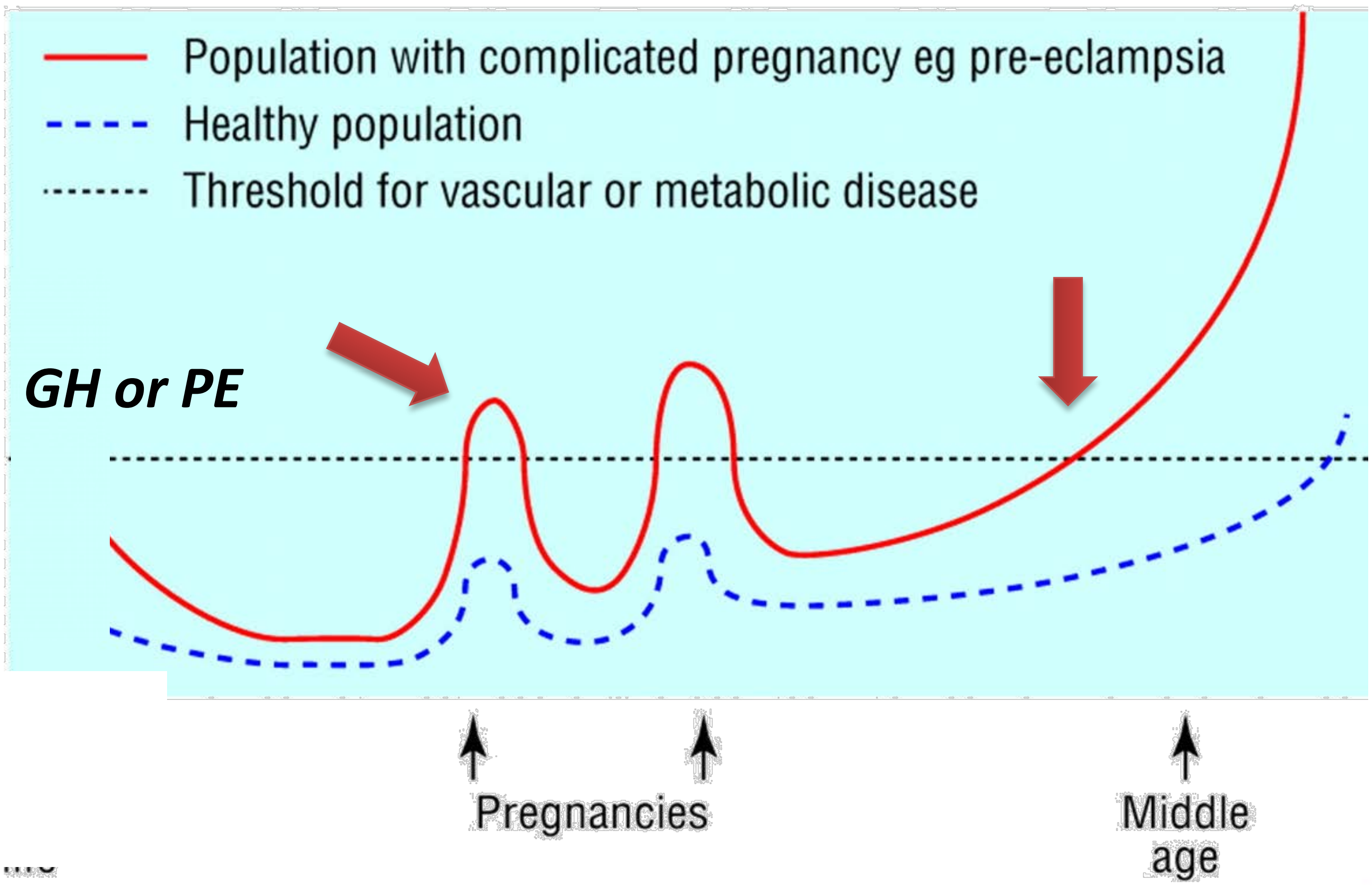
Davenport, Skow and Steinback 2016. *Clin Obstet & Gynecol*

Not all pregnancies progress smoothly

85% of women will become pregnant in their lifetime

20% of women will develop complications during pregnancy that impact current & future cardiovascular health

Pregnancy is a stress test for life!



Sattar and Greer, *BMJ* 2002

Implications / Complications

Table 2. Summary Estimates of Random-Effects Likelihood Meta-Analyses by Pregnancy Complication

		Primary Analysis				Sensitivity Analyses†			
Pregnancy Complication	Study Design	No. Studies	Pooled Odds Ratio (95% ICI)	I^2, %	Tau²	No. Studies	Pooled Odds Ratio (95% ICI)	I^2, %	Tau²
Cardiovascular-related morbidity*									
Gestational hypertension	Cohort	9	1.67 (1.28–2.19)	83.9	0.102	7	1.87 (1.55–2.25)	60.6	0.035
Moderate preeclampsia	Cohort	16	2.24 (1.72–2.93)	95.0	0.176	11	1.97 (1.74–2.22)	65.9	0.021
Severe preeclampsia	Cohort	6	2.74 (2.48–3.04)	0	0	-	-	-	-
Preterm birth	Cohort	12	1.63 (1.39–1.93)	91.1	0.036	10	1.66 (1.48–1.86)	74.4	0.014
S									074
Car									
P									-
C									0
L									035
Cardiovascular-related mortality*									
Preeclampsia	Cohort	9	1.73 (1.46–2.06)	60.6	0.035	-	-	-	-
Preterm birth	Cohort	4	1.93 (1.83–2.03)	0	0	-	-	-	-
Stillbirth	Cohort	4	2.23 (1.90–2.62)	0	0	-	-	-	-
Cerebrovascular-related morbidity									
Gestational hypertension	Cohort	4	1.83 (0.79–4.22)	98.4	0.459	3	1.41 (1.31–1.52)	0	0
Preeclampsia	Cohort	9	2.95 (1.10–7.90)	99.4	1.403	4	1.43 (1.36–1.50)	0	0
Ischemic heart disease									
Preeclampsia	Cohort	7	1.73 (1.46–2.06)	99.0	1.036	5	1.46 (1.21–1.76)	62.5	0.025

Hypertensive disorders of pregnancy increases risk of cardiovascular morbidity/mortality OR1.63-2.95

CVD indicates cardiovascular disease; and ICI, intrinsic confidence interval.
*Including coronary artery disease, myocardial infarction, coronary revascularization, peripheral arterial disease, transient ischemic attack, and stroke.
†Studies were excluded based on the use of composite outcomes with less severe forms of CVD (ie, unstable angina, thrombosis) or use of self-report to define exposure.

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

Circulation 2019 139:1069-1079

Cardiovascular disease unmasked

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association

Effectiveness-Based Guidelines for the Prevention of Cardiovascular Disease in Women-- 2011 Update: A Guideline From the American Heart Association

Lori Mosca, Emelia J. Benjamin, Kathy Berra, Judy L. Bezanson, Rowena J. Dolor, Donald M. Lloyd-Jones, L. Kristin Newby, Ileana L. Piña, Véronique L. Roger, Leslee J. Shaw, Dong Zhao, Theresa M. Beckie, Cheryl Bushnell, Jeanine D'Armiento, Penny M. Kris-Etherton, Jing Fang, Theodore G. Ganiats, Antoinette S. Gomes, Clarisa R. Gracia, Constance K. Haan, Elizabeth A. Jackson, Debra R. Judelson, Ellie Kelepouris, Carl J. Lavie, Anne Moore, Nancy A. Nussmeier, Elizabeth Ofili, Suzanne Oparil, Pamela Ouyang, Vivian W. Pinn, Katherine Sherif, Sidney C. Smith, Jr, George Sopko, Nisha Chandra-Strobos, Elaine M. Urbina, Viola Vaccarino and Nanette K. Wenger

Table 2. Classification of CVD Risk in Women

Risk Status	Criteria
High risk (≥1 high-risk states)	Clinically manifest CHD
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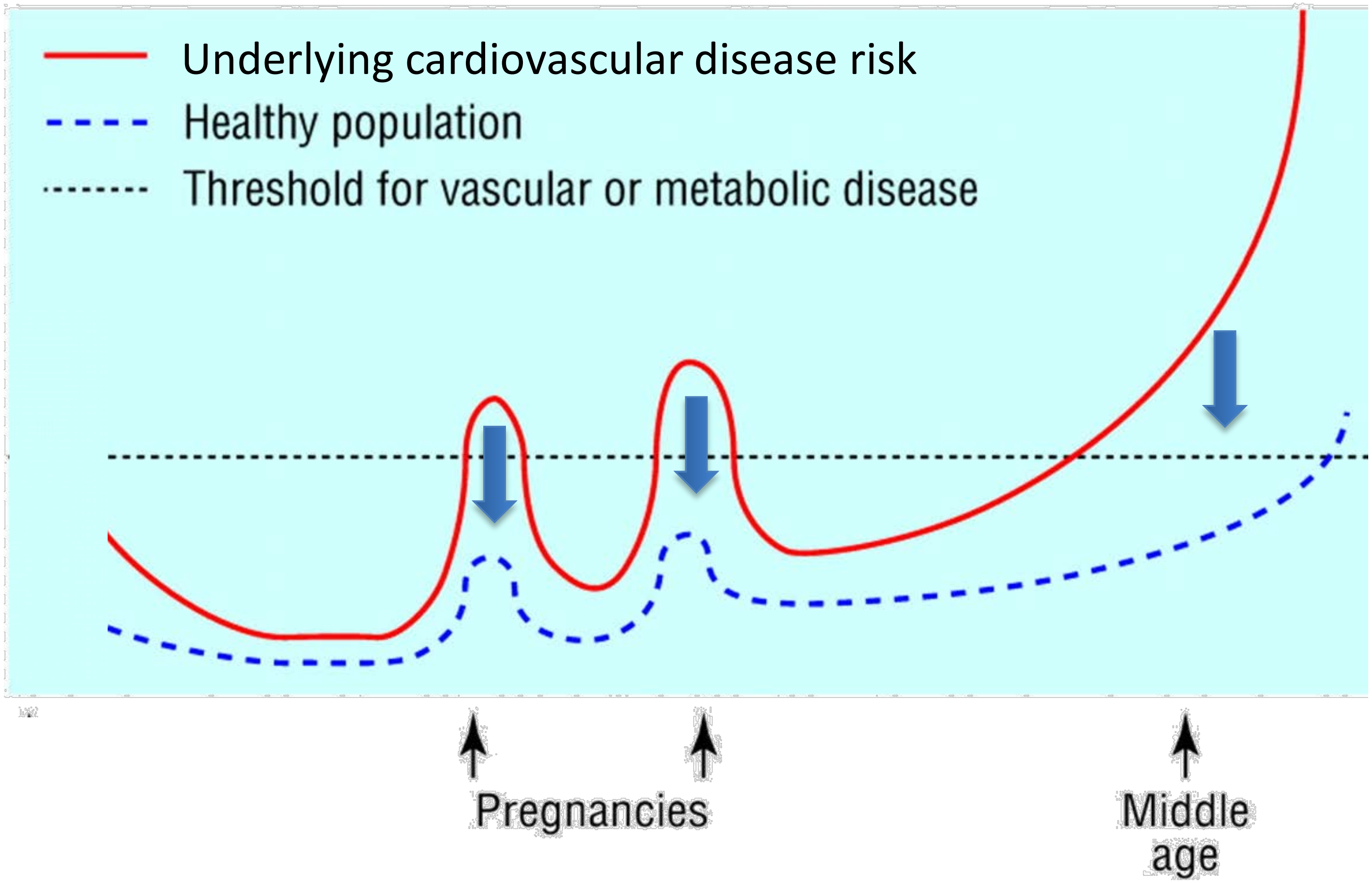
	Clinically manifest peripheral arterial disease
	Abdominal aortic aneurysm
	End-stage or chronic kidney disease
	Diabetes mellitus
	10-y Predicted CVD risk ≥10%
At risk (≥1 major risk factor[s])	Cigarette smoking
	SBP ≥120 mm Hg, DBP ≥80 mm Hg, or treated hypertension
	Physical inactivity
	History of preeclampsia, gestational diabetes, o[r] pregnancy-induced hypertension

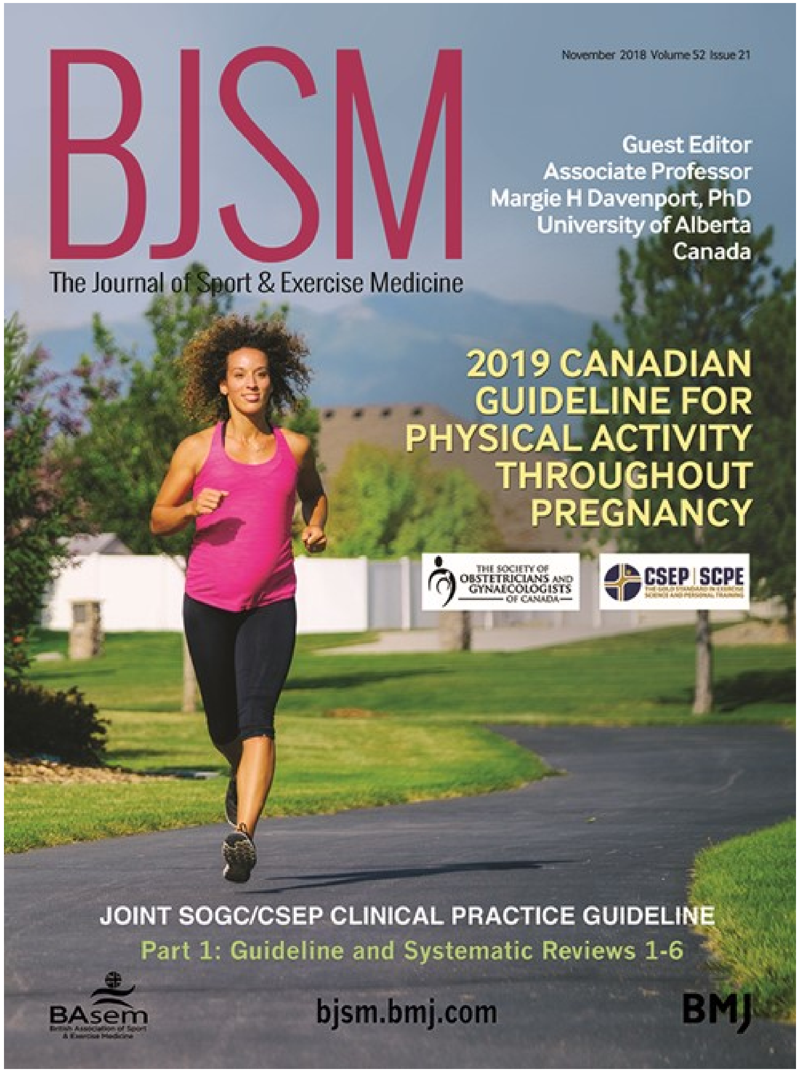
Can we prevent them from developing?

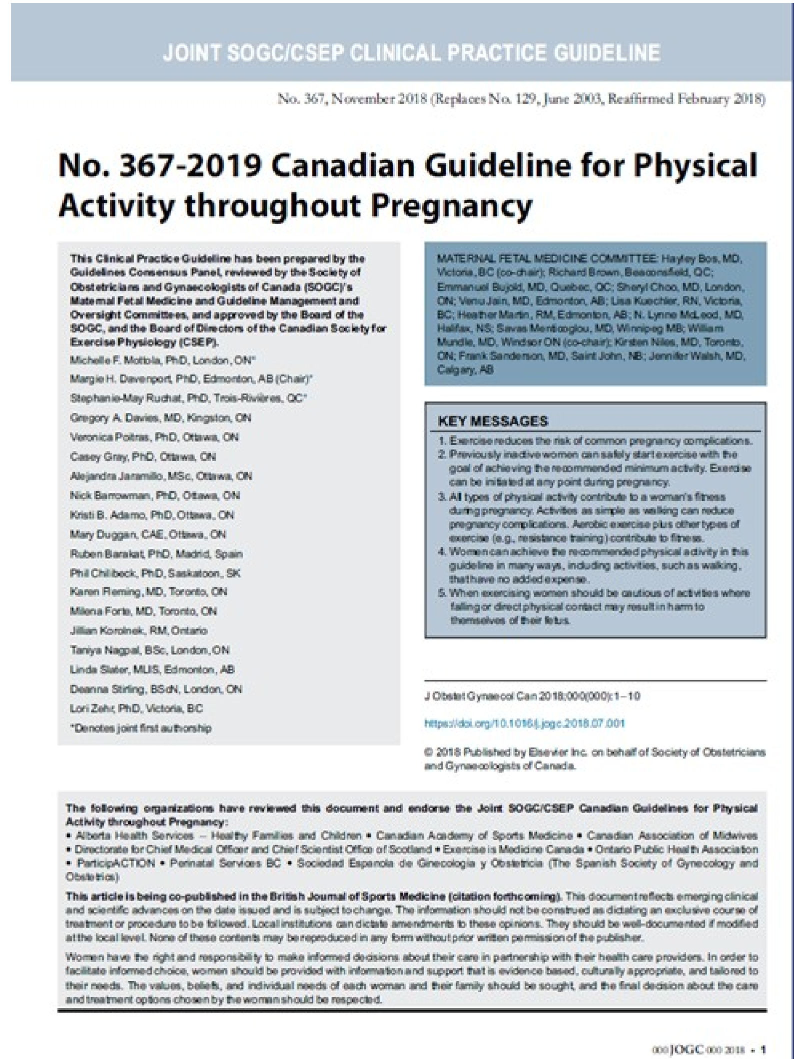
Emerging risk factors: preterm delivery, small baby

Exercise as an Intervention to Promote Cardiovascular Health



Sattar and Greer BMJ 2002




JOINT SOGC/CSEP CLINICAL PRACTICE GUIDELINE

No. 367, November 2018 (Replaces No. 129, June 2003, Reaffirmed February 2018)

No. 367-2019 Canadian Guideline for Physical Activity throughout Pregnancy

This Clinical Practice Guideline has been prepared by the Guidelines Consensus Panel, reviewed by the Society of Obstetricians and Gynaecologists of Canada (SOGC)'s Maternal Fetal Medicine and Guideline Management and Oversight Committees, and approved by the Board of the SOGC, and the Board of Directors of the Canadian Society for Exercise Physiology (CSEP).

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KEY MESSAGES

1. Exercise reduces the risk of common pregnancy complications.
2. Previously inactive women can safely start exercise with the goal of achieving the recommended minimum activity. Exercise can be initiated at any point during pregnancy.
3. All types of physical activity contribute to a woman's fitness during pregnancy. Activities as simple as walking can reduce pregnancy complications. Aerobic exercise plus other types of exercise (e.g., resistance training) contribute to fitness.
4. Women can achieve the recommended physical activity in this guideline in many ways, including activities, such as walking, that have no added expense.
5. When exercising women should be cautious of activities where falling or direct physical contact may result in harm to themselves of their fetus.

J Obstet Gynaecol Can 2018;000(000):1–10

https://doi.org/10.1016/j.jogc.2018.07.001

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The following organizations have reviewed this document and endorse the Joint SOGC/CSEP Canadian Guidelines for Physical Activity throughout Pregnancy:
• Alberta Health Services – Healthy Families and Children • Canadian Academy of Sports Medicine • Canadian Association of Midwives • Directorate for Chief Medical Officer and Chief Scientist Office of Scotland • Exercise is Medicine Canada • Ontario Public Health Association • ParticipACTION • Perinatal Services BC • Sociedad Espanola de Ginecologia y Obstetricia (The Spanish Society of Gynecology and Obstetrica)

This article is being co-published in the British Journal of Sports Medicine (citation forthcoming). This document reflects emerging clinical and scientific advances on the date issued and is subject to change. The information should not be construed as dictating an exclusive course of treatment or procedure to be followed. Local institutions can dictate amendments to these opinions. They should be well-documented if modified at the local level. None of these contents may be reproduced in any form without prior written permission of the publisher.

Women have the right and responsibility to make informed decisions about their care in partnership with their health care providers. In order to facilitate informed choice, women should be provided with information and support that is evidence based, culturally appropriate, and tailored to their needs. The values, beliefs, and individual needs of each woman and their family should be sought, and the final decision about the care and treatment options chosen by the woman should be respected.

000 JOGC 000 2018 • 1

Co-published in Journal of Obstetricians and Gynaecologists Canada (English and French) & British Journal of Sports Medicine.
www.csep.ca/guidelines

The evidence

- 12 systematic reviews
- Key evidence follows
- “critical” and “important” outcomes not presented generally found no impact of physical activity or had a lack of available information

GDM – what is it?

- Glucose intolerance with first diagnosis during pregnancy
- Affects 3-20% of pregnancies
- If left untreated can increase the risk
  - Fetal malformations
  - Macrosomia (birthweight >4,000g)
  - Cesarean section
  - Other pregnancy complications including preeclampsia
  - Future risk of type 2 diabetes in the mother
  - Future risk of obesity and diabetes in the offspring

Horvath et al. BMJ 2010; Kim et al. Dia Care 2002;25:1862-1868

Metabolism

- Glucose is the major source of nutrition for fetus
- Pregnancy is a state of progressive maternal insulin resistance
- Cannot compensate for the insulin resistance by increased production of insulin
- Hyperglycemia develops

Davenport, Skow and Steinback Clin Obstet Gynecol 2016

Risk to the baby

- Glucose crosses the placenta but insulin doesn't
  - Fetus makes it's own
- High levels of glucose (eg. GDM) overworks the fetal pancreas
- Insulin drives fat synthesis stores the excess energy as fat
- macrosomia

Horvath K et al. BMJ 2010

GDM Risk Factors

- Family history of diabetes
- Personal history of GDM (30-50% recurrence) or glucose intolerance
- Pre-pregnancy BMI $\geq$30kg/m^2
- Previous delivery of baby >4kg
- Age >35 years
- Ethnicity (Indigenous, Asian)

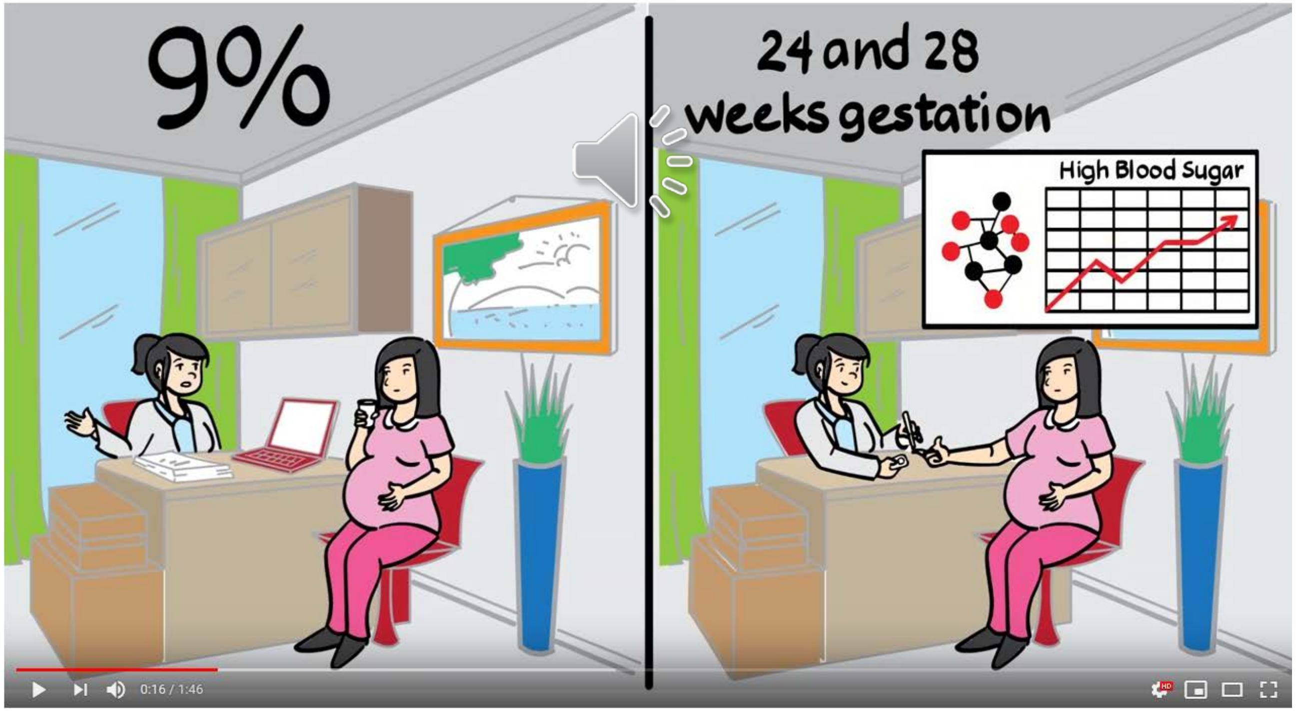
GDM Screening and Management

- Universal screening for GDM occurs between 24 and 28 weeks gestation
  - Low risk – 50g glucose challenge
  - Higher risk – fasted 75g oral glucose tolerance test

- Test blood sugars fasted and after meals
- Nutrition and lifestyle
- If blood glucose targets are not achieved in 1-2 weeks, pharmacological treatment is started
  - Insulin
  - metformin

Prenatal exercise reduces the odds of:

Gestational diabetes mellitus by 38%



Diabetes during Pregnancy: how exercise can help!

https://youtu.be/YETqZcB36pM

Hypertensive Disorders of Pregnancy

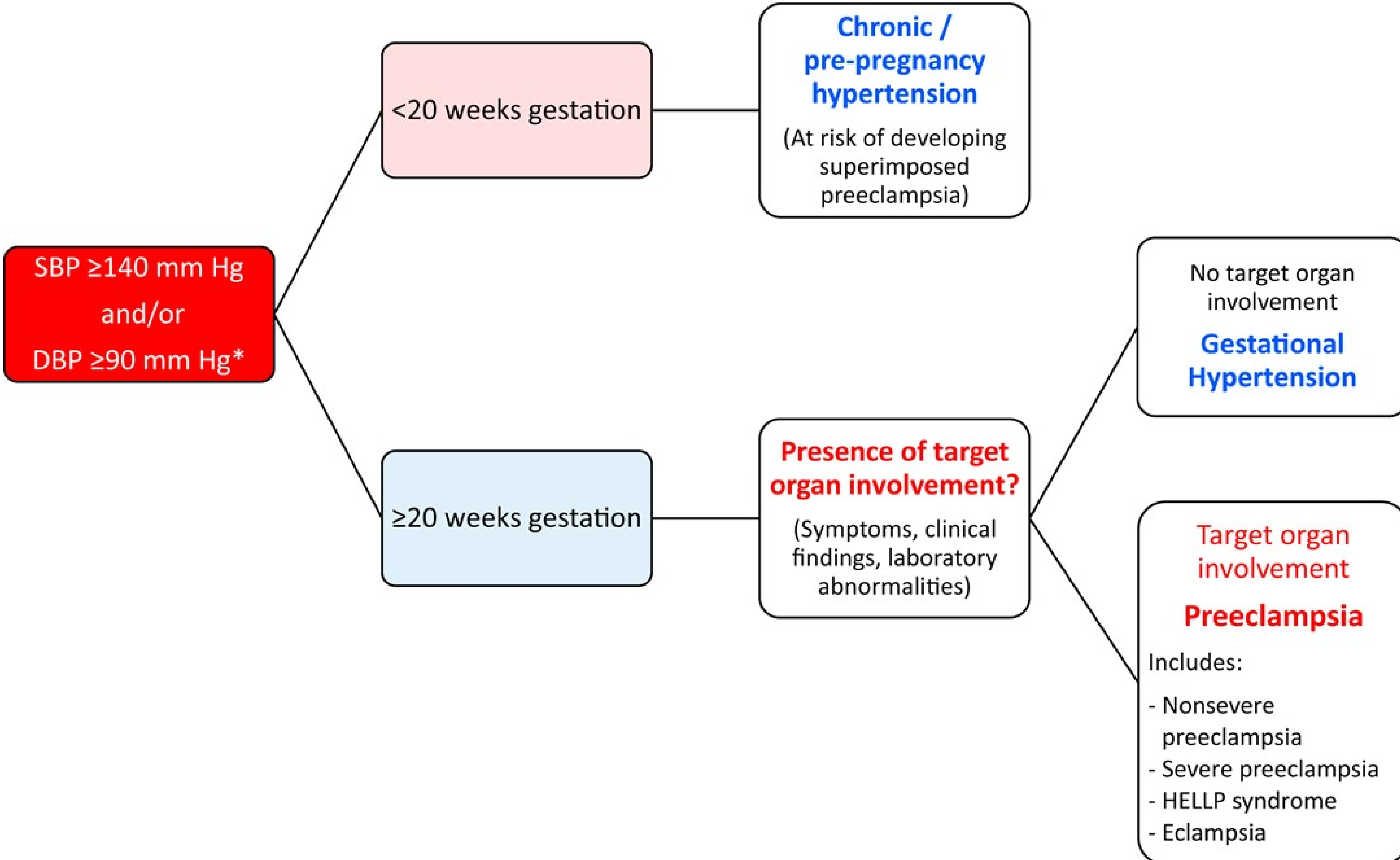
- What are they?
- How are they diagnosed?
- Impact on mother and baby.
- Prevention and management of HDP.

Hypertension CANADA

Hypertensive disorders of pregnancy

- Occur in ~7% of pregnancies in Canada
- Risk factors first degree relative with hypertension, obesity, diabetes, chronic hypertension, multiple gestation, older age (35+)
- Associated with fetal growth restriction, preterm delivery, fetal morbidity / mortality
- Independent risk factor for future cardiovascular disease
  - gestational hypertension – 70%
  - severe preeclampsia with fetal death – 440%

Canadian Journal of Cardiology 2018 34, 526-531DOI: (10.1016/j.cjca.2018.02.021)



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What causes preeclampsia?

- Several theories these are most prevalent
  - Placental defect
    - Abnormal placentation
    - Genetic vs. inflammatory
  - Maternal maladaptation
    - Endothelial dysfunction
    - Sympathetic activation

- Signs and symptoms
  - Headaches
  - Tinnitus (ringing in ears)
  - Blurred vision

Risk to the baby

- Growth restriction, premature birth, fetal death
- Lifelong risk of obesity, diabetes, cardiovascular disease
- Prevention and treatment are key

Treatment

- Currently bed rest is not supported but hospitalization may be required
- Antihypertensive medication in non-severe hypertension (140-159/90-109mmHg) was associated with a decreased risk of progression to severe hypertension ($\geq$160/110)
  - Labetalol, methyldopa, other beta-blockers
- Severe hypertension is considered an obstetrical emergency requiring urgent anti-hypertensive therapy
- The only "cure" is delivery

Canadian Journal of Cardiology 2018 34, 526-531DOI: (10.1016/j.cjca.2018.02.021)

Prevention

SOGC CLINICAL PRACTICE GUIDELINE

No. 307, May 2014 (Replaces No. 206, March 2008)

Diagnosis, Evaluation, and Management of the Hypertensive Disorders of Pregnancy: Executive Summary

- A leading cause of maternal/fetal morbidity and mortality
- Prevalence of hypertensive disorders of pregnancy are rising
- Women at high risk for developing preeclampsia may be prescribed low-dose aspirin, calcium (if have low dietary intake), heparin or others by their health care provider
- Insufficient evidence on other preventative therapies

Prenatal exercise reduces the odds of:

Gestational hypertension by 39%
Preeclampsia by 41%

Pregnancy and Hypertension: how exercise can help!

https://youtu.be/cKOzIirZqAU

Considerations for exercise

- Women at risk of hypertension may benefit from exercise
- Preeclampsia is an absolute contraindication and women are recommended to avoid strenuous physical activity
  - Activities of daily living may be continued
- Gestational hypertension is a relative contraindication
  - Patient and obstetric care provider need to discuss benefits vs. harms of exercise
- Controlled chronic hypertension is not a contraindication

https://youtu.be/cKOzIirZqAU

Pregnancy and Hypertension: how exercise can help!

Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION

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Effectiveness-Based Guidelines for the Prevention of Cardiovascular Disease in Women--2011 Update: A Guideline From the American Heart Association

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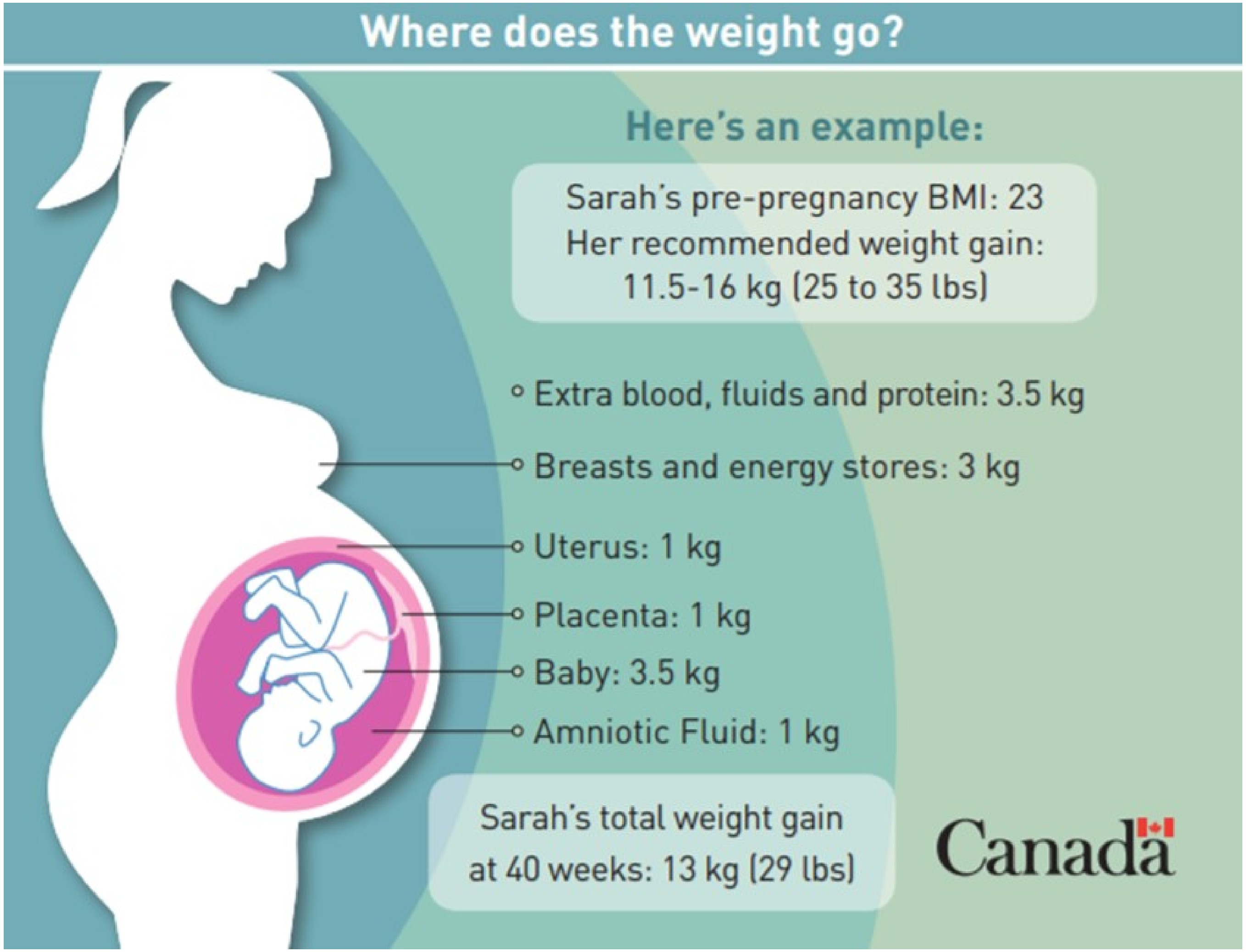
	10-y Predicted CVD risk ≥10%
At risk (≥1 major risk factor[s])	Cigarette smoking
	SBP ≥120 mm Hg, DBP ≥80 mm Hg, or treated hypertension
	Physical inactivity
	History of preeclampsia, gestational diabetes, or pregnancy-induced hypertension

Pregnancy unmasks future chronic disease risk.

If prenatal exercise reduces gestational diabetes and preeclampsia, long term risk for cardiovascular disease may be decreased.

Gestational weight gain



https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fn-an/alt_formats/pdf/nutrition/prenatal/hwgdp-ppspg-eng.pdf

Preconception body mass index and gestational weight gain

Prepregnancy BMI	BMI+ (kg/m²) (WHO)	Total Weight Gain Range (lbs)	Rates of Weight Gain* 2nd and 3rd Trimester (Mean Range in lbs/wk)
Underweight	<18.5	28–40	1 (1–1.3)
Normal weight	18.5-24.9	25–35	1 (0.8–1)
Overweight	25.0-29.9	15–25	0.6 (0.5–0.7)
Obese (includes all classes)	≥30.0	11–20	0.5 (0.4–0.6)

+ *To calculate BMI go to www.nhlbisupport.com/bmi/*

* *Calculations assume a 0.5–2 kg (1.1–4.4 lbs) weight gain in the first trimester (based on Siega-Riz et al., 1994; Abrams et al., 1995; Carmichael et al., 1997)*

IOM Weight Gain During Pregnancy: Reexamining the Guidelines, 2009

Inadequate vs. Excessive Weight Gain

Excessive

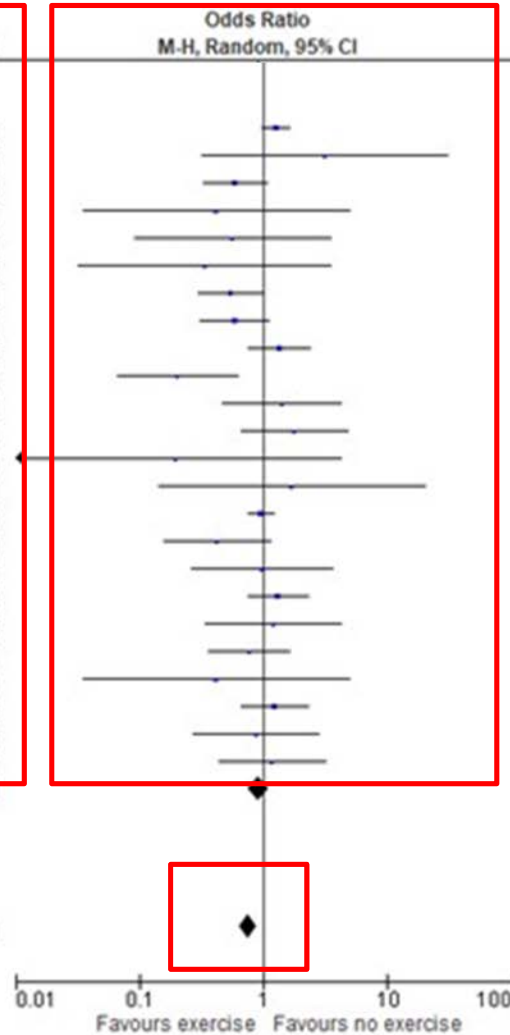
- Gestational diabetes mellitus
- Hypertensive disorders of pregnancy
- Cesarean delivery
- Preterm delivery
- Large for gestational age baby

Inadequate

- Small for gestational age

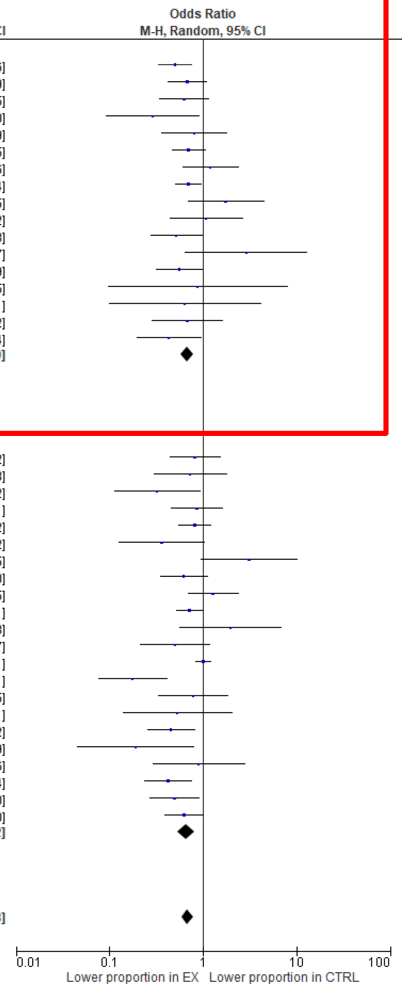
Public Health Agency of Canada. Fact Sheet (2017). https://www.canada.ca/en/public-health/services/publications/healthy-living/effect-maternal-weight-pregnancy-outcomes.html

Study or Subgroup	Exercise Events	Exercise Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
1.3.2 Exercise + co-intervention						
Dodd, 2014	148	1080	120	1073	6.8%	1.26 [0.98, 1.63]
Guelinckx, 2010 - Active	3	65	1	65	0.4%	3.10 [0.31, 30.58]
Harrison, 2013	27	121	35	107	3.8%	0.59 [0.33, 1.06]
Hui, 2006	1	24	2	21	0.4%	0.41 [0.03, 4.91]
Hui, 2012	2	102	3	88	0.7%	0.57 [0.09, 3.47]
Hui, 2014 - OW/OB	1	27	3	29	0.4%	0.33 [0.03, 3.42]
Jing, 2015	26	115	37	106	3.7%	0.54 [0.30, 0.98]
Koivusalo, 2016	20	144	27	125	3.4%	0.59 [0.31, 1.11]
Luoto, 2011	34	216	22	179	3.8%	1.33 [0.75, 2.37]
Petrella, 2014	7	33	16	28	1.5%	0.20 [0.07, 0.62]
Phelan, 2011 - NW	8	90	6	92	1.6%	1.40 [0.47, 4.20]
Phelan, 2011 - OW/OB	11	81	7	86	1.8%	1.77 [0.65, 4.82]
Polley, 2002 - NW	0	30	2	31	0.2%	0.19 [0.01, 4.20]
Polley, 2002 - OW/OB	2	27	1	22	0.4%	1.68 [0.14, 19.85]
Poston, 2015	160	629	172	651	6.9%	0.95 [0.74, 1.22]
Rauh, 2013	8	156	9	79	1.9%	0.42 [0.16, 1.14]
Renault, 2014 - Diet + Exercise	6	103	4	67	1.2%	0.97 [0.26, 3.59]
Sagedal, 2017	32	296	25	295	4.0%	1.31 [0.76, 2.27]
Simmons, 2015 - Diet + Exercise	11	35	5	18	1.3%	1.19 [0.34, 4.18]
Simmons, 2016 - Exercise + Diet	27	84	18	47	2.8%	0.76 [0.36, 1.61]
Smith, 2016	1	24	2	21	0.4%	0.41 [0.03, 4.91]
Stafne, 2012	25	375	18	327	3.5%	1.23 [0.66, 2.29]
Vesco, 2014	6	56	7	58	1.5%	0.87 [0.27, 2.78]
Vinter, 2011	9	150	8	154	1.9%	1.16 [0.44, 3.10]
Subtotal (95% CI)		4063		3769	54.3%	0.90 [0.74, 1.10]
Total events	575		550			
Heterogeneity: Tau² = 0.05; Chi² = 32.70, df = 23 (P = 0.09); I² = 30%						
Test for overall effect: Z = 1.03 (P = 0.30)						
Total (95% CI)		**7568**		**7198**	**100.0%**	**0.76 [0.65, 0.88]**
Total events	846		930			
Heterogeneity: Tau² = 0.07; Chi² = 72.72, df = 50 (P = 0.02); I² = 31%						
Test for overall effect: Z = 3.56 (P = 0.0004)						
Test for subgroup differences: Chi² = 7.40, df = 1 (P = 0.007), I² = 86.5%						



Excessive gestational weight gain

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
10.1.1 Exercise only						
16741 - Ruiz, 2013 - NW	42	335	78	352	4.4%	0.50 [0.33, 0.76]
16741 - Ruiz, 2013 - OW/OB	72	146	76	129	3.9%	0.68 [0.42, 1.09]
16780 - Renault, 2014 - Exercise	64	125	42	67	3.1%	0.62 [0.34, 1.15]
18056 - Perales, 2015	7	38	11	25	1.3%	0.29 [0.09, 0.90]
31761 - Haakstad, 2011	17	52	20	53	2.1%	0.80 [0.36, 1.79]
31986 - Ronnberg, 2015	79	192	91	182	4.4%	0.70 [0.46, 1.05]
32014 - Ussher, 2015	30	74	24	66	2.7%	1.19 [0.60, 2.36]
33043 - Barakat, 2016	101	382	131	383	5.2%	0.69 [0.51, 0.94]
33074 - Garnaes, 2016	21	36	16	36	1.7%	1.75 [0.69, 4.45]
50068 - Simmons, 2016 - Exercise	58	76	30	40	1.9%	1.07 [0.44, 2.62]
Barakat, 2014	22	107	31	93	2.9%	0.52 [0.27, 0.98]
Bisson, 2015	21	24	17	24	0.8%	2.88 [0.65, 12.87]
Codero, 2015	23	101	54	156	3.3%	0.56 [0.31, 0.99]
Kong, 2014 - OB	7	9	8	10	0.4%	0.88 [0.10, 7.95]
Kong, 2014 - OW	4	9	5	9	0.5%	0.64 [0.10, 4.11]
Nascimento, 2011	19	40	24	42	1.9%	0.68 [0.28, 1.62]
Perales, 2015	24	52	36	54	2.2%	0.43 [0.20, 0.94]
Subtotal (95% CI)		**1798**		**1721**	**42.6%**	**0.68 [0.57, 0.80]**
Total events	611		694			
Heterogeneity: Tau² = 0.01; Chi² = 18.19, df = 16 (P = 0.31); I² = 12%						
Test for overall effect: Z = 4.64 (P < 0.00001)						
10.1.2 Exercise plus co-intervention						
31713 - Althuizen, 2013	75	103	82	107	3.0%	0.82 [0.44, 1.52]
31715 - Jing, 2015	102	115	97	106	1.8%	0.73 [0.30, 1.78]
31941 - Petrella, 2014	11	33	17	28	1.4%	0.32 [0.11, 0.92]
32174 - Ferrera, 2011	25	91	30	98	2.9%	0.86 [0.46, 1.61]
32198 - Kinnunun, 2012	101	219	92	180	4.5%	0.82 [0.55, 1.22]
32228 - Polley, 2002 - NW	10	30	18	31	1.5%	0.36 [0.13, 1.02]
32228 - Polley, 2002 - OW/OB	16	27	7	22	1.2%	3.12 [0.96, 10.15]
32230 - Phelan, 2011 - NW	37	92	49	94	3.2%	0.62 [0.35, 1.10]
32230 - Phelan, 2011 - OW/OB	58	87	55	90	3.0%	1.27 [0.69, 2.35]
33145 - Sagedal, 2017	111	279	133	278	5.0%	0.72 [0.51, 1.01]
33155 - Smith, 2016 - 34 to 36 weeks	15	22	11	21	1.1%	1.95 [0.56, 6.73]
50068 - Simmons, 2016 - Diet + Exercise	45	75	30	40	2.0%	0.50 [0.21, 1.17]
60010 - Dodd, 2014	380	897	368	871	6.2%	1.00 [0.83, 1.21]
60011 - Vesco, 2014	24	56	47	58	2.0%	0.18 [0.08, 0.41]
Guelinckx, 2010	17	42	20	43	2.0%	0.78 [0.33, 1.85]
Hui, 2006	5	24	7	21	1.0%	0.53 [0.14, 2.01]
Hui, 2012	36	102	48	88	3.2%	0.45 [0.25, 0.82]
Hui, 2014 - NW	3	30	10	27	0.9%	0.19 [0.05, 0.79]
Hui, 2014 - OW/OB	18	27	20	29	1.3%	0.90 [0.29, 2.76]
Rauh, 2013	58	152	44	74	3.3%	0.42 [0.24, 0.74]
Renault, 2014 - Diet + Exercise	59	130	42	67	3.1%	0.49 [0.27, 0.90]
Vinter, 2011	51	144	69	148	3.9%	0.63 [0.39, 1.00]
Subtotal (95% CI)		**2777**		**2521**	**57.4%**	**0.66 [0.54, 0.82]**
Total events	1257		1296			
Heterogeneity: Tau² = 0.12; Chi² = 50.53, df = 21 (P = 0.0003); I² = 58%						
Test for overall effect: Z = 3.83 (P = 0.0001)						
Total (95% CI)		**4575**		**4242**	**100.0%**	**0.68 [0.59, 0.78]**
Total events	1868		1990			
Heterogeneity: Tau² = 0.07; Chi² = 70.58, df = 38 (P = 0.001); I² = 46%						
Test for overall effect: Z = 5.36 (P < 0.00001)						
Test for subgroup differences: Chi² = 0.02, df = 1 (P = 0.89), I² = 0%						



Exercise reduces the risk of:

Gestational diabetes ↓38%
Gestational hypertension ↓39%
Preeclampsia ↓41%
Excessive gestational weight gain ↓32%

Ruchat *et al* Br J Sports Med 2018

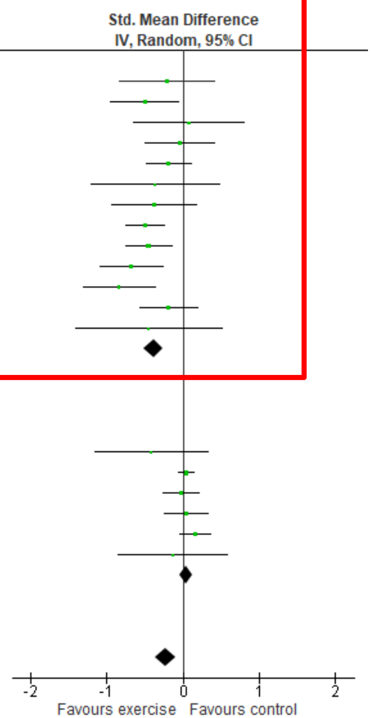
Prenatal depression

https://www.youtube.com/watch?v=WsBQ2cuXU2Y

- Affects~13% of pregnant women
- Strongly predicts the development of postpartum depression
- Standard treatment is pharmacological treatment and psychological intervention

Prenatal depressive symptoms

Study or Subgroup	Exercise Mean	Exercise SD	Exercise Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.2.1 Exercise Only								
Davis, 2015	6.35	3.99	20	7.32	5.06	19	3.4%	-0.21 [-0.84, 0.42]
Field, 2013	8.5	5.3	40	11.5	6.5	39	5.0%	-0.50 [-0.95, -0.05]
Field, 2012	20.12	10.51	11	19.27	10.12	21	2.7%	0.08 [-0.65, 0.81]
Field, 2013	23.5	9	37	23.9	11.4	38	5.0%	-0.04 [-0.49, 0.41]
Guelfi, 2016	3.88	2.95	85	4.48	3.33	87	7.0%	-0.19 [-0.49, 0.11]
Mitchell, 2012	17.92	8.67	11	21.42	9.79	11	2.2%	-0.36 [-1.21, 0.48]
Newham, 2014	5.14	3.86	29	6.77	4.82	22	3.9%	-0.37 [-0.93, 0.19]
Perales, 2015	7.65	6.65	120	11.93	10.19	121	7.6%	-0.50 [-0.75, -0.24]
Perales, 2015	7.67	6.3	90	11.34	9.74	77	6.9%	-0.45 [-0.76, -0.14]
Perales, 2014	9.33	7.17	45	15.26	9.76	53	5.5%	-0.68 [-1.09, -0.27]
Robledo-Colonia, 2012	10	6	37	16	8	37	4.7%	-0.84 [-1.32, -0.36]
Taniguchi, 2016	4.1	4.8	54	5.2	6.7	53	5.9%	-0.19 [-0.57, 0.19]
Uebelacker, 2016	5.27	4.47	11	7.43	4.72	7	1.8%	-0.45 [-1.41, 0.51]
Subtotal (95% CI)			**590**			**585**	**61.5%**	**-0.39 [-0.51, -0.26]**
Heterogeneity: Tau² = 0.01; Chi² = 13.44, df = 12 (P = 0.34); I² = 11%								
Test for overall effect: Z = 5.98 (P < 0.00001)								
1.2.2 Exercise plus co-intervention								
Choi, 2016	8.8	2.7	13	11.1	6.9	15	2.6%	-0.41 [-1.17, 0.34]
Dodd, 2016	5.83	4.58	695	5.63	4.72	687	9.6%	0.04 [-0.06, 0.15]
Phelan, 2014	4.9	4.4	128	5	4	133	7.8%	-0.02 [-0.27, 0.22]
Poston, 2013	7.1	4.5	94	6.9	4.2	87	7.1%	0.05 [-0.25, 0.34]
Ussher, 2015	8	4.9	189	7.2	5	194	8.5%	0.16 [-0.04, 0.36]
Vieten, 2008	16.2	7.3	13	17.2	7.4	18	2.8%	-0.13 [-0.85, 0.58]
Subtotal (95% CI)			**1132**			**1134**	**38.5%**	**0.05 [-0.03, 0.13]**
Heterogeneity: Tau² = 0.00; Chi² = 3.27, df = 5 (P = 0.66); I² = 0%								
Test for overall effect: Z = 1.13 (P = 0.26)								
Total (95% CI)			**1722**			**1719**	**100.0%**	**-0.23 [-0.37, -0.09]**
Heterogeneity: Tau² = 0.05; Chi² = 52.57, df = 18 (P < 0.0001); I² = 66%								
Test for overall effect: Z = 3.17 (P = 0.002)								
Test for subgroup differences: Chi² = 31.67, df = 1 (P < 0.00001), I² = 96.8%								

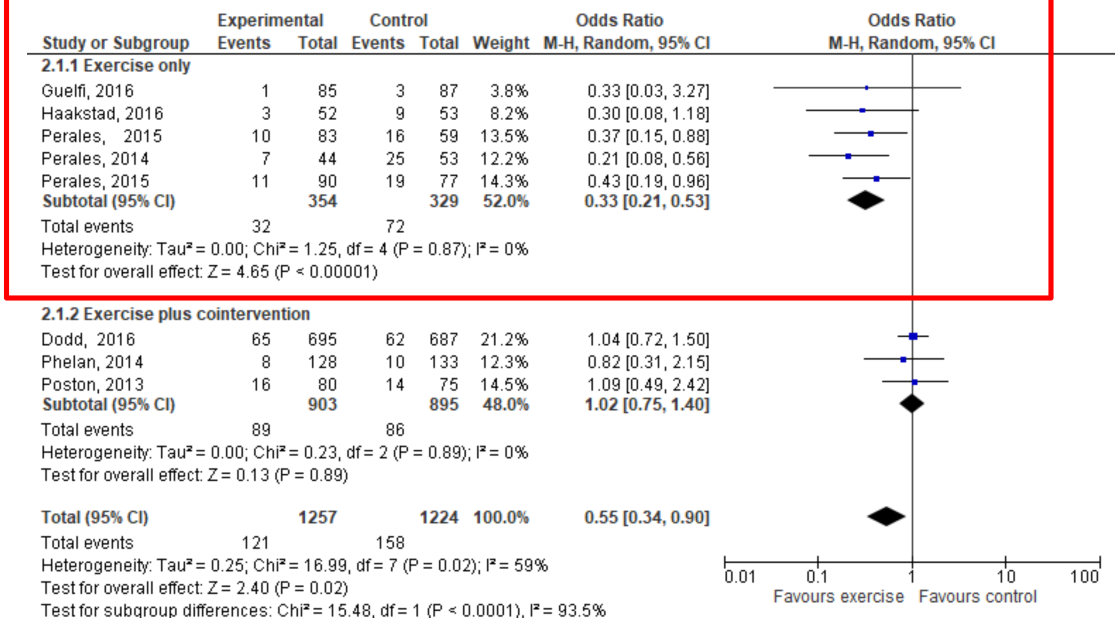


Exercise reduces the risk of:

Gestational diabetes ↓38%
Gestational hypertension ↓39%
Preeclampsia ↓41%
Excessive gestational weight gain ↓32%
Depressive symptoms = moderate

Davenport, McCurdy *et al* Br J Sports Med 2018

Prenatal depression



Exercise reduces the risk of:

Gestational diabetes ↓38%
Gestational hypertension ↓39%
Preeclampsia ↓41%
Excessive gestational weight gain ↓32%
Depressive symptoms = moderate
Depression ↓67%

Davenport, McCurdy *et al* Br J Sports Med 2018

However….

- Prenatal exercise does not reduce the incidence or severity of postpartum depression
- Prenatal exercise did not alter the incidence or severity of anxiety during or following pregnancy
- Few studies, limited follow up
- BUT, re-starting exercise in the postpartum period has a protective effect on mental health.

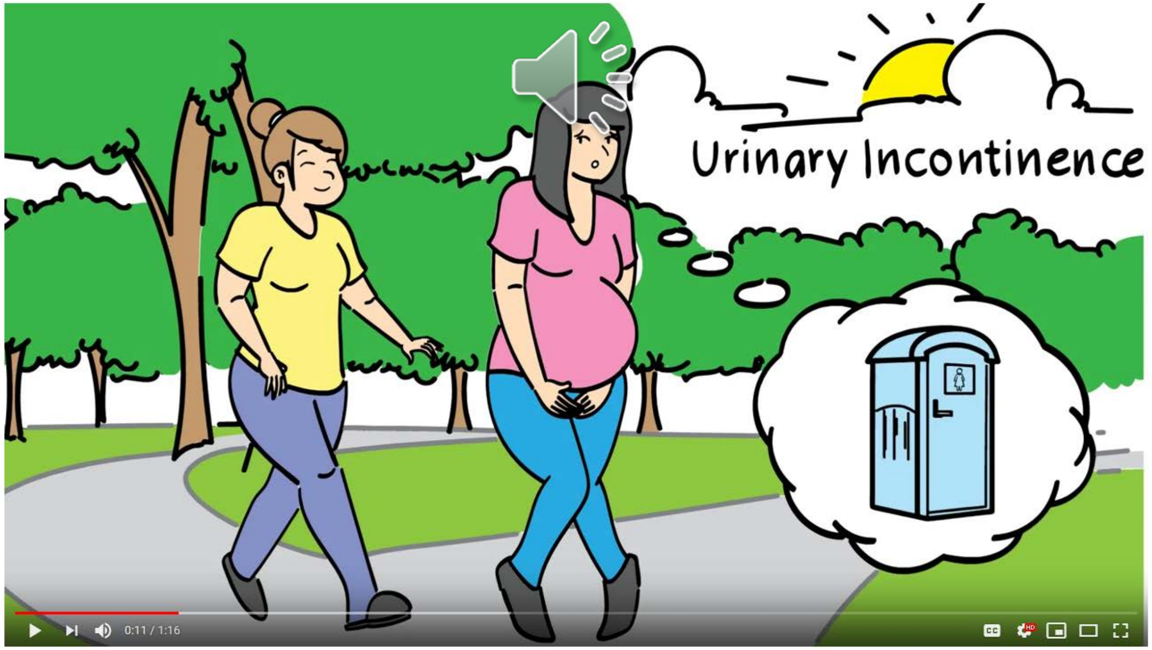
Urinary incontinence

- Previously covered by Kari Bo
- Involuntary leakage of urine.
- Hormones and increased weight of the uterus can increase the risk of UI.
- Up to 75% of pregnant women experience UI, often persisting into the postpartum period.

Prenatal exercise reduces the odds of:

Prenatal urinary incontinence by 51%

Postpartum urinary incontinence by 37%

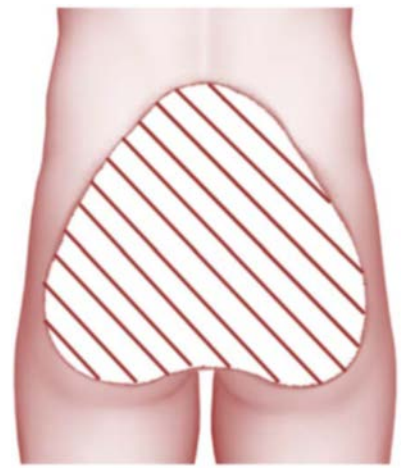


Pregnancy and Urinary incontinence: how exercise can help!

https://youtu.be/E-65pYlG9hI

Lumbopelvic pain

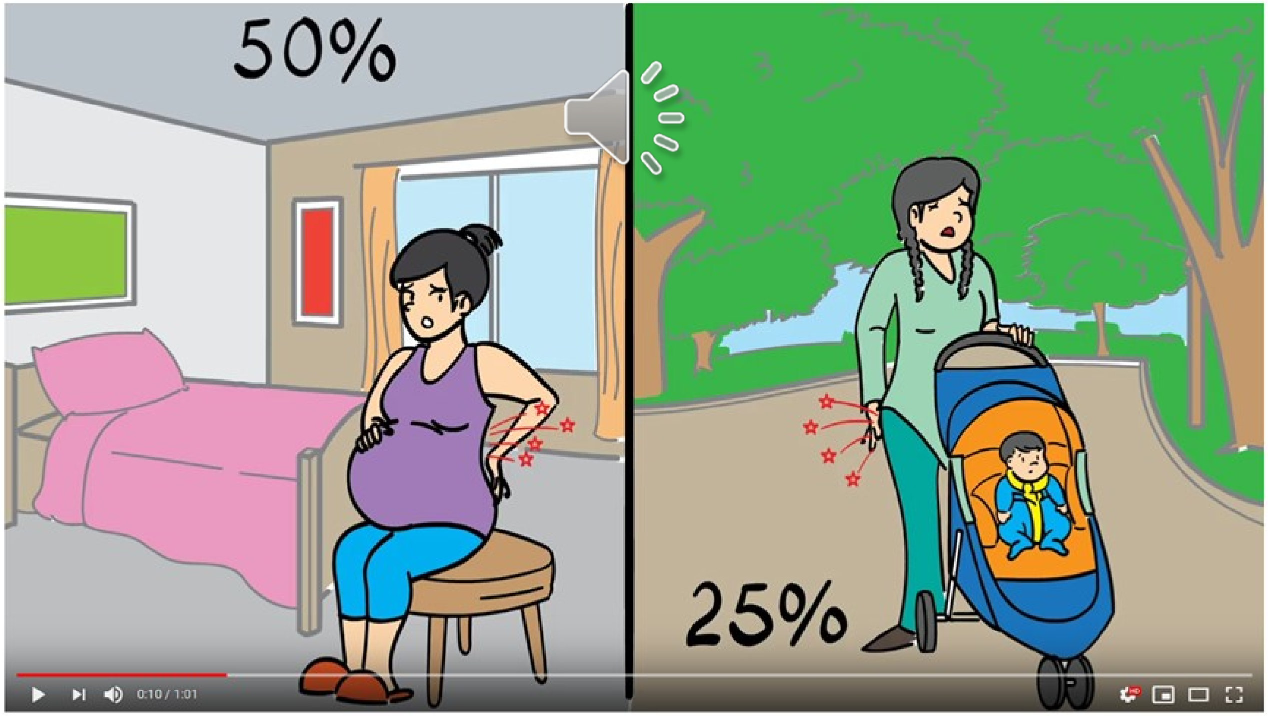
- **Lumbopelvic pain:** pain arises from both the low back and the pelvis.
- **Low back pain**: below the ribs, but above the gluteal folds, with or without radiation down the legs
- **Pelvic girdle pain**: pain around the pubic and sacroiliac joints with our without radiate down the posterior thigh.



Girard et al J Manipulative Physiol Ther 2016

Prenatal exercise reduces the odds of:

Severity (but not development) of low back, pelvic girdle and lumbopelvic pain.



Pregnancy and Back Pain: how exercise can help!

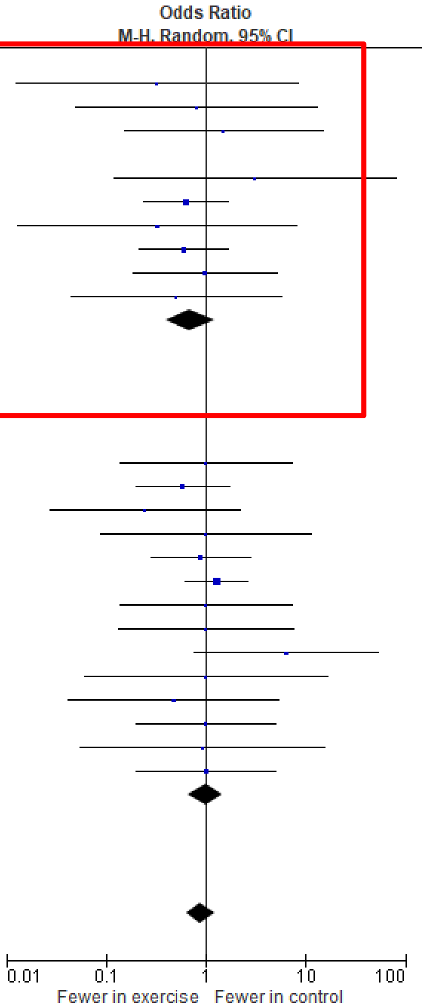
https://youtu.be/1Of5shx3BU8

Traditional concerns about prenatal exercise

1) Increase early pregnancy loss;
2) Premature delivery;
3) Increased core body temperature leading to congenital anomalies;
4) Fetal growth restriction

Miscarriage

Study or Subgroup	Exercise Events	Exercise Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
1.2.1 Exercise only						
15952 - Bisson, 2015	0	25	1	25	1.0%	0.32 [0.01, 8.25]
16660 - Petrov Fieril, 2015	1	51	1	41	1.4%	0.80 [0.05, 13.19]
16780 - Renault, 2014 - Exercise	3	142	1	71	2.1%	1.51 [0.15, 14.79]
18059 - Prabhu, 2015	0	52	0	53		Not estimable
30284 - Erkkola, 1976	1	31	0	31	1.0%	3.10 [0.12, 79.04]
31986 - Ronnberg, 2015	7	221	11	224	11.5%	0.63 [0.24, 1.66]
32331 - Kihlstrand,1999	0	124	1	122	1.0%	0.33 [0.01, 8.06]
32445 - Ussher, 2015	6	383	10	389	10.3%	0.60 [0.22, 1.68]
33074 - Garnaes, 2016	3	46	3	45	3.9%	0.98 [0.19, 5.12]
40398 - Guelfi, 2016	1	85	2	87	1.8%	0.51 [0.05, 5.69]
Subtotal (95% CI)		**1160**		**1088**	**34.0%**	**0.69 [0.40, 1.22]**
Total events	22		30			
Heterogeneity: Tau² = 0.00; Chi² = 2.04, df = 8 (P = 0.98); I² = 0%						
Test for overall effect: Z = 1.27 (P = 0.20)						
1.2.2 Exercise plus co-intervention						
15082 - Guelinckx, 2010 - Active	2	65	2	65	2.7%	1.00 [0.14, 7.32]
15310 - Luoto, 2011	6	246	8	196	9.3%	0.59 [0.20, 1.72]
15704 - Vinter, 2011	1	180	4	180	2.2%	0.25 [0.03, 2.22]
16780 - Renault, 2014 - Diet + Exercise	2	142	1	71	1.8%	1.00 [0.09, 11.22]
18043 - Koivusalo, 2016	6	155	6	138	8.0%	0.89 [0.28, 2.81]
18058 - Poston, 2015	18	783	14	772	21.5%	1.27 [0.63, 2.58]
31715 - Jing, 2015	2	131	2	131	2.7%	1.00 [0.14, 7.21]
31743 - Korpi-Hyovalti, 2012	2	27	2	27	2.6%	1.00 [0.13, 7.67]
31968 - Jackson, 2011	6	158	1	163	2.4%	6.39 [0.76, 53.73]
32177 - Hawkins, 2015	1	35	1	35	1.4%	1.00 [0.06, 16.65]
32228 - Polley, 2002	1	61	2	59	1.8%	0.47 [0.04, 5.38]
32230 - Phelan, 2011	3	201	3	200	4.1%	0.99 [0.20, 4.99]
32282 - Kluge, 2011	1	26	1	24	1.3%	0.92 [0.05, 15.58]
33145 - Sagedal, 2017	3	303	3	303	4.1%	1.00 [0.20, 4.99]
Subtotal (95% CI)		**2513**		**2364**	**66.0%**	**0.99 [0.66, 1.48]**
Total events	54		50			
Heterogeneity: Tau² = 0.00; Chi² = 6.29, df = 13 (P = 0.94); I² = 0%						
Test for overall effect: Z = 0.07 (P = 0.95)						
Total (95% CI)		**3673**		**3452**	**100.0%**	**0.88 [0.63, 1.21]**
Total events	76		80			
Heterogeneity: Tau² = 0.00; Chi² = 9.32, df = 22 (P = 0.99); I² = 0%						
Test for overall effect: Z = 0.79 (P = 0.43)						
Test for subgroup differences: Chi² = 0.99, df = 1 (P = 0.32), I² = 0%						



No increased risk, possible protective effect?

Same finding in other study designs.

Miscarriage

- 93,000 pregnant women in Danish National Birth Cohort (*Madsen 2007*).
  - High-volume or high-impact exercise in 1st trimester associated with increased risk of miscarriage.
    - » 7+ hours per week, running.

- BUT 2/3 of women were interviewed after having a miscarriage.
  - After restricting to women interviewed about exercise practice while pregnant exercise did not increase risk (*Nilsson 2014*).
    - » Recall bias after miscarriage?

Madsen et al BJOG 2007, Nilsson et al BJOG 2014, Maconochie et al BJOG 2007

Traditional concerns about prenatal exercise

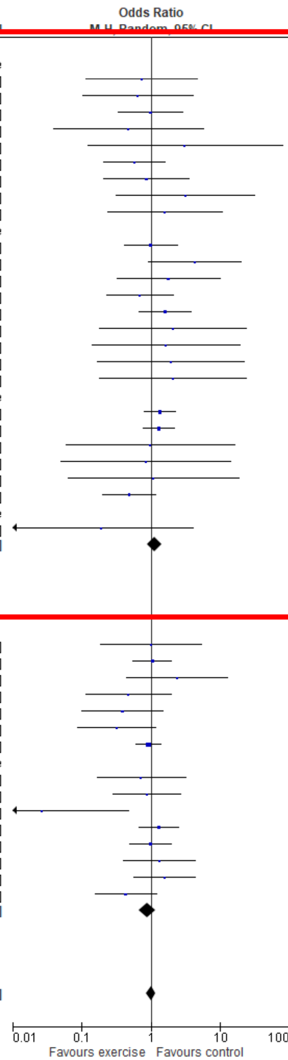
1) Increase early pregnancy loss;
2) Premature delivery;
3) Increased core body temperature leading to congenital anomalies;
4) Fetal growth restriction

Why do we care about prematurity?

- Premature <37 weeks.
- 1 in 10 babies born premature worldwide.
- Short term:
  - Underdeveloped lungs
  - NICU
- Long term:
  - Cognitive impairments
  - Developmental delay
  - Chronic health issues

Premature delivery

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
12.5.1 Exercise only						
13662 - Suputtitada, 2002	0	32	0	35		Not estimable
13826 - Baciuk, 2008	2	33	3	37	0.8%	0.73 [0.11, 4.67]
13838 - Barakat, 2009	2	71	3	70	0.8%	0.65 [0.10, 4.00]
14032 - Elden, 2008	7	130	7	129	2.4%	0.99 [0.34, 2.91]
14962 - Dias, 2011	1	21	2	21	0.4%	0.47 [0.04, 5.68]
15487 - Price, 2012	1	31	0	31	0.3%	3.10 [0.12, 79.04]
15909 - Barakat, 2013 - All	6	138	11	152	2.6%	0.58 [0.21, 1.62]
15912 - Barakat, 2014	4	107	4	93	1.4%	0.86 [0.21, 3.56]
16203 - Ghodsi, 2014	3	40	1	40	0.5%	3.16 [0.31, 31.78]
16254 - Halse, 2015	3	20	2	20	0.8%	1.59 [0.24, 10.70]
16406 - Kong, 2014- OW	0	9	0	10		Not estimable
16611 - Nobles, 2015	11	124	11	123	3.6%	0.99 [0.41, 2.38]
16741 - Ruiz, 2013 - NW	8	335	2	352	1.1%	4.28 [0.90, 20.31]
16741 - Ruiz, 2013 - OW/OB	4	146	2	129	0.9%	1.79 [0.32, 9.93]
16780 - Renault, 2014	8	125	6	67	2.3%	0.70 [0.23, 2.09]
16904 - Tomic, 2013	14	167	9	167	3.6%	1.61 [0.68, 3.82]
18059 - Prabhu, 2015	2	52	1	53	0.5%	2.08 [0.18, 23.67]
18064 - Seneviratne, 2015	2	37	1	30	0.5%	1.66 [0.14, 19.21]
31578 - Santos, 2005	2	37	1	35	0.5%	1.94 [0.17, 22.43]
31761 - Haakstad, 2011	2	52	1	53	0.5%	2.08 [0.18, 23.67]
31783 - Avery, 1997	0	15	0	14		Not estimable
32445 - Ussher, 2015	35	356	26	348	9.7%	1.35 [0.79, 2.30]
33043 - Barakat, 2016	37	383	29	382	10.6%	1.30 [0.78, 2.16]
33074 - Garnaes, 2016	1	46	1	45	0.3%	0.98 [0.06, 16.12]
Bell, 2000	1	33	1	28	0.3%	0.84 [0.05, 14.14]
Clapp, 2000	1	22	1	24	0.3%	1.10 [0.06, 18.64]
Kasawara, 2013	11	55	18	53	3.6%	0.49 [0.20, 1.16]
Kong, 2014- OB	0	9	0	9		Not estimable
Taniguchi, 2016	0	54	2	53	0.3%	0.19 [0.01, 4.03]
Subtotal (95% CI)		**2680**		**2603**	**48.6%**	**1.12 [0.88, 1.42]**
Total events	168		145			
Heterogeneity: Tau² = 0.00; Chi² = 15.11, df = 24 (P = 0.92); I² = 0%						
Test for overall effect: Z = 0.94 (P = 0.35)						
12.5.2 Exercise plus co-intervention						
14951 - de Barros, 2010	3	32	3	32	1.0%	1.00 [0.19, 5.37]
15622 - Stafne, 2012	20	429	19	426	6.6%	1.05 [0.55, 1.99]
15704 - Vinter, 2011	5	82	2	75	1.0%	2.37 [0.45, 12.60]
15964 - Bo, 2014	3	101	6	99	1.4%	0.47 [0.12, 1.95]
16707- Rauh, 2013	4	156	5	79	1.5%	0.39 [0.10, 1.49]
16780 - Renault, 2014 - Exercise + Diet	4	130	6	67	1.6%	0.32 [0.09, 1.19]
18058 - Poston, 2015	45	761	48	751	15.5%	0.92 [0.60, 1.40]
30325 - Hollingsworth, 1987	0	12	0	8		Not estimable
30325 - Hollingsworth, 1987 - Type 1 Diabetes	4	13	8	21	1.3%	0.72 [0.17, 3.14]
31713 - Althuizen, 2013	6	103	7	107	2.2%	0.88 [0.29, 2.72]
31941 - Petrella, 2014	0	33	10	28	0.3%	0.03 [0.00, 0.47]
31968 - Jackson, 2011	22	158	18	163	6.2%	1.30 [0.67, 2.53]
33145 - Sagedal, 2016	17	296	17	295	5.7%	1.00 [0.50, 1.99]
Miquelutti, 2013	7	74	5	69	1.9%	1.34 [0.40, 4.43]
Phelan, 2011 - OW/OB	10	81	7	86	2.6%	1.59 [0.57, 4.40]
Phelan, 2011- NW	6	90	13	92	2.7%	0.43 [0.16, 1.20]
Subtotal (95% CI)		**2551**		**2398**	**51.4%**	**0.88 [0.67, 1.16]**
Total events	156		174			
Heterogeneity: Tau² = 0.05; Chi² = 17.04, df = 14 (P = 0.25); I² = 18%						
Test for overall effect: Z = 0.89 (P = 0.38)						
Total (95% CI)		**5231**		**5001**	**100.0%**	**1.00 [0.85, 1.18]**
Total events	324		319			
Heterogeneity: Tau² = 0.00; Chi² = 33.65, df = 39 (P = 0.71); I² = 0%						
Test for overall effect: Z = 0.05 (P = 0.96)						
Test for subgroup differences: Chi² = 1.65, df = 1 (P = 0.20), I² = 39.4%						



No increased risk of premature delivery

Davenport et al BJSM 2018

Traditional concerns about prenatal exercise

1) Increase early pregnancy loss;
2) Premature delivery;
3) Increased core body temperature leading to congenital anomalies;
4) Fetal growth restriction

Body temperature and congenital anomalies?

- Hot tub use during embryogenesis early in pregnancy ↑ neural tube defects.
- Maternal core temperature +2.0 degrees Celsius during embryogenesis.
- Exercise increases body temperature.

Impact of pregnancy on thermogenesis?

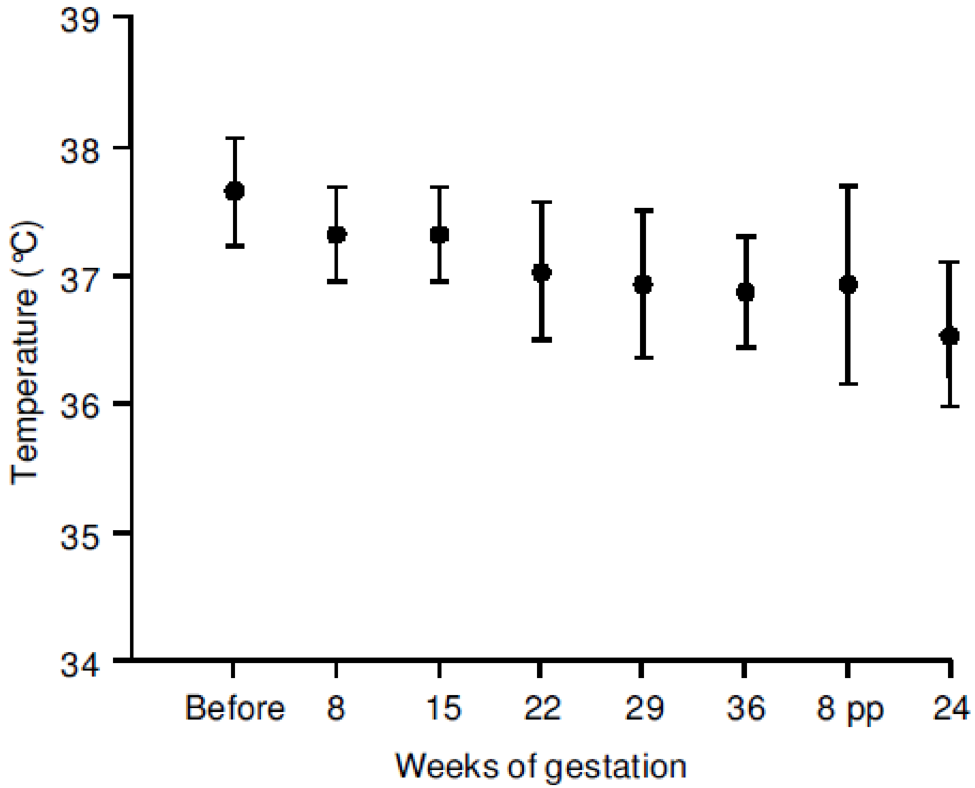


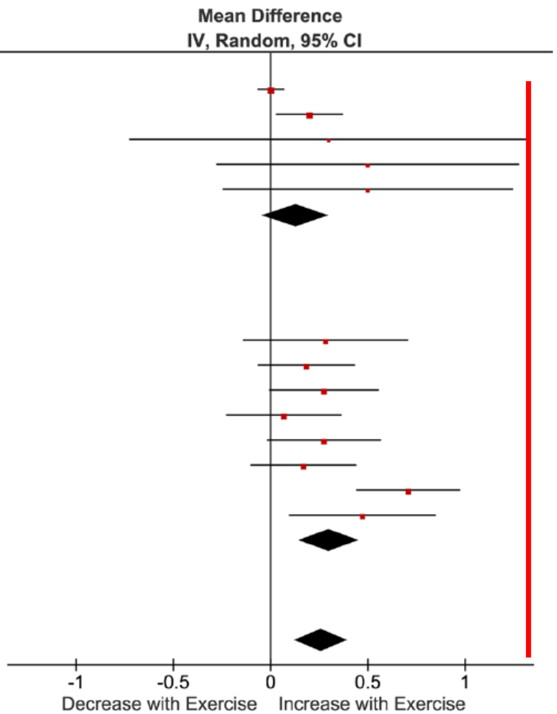
Figure 2 Temperature during exercise at submaximal workload (mean ± 1 SD; n = 14)

Improved thermoregulation due to increased plasma volume, decreased vascular resistance and increased skin blood flow.

Lindqvist et al 2003

Maternal temperature with exercise

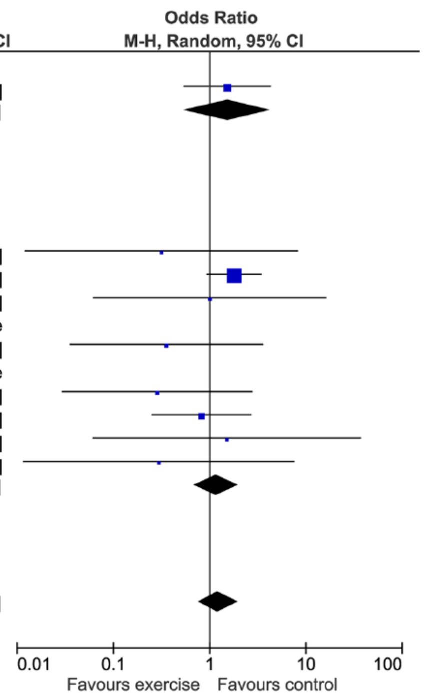
Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
1.4.2 Moderate Intensity				
Clapp, J.F. (1991)	0.00155	0.0349	13.8%	0.00 [-0.07, 0.07]
Larsson & Lindqvist (2005)	0.2	0.088	11.7%	0.20 [0.03, 0.37]
Soultanakis et al., 15 min (1996)	0.298	0.5223	1.6%	0.30 [-0.73, 1.32]
Soultanakis et al., 30 min (1996)	0.5	0.3974	2.6%	0.50 [-0.28, 1.28]
Soultanakis et al., 45 min (1996)	0.5	0.3805	2.8%	0.50 [-0.25, 1.25]
Subtotal (95% CI)			**32.5%**	**0.13 [-0.04, 0.30]**
Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 7.55$, df = 4 ($P = 0.11$); $I^2 = 47\%$				
Test for overall effect: $Z = 1.45$ ($P = 0.15$)				
1.4.3 Vigorous Intensity				
Baciuk et al. (2008) - CONTROL (19wks)	0.2824	0.2167	6.1%	0.28 [-0.14, 0.71]
Baciuk et al. (2008) - CONTROL (25wks)	0.1841	0.1273	9.7%	0.18 [-0.07, 0.43]
Baciuk et al. (2008) - CONTROL (35wks)	0.274	0.144	9.0%	0.27 [-0.01, 0.56]
Baciuk et al. (2008) - EX GROUP (19wks)	0.0689	0.1516	8.6%	0.07 [-0.23, 0.37]
Baciuk et al. (2008) - EX GROUP (25wks)	0.2737	0.1495	8.7%	0.27 [-0.02, 0.57]
Baciuk et al. (2008) - EX GROUP (35wks)	0.1688	0.1388	9.2%	0.17 [-0.10, 0.44]
Clapp et al. (1987) 20WKS	0.7082	0.1362	9.3%	0.71 [0.44, 0.98]
Clapp et al. (1987) 32WKS	0.4721	0.1928	6.9%	0.47 [0.09, 0.85]
Subtotal (95% CI)			**67.5%**	**0.30 [0.15, 0.45]**
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 13.90$, df = 7 ($P = 0.05$); $I^2 = 50\%$				
Test for overall effect: $Z = 3.95$ ($P < 0.0001$)				
Total (95% CI)			**100.0%**	**0.26 [0.12, 0.40]**
Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 39.37$, df = 12 ($P < 0.0001$); $I^2 = 70\%$				
Test for overall effect: $Z = 3.67$ ($P = 0.0002$)				
Test for subgroup differences: $Chi^2 = 2.16$, df = 1 ($P = 0.14$), $I^2 = 53.8\%$				



Prenatal exercise did not result in hyperthermia.

Congenital anomalies

Study or Subgroup	Exercise Events	Exercise Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
2.4.1 Exercise only						
Ussher, 2015	9	346	6	348	19.5%	1.52 [0.54, 4.32]
Subtotal (95% CI)		**346**		**348**	**19.5%**	**1.52 [0.54, 4.32]**
Total events	9		6			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.79 (P = 0.43)						
2.4.2 Exercise+co-intervention						
Bung, 1993	0	17	1	17	2.0%	0.31 [0.01, 8.27]
Dodd, 2014	25	1075	14	1067	48.7%	1.79 [0.93, 3.46]
Guelinckx, 2010 - Active	1	65	1	65	2.7%	1.00 [0.06, 16.34]
Hollingsworth, 1987 - Non Diabetic	0	12	0	8		Not estimable
Hollingsworth, 1987 - Type 1 Diabetic	1	13	4	21	4.0%	0.35 [0.04, 3.58]
Jovanovic-Peterson, 1989	0	10	0	9		Not estimable
Koivusalo, 2016	1	144	3	125	4.1%	0.28 [0.03, 2.77]
Poston, 2015	5	760	6	751	15.0%	0.82 [0.25, 2.71]
Rauh, 2013	1	159	0	79	2.1%	1.50 [0.06, 37.36]
Smith, 2016	0	26	1	24	2.0%	0.30 [0.01, 7.61]
Subtotal (95% CI)		**2281**		**2166**	**80.5%**	**1.16 [0.70, 1.95]**
Total events	34		30			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 5.80$, df = 7 (P = 0.56); $I^2 = 0\%$						
Test for overall effect: Z = 0.58 (P = 0.56)						
Total (95% CI)		**2627**		**2514**	**100.0%**	**1.23 [0.77, 1.95]**
Total events	43		36			
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 6.01$, df = 8 (P = 0.65); $I^2 = 0\%$						
Test for overall effect: Z = 0.87 (P = 0.38)						
Test for subgroup differences: $Chi^2 = 0.20$, df = 1 (P = 0.65), $I^2 = 0\%$						



Minimal evidence.

Non-RCT evidence did not support an increased risk of congenital anomalies.

Encourage exercise throughout pregnancy.

Traditional concerns about prenatal exercise

1) Increase early pregnancy loss;
2) Premature delivery;
3) Increased core body temperature leading to congenital anomalies;
4) Fetal growth restriction

Why do we care about having a small baby?

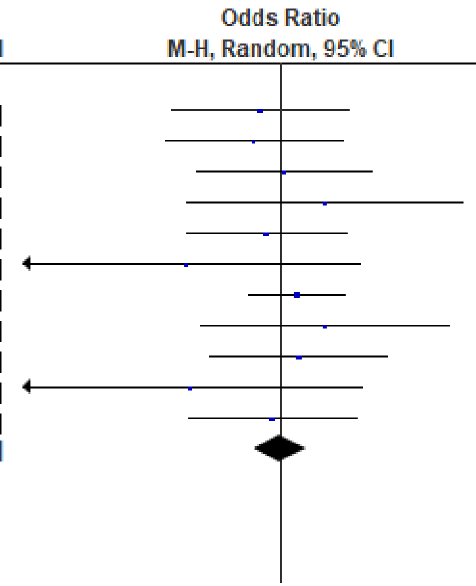
- Early studies suggested exercise may result in a decrease in birthweight.
- Redistribute oxygen and nutrients away from baby.
- More likely to be admitted to NICU
- Barker demonstrated small for gestational age was a risk for cardiovascular disease later in life.

Small for gestational age baby

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
3.4.1 Exercise only						
14953 - de Oliveria, 2012 - 13 weeks	4	54	3	29	2.0%	0.69 [0.14, 3.33]
14953 - de Oliveria, 2012 - 20 weeks	4	60	3	29	2.0%	0.62 [0.13, 2.97]
15148 - Hopkins, 2010	4	47	3	37	2.0%	1.05 [0.22, 5.03]
15417 - Nascimento, 2011	2	39	1	41	0.8%	2.16 [0.19, 24.85]
15487 - Price, 2012	4	31	5	31	2.4%	0.77 [0.19, 3.19]
15952 - Bisson, 2015	0	25	2	25	0.5%	0.18 [0.01, 4.04]
16611 - Nobles, 2015	13	124	10	123	6.5%	1.32 [0.56, 3.14]
16780 - Renault, 2014	4	125	1	67	1.0%	2.18 [0.24, 19.92]
18064 - Seneviratne, 2015	4	37	3	37	2.0%	1.37 [0.29, 6.61]
Guelfi, 2016	0	84	2	85	0.5%	0.20 [0.01, 4.18]
Simmons, 2016	5	87	3	45	2.2%	0.85 [0.19, 3.75]
Subtotal (95% CI)		**713**		**549**	**21.8%**	**0.98 [0.61, 1.57]**
Total events	44		36			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 4.41$, $df = 10$ ($P = 0.93$); $I^2 = 0\%$

Test for overall effect: $Z = 0.08$ ($P = 0.94$)

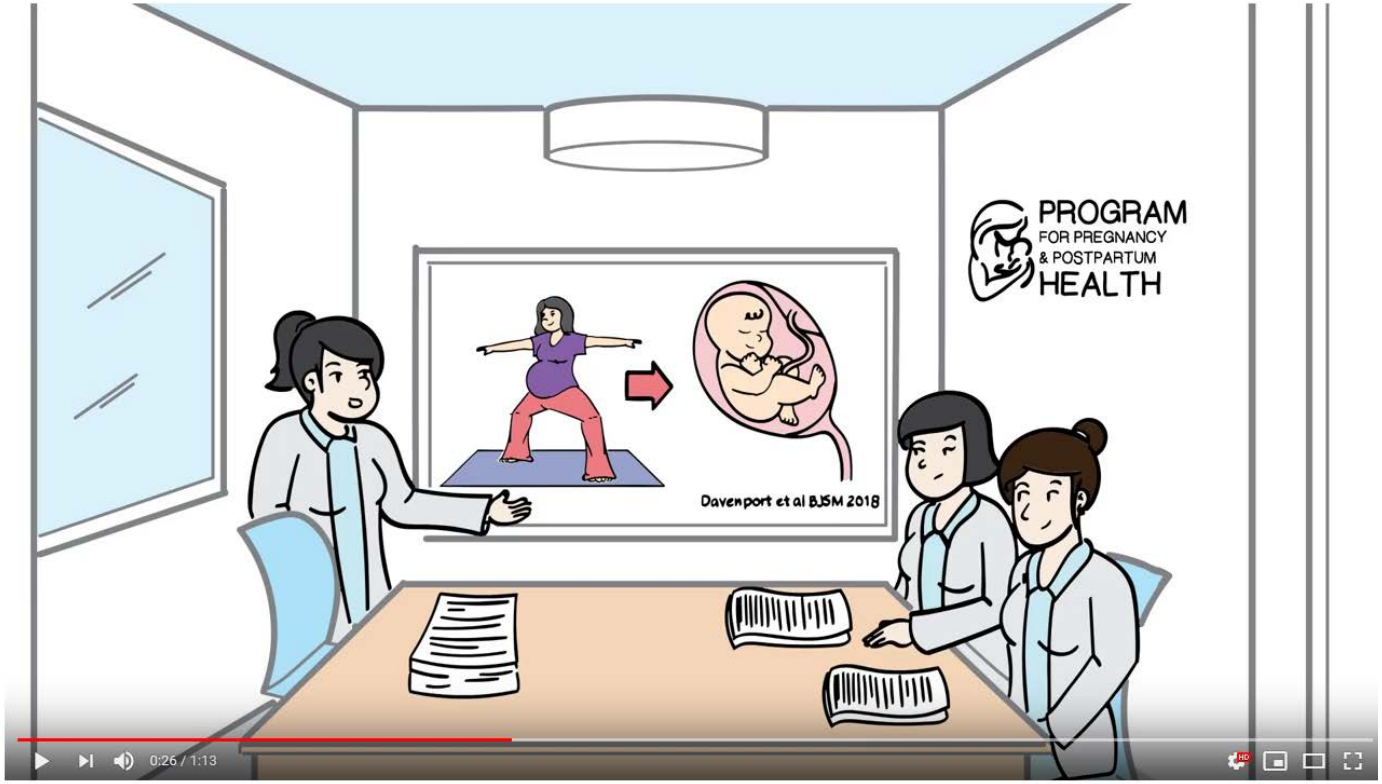


- Exercise was not associated with increased risk of a small baby.

Davenport, Meah *et al* Br J Sports Med 2018

Prenatal exercise reduces the odds of:

Macrosomia by 39%

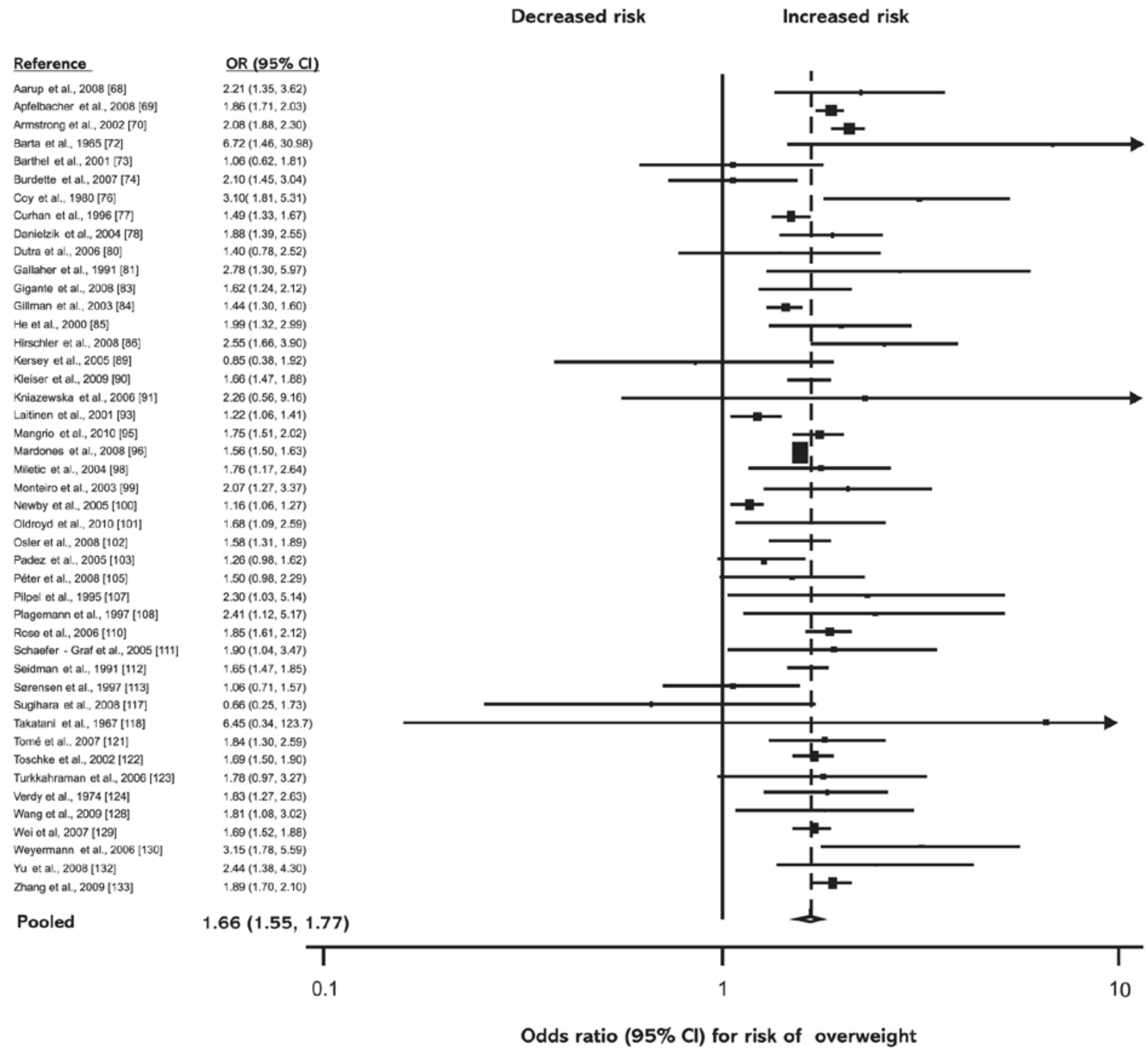


Pregnancy and Exercise: the effect on your baby!

https://youtu.be/iODWEAISuN4

Birthweight >4000g and risk of overweight

- 45 cohort/case control studies.
- OR = 1.66
- (1.55-1.77)



Schellong et al PLOS One 2012

Fetal response to acute exercise

- Limited information
- Fetal HR increased with maternal exercise ~6bpm (2-10bpm)
- Incidence of fetal bradycardia was low and unchanged with acute exercise
- Metrics of uterine/umbilical blood flow were unchanged with exercise

Skow, Davenport et al BJSM 2019

www.youtube.com/channel/UCtvzYizIALcs5-RzfHrf5UA

@ExercisePreg

@exerciseandpregnancy