UPBEAT
Uk Pregnancies Better Eating and Activity Trial

Newcastle University

UPBEAT study: Association between physical activity in obese pregnant women and health of the offspring

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Institute of Health&Society

Overview

- Maternal obesity and offspring health
- Physical activity and insulin resistance
- Physical activity, obesity and pregnancy
- Physical activity in UPBEAT
- Physical activity level and off-spring health

Background

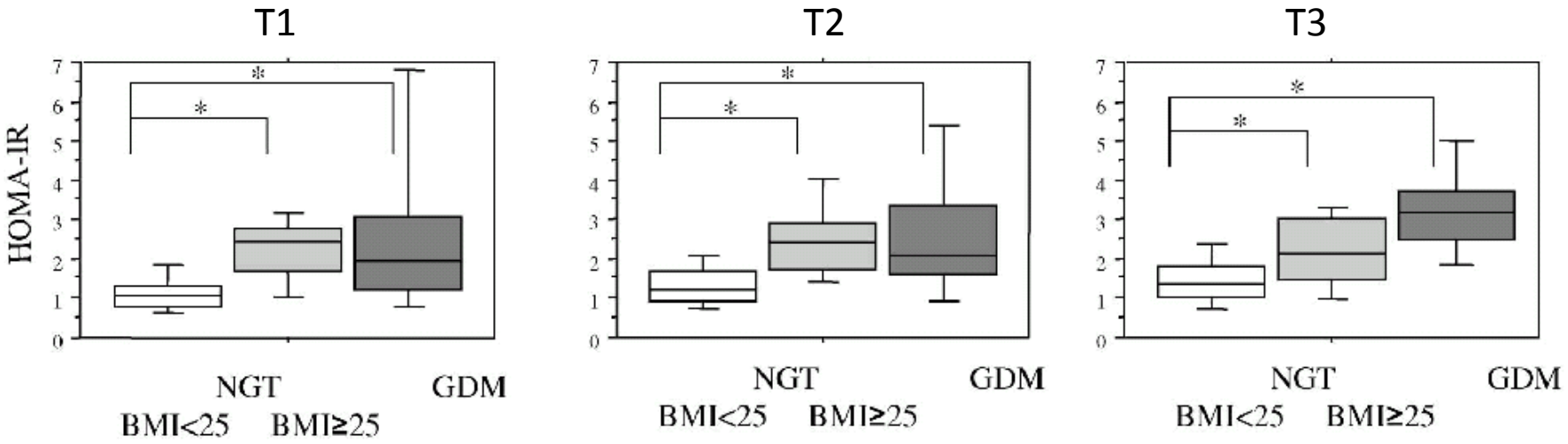
- Maternal obesity and weight gain during pregnancy are related to obesity in childhood and adulthood (e.g. Parsons, 1999, *IJO*)
- Macrosomia associated with 2-fold risk of obesity in adulthood (Yu et al, 2011, *Obesity Reviews*)
- Offspring of overweight/obese mothers have worse cardiometabolic profile in adulthood (Hochner et al, 2012, *Circulation*)
- Contribution of intrauterine environment, genes and shared lifestyle

Background

- Role for insulin resistance
- Impact of physical activity on insulin resistance

Obesity, pregnancy and insulin resistance

- Insulin resistance is increased in obese pregnant women compared to normal weight women



* p<0.05

Endo et al, *Gynecol Endocrinol 2006*

Obesity, pregnancy and insulin resistance

- Insulin resistance is increased in obese pregnant women compared to normal weight women
- Over-nutrition for the fetus and macrosomia
- Impact on offspring development and metabolism in long term

Maternal glucose and childhood obesity

Table 3—*Risk ratios for maternal glucose concentration and child BMI ≥85th percentile at 3 years in the PIN Study*

	Model 1* (n = 263)		Model 2† (n = 256)		Model 3‡ (n = 254)	
	Risk ratio (95% CI)	P	Risk ratio (95% CI)	P	Risk ratio (95% CI)	P
Glucose concentration (per mg/dL)	1.01 (1.00–1.02)	0.15	1.01 (1.00–1.02)	0.08	1.01 (1.00–1.02)	0.11
<100 mg/dL	Reference		Reference		Reference	
100–<130 mg/dL	1.00 (0.56–1.78)	1.00	1.04 (0.60–1.81)	0.88	0.98 (0.56–1.71)	0.94
≥130 mg/dL	2.15 (1.21–3.84)	0.01	2.34 (1.25–4.38)	0.01	2.48 (1.27–4.82)	0.01

Risk ratios for maternal glucose concentration are per mg/dL and categories. *Model 1: unadjusted. †Model 2: adjusted for maternal education, race, prenatal smoking, prepregnancy BMI, and maternal height. ‡Model 3: adjusted for Model 2 and birth weight z score.

Deierlein et al *Diabetes Care* 2011

GDM, LGA and childhood metabolic syndrome

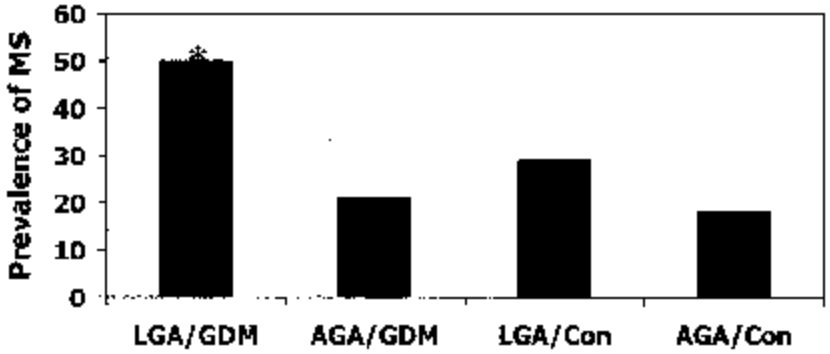


Fig 1. Prevalence of MS at any age among children grouped according to birth weight and maternal diabetes. Children (n = 175) were divided into 4 groups, ie, LGA with maternal GDM, AGA with maternal GDM, LGA with control (Con) mothers, and AGA with control mothers. MS was defined as the presence of ≥2 of 4 major components (obesity, hypertension, high triglyceride or low HDL levels, glucose intolerance); children were not counted more than once during the 5-year study period. *Overall χ^2 group differences, P = .008; LGA/GDM versus all other groups χ^2, P = .001.

Boney et al *Pediatrics* 2005

Physical activity and insulin resistance

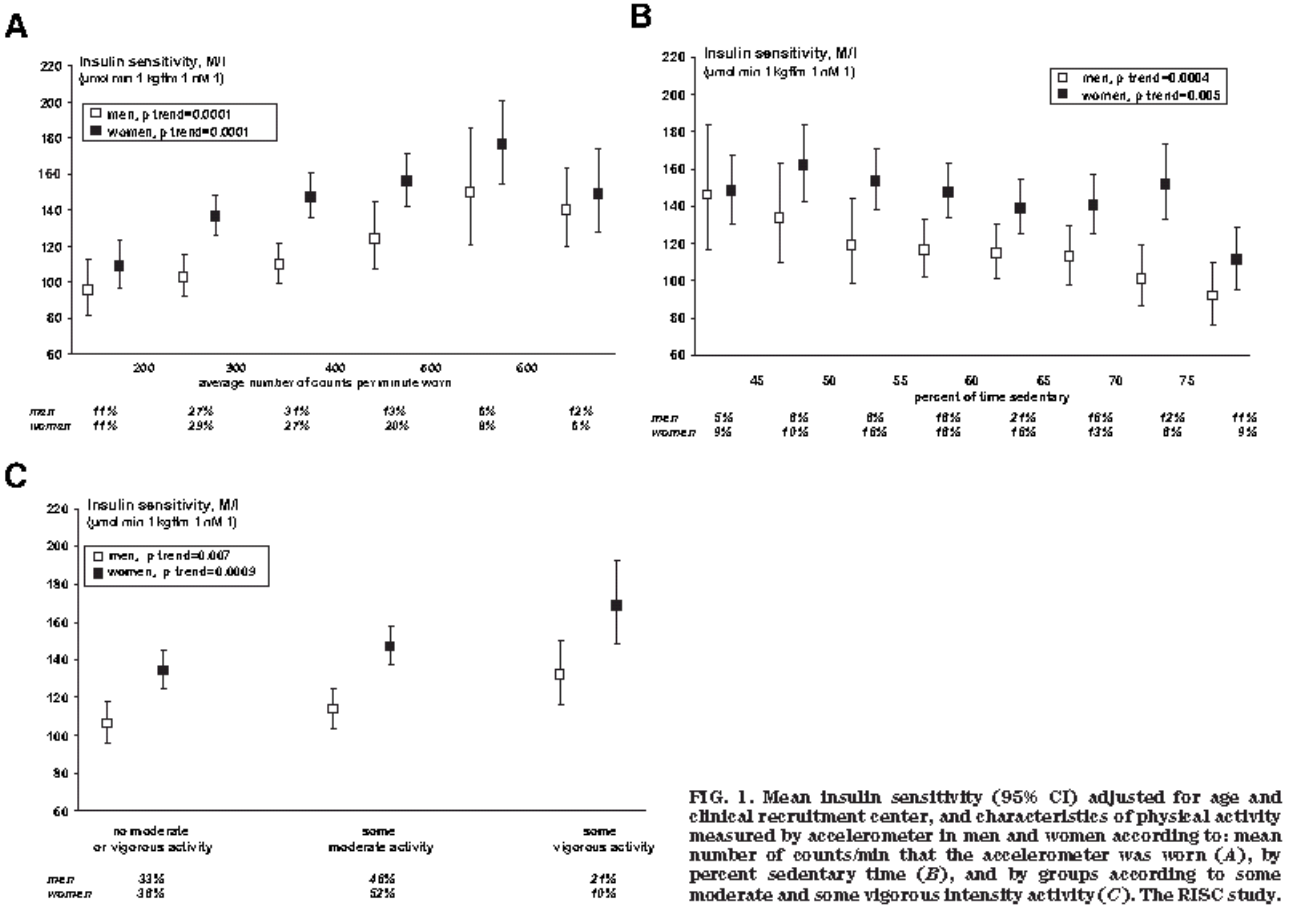


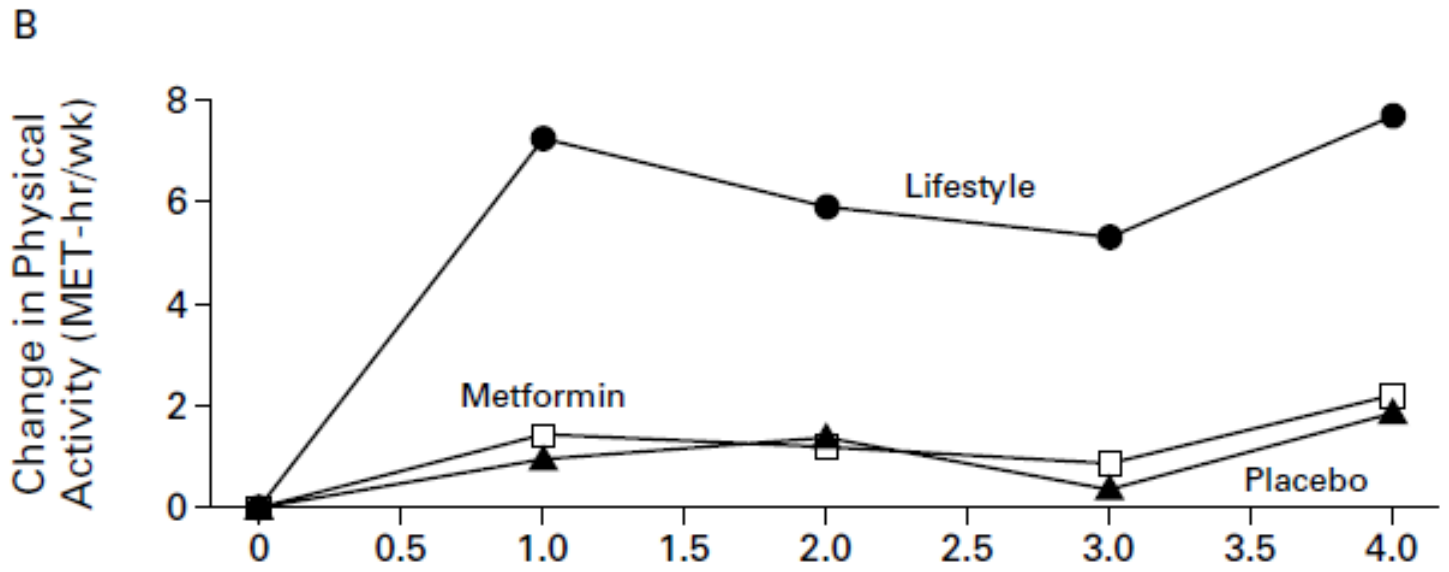
FIG. 1. Mean insulin sensitivity (95% CI) adjusted for age and clinical recruitment center, and characteristics of physical activity measured by accelerometer in men and women according to: mean number of counts/min that the accelerometer was worn (*A*), by percent sedentary time (*B*), and by groups according to some moderate and some vigorous intensity activity (*C*). The RISC study.

Balkau et al *Diabetes* 2008

Physical activity and insulin resistance

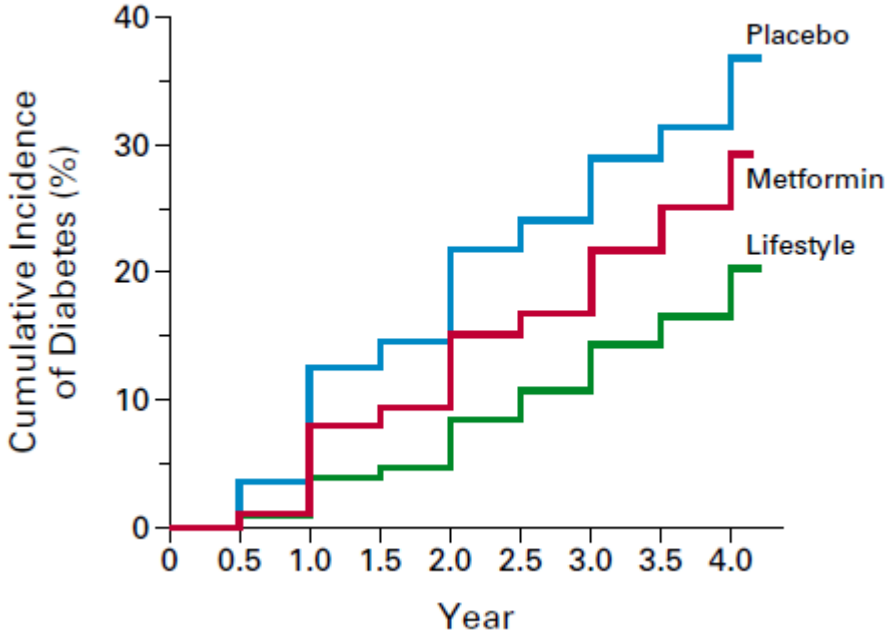
- Good evidence from intervention trials in non-pregnant populations that progression to diabetes can be delayed/prevented if changes in diet and PA achieved
- E.g. DPP, Da Qing, Finnish Diabetes Prevention Study

Mean change in leisure physical activity in DPP (Met hours per week)



Knowler et al. NEJM:2002

Diabetes incidence from baseline in DPP



Reduction in incident diabetes:

Lifestyle - 58%

Metformin - 31%

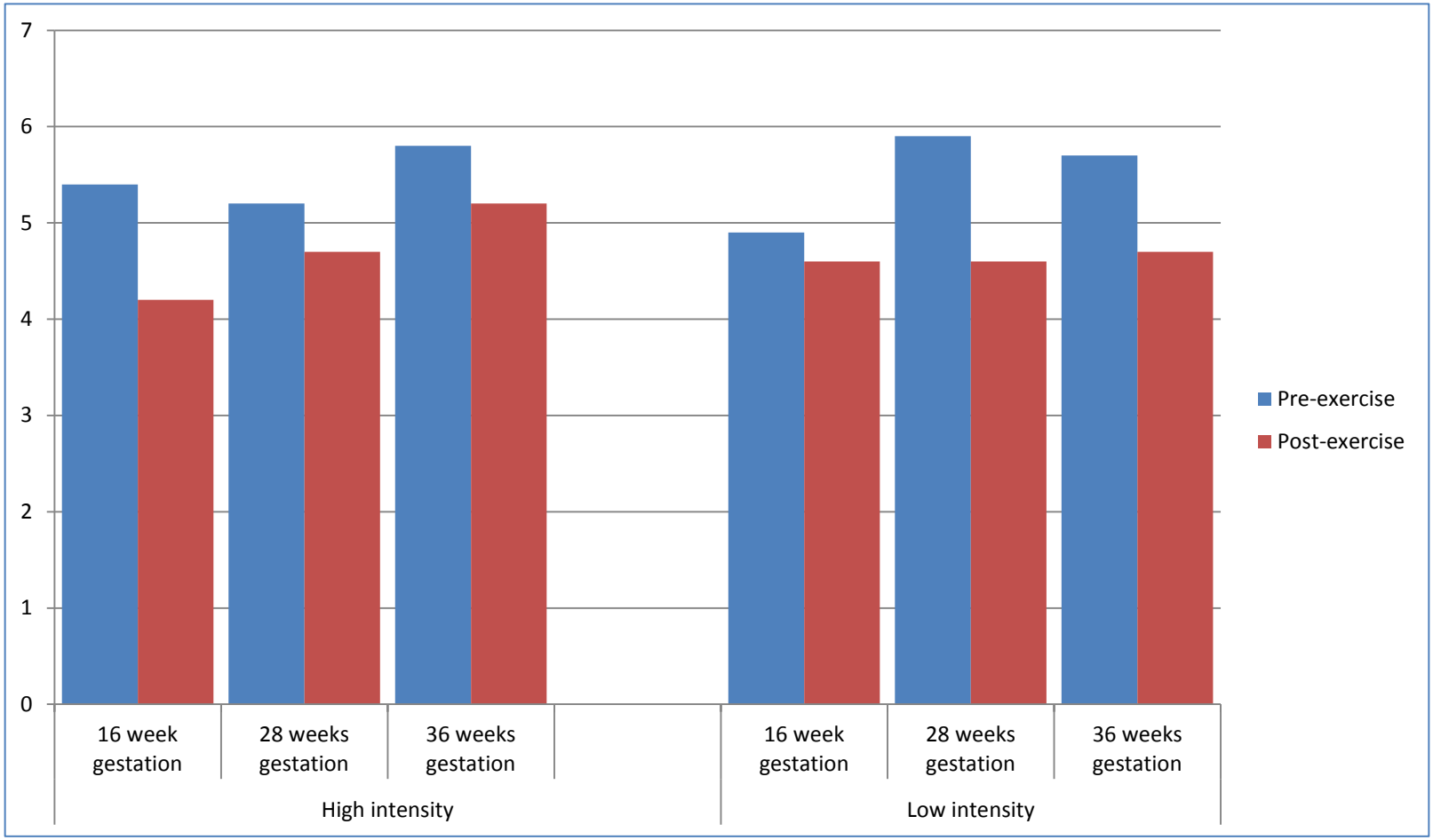
Knowler et al. NEJM:2002

Pregnancy, physical activity and insulin resistance

- What evidence that PA during pregnancy reduces insulin resistance?

- Obese pregnant women specifically?

Effect of exercise on blood glucose

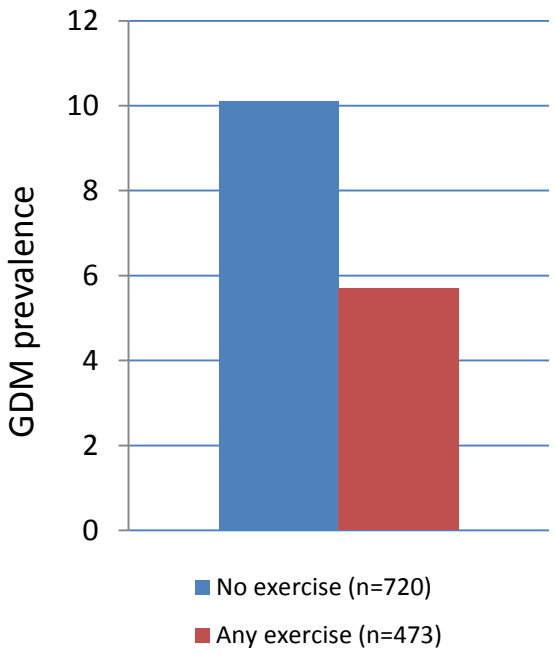


Women at high risk of GDM (n=22)

Ruchat et al, *Diabetes Metab Res Rev* 2012

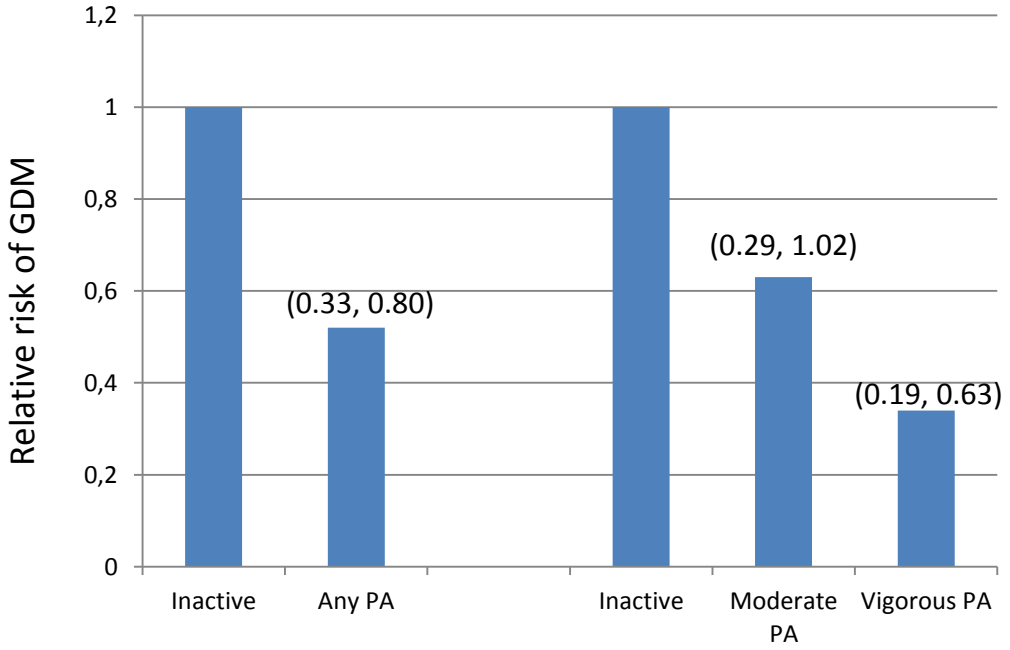
Physical activity and GDM

- Physical activity during pregnancy reduces the risk of GDM



OR = 1.9 (1.2, 3.1)

Source: Dye et al, *American Journal Epi* 1997

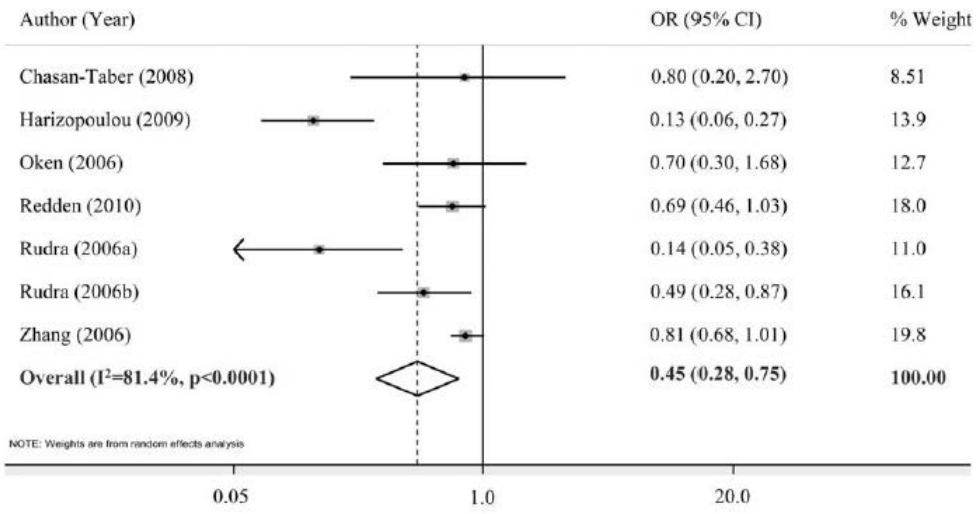


Source: Dempsey et al, *Diab Res Clin Prac* 2004

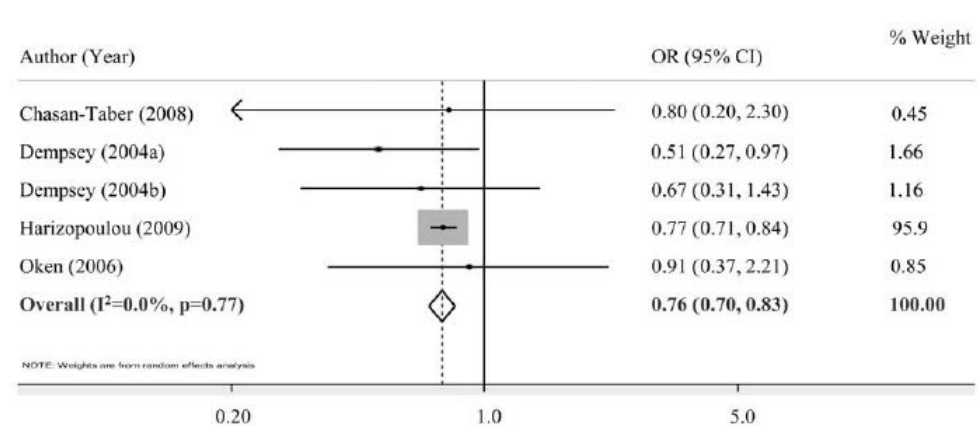
Physical activity and GDM

Figure 2

a.



b.



Tobias et al *Diabetes Care* 2011

Physical activity and infant body composition

Pomeroy et al, *Diabetes Care,* 2013

- 30 pregnant women
- OGTT and objective PA measurement at 28-32 weeks
- Infant body composition measured at 11-19 weeks postpartum
- PA associated (negatively)with insulin response (r= -0.41, p=0.027) and (positively) with infant fat free mass (0.52, [0.17, 0.74])

Physical activity in pregnancy – in the past

- Much of 20th century women advised to avoid exercise when pregnant

  Women who exercise '*temperamentally unsound*'

- By 1985 ACOG guidelines
  - - HR <140bpm
  - - Max 15 mins
  - - No weight lifting

  'pregnant women should stringently limit the type, duration and intensity of their exercise to minimize both fetal and maternal risk'

Current guidance - RCOG

- All women should be encouraged to participate in aerobic and strength-conditioning exercise during pregnancy
- Goal = maintenance of fitness level
- Choose activities that minimise risk
- Advise women that adverse pregnancy or neonatal outcomes are not increased by exercise

Source: RCOG Statement No 4

Guidance for obese pregnant women

- NICE
  - Explain risk of being obese and pregnancy
  - Explain that pregnancy not time for weight loss
  - Moderate PA will not harm mother or unborn child
  - 30 mins moderate PA per day
  - Be specific
  - Previously sedentary – 15 mins, 3 times per week
  - Importance of non being sedentary – be active in daily life
  - Offer referral to appropriately trained professional for advice
  - Encourage weight loss after pregnancy

Physical activity levels during pregnancy

- In general been reported that activity declines as pregnancy progresses

  - Harrison et al 2012, *BJOG*
    97 women at high risk GDM, mean BMI 30.3, **steps per day fell by 1340** (606, 2074) between 12 and 28 weeks' gestation

  - Renault et al 2010, *Acta Obs Gyn Scand*
    338 women (163 BMI 30+)
    steps per day fell by 1856 (obese women) between 12 and 36 weeks' gestation
    (smaller reduction in normal weight – 1269 steps)

Physical activity in pregnancy - interventions

- Generally PA interventions to improve pregnancy outcomes have been unsuccessful (e.g. Oostdam FitFor2)
- Conclusion of recent (2012) systematic review of lifestyle interventions in pregnancy (Thangaratinam et al, *BMJ*):
  'interventions….based on diet are the most effective and are associated with reductions in maternal gestational weight gain and improved obstetric outcomes'

Successful PA interventions

- Ong et al 2009 – *Diab Metabol*
  - 12 sedentary obese women randomised to supervised PA (X3 per week) or control
  - those in intervention group had lower (p=0.07) blood glucose at 28 weeks than those in the control group
- Barakat et al 2011 – *Brit J Spor Med*
  - 80 sedentary women randomised to supervised PA (X3 per week) or control
  - those in intervention group had significantly lower blood glucose at 28 weeks than those in the control group

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- Combined lifestyle intervention
- Aim: to improve glucose homeostasis in obese pregnant women
  - reduce dietary glycaemic load
  - increase physical activity
- Pilot trial completed: March 2010 - May 2011
  Newcastle, London, Glasgow

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pilot RCT

- Women recruited by research midwives
- Inclusion criteria: BMI $\geq$30kg/m^2, singleton pregnancy, gestation 15^{+0} to 17^{+6}
- Randomised to intervention or control (standard care)
  - Standard care: appointment with study midwife at 28 weeks' and 35 weeks' gestation

UPBEAT intervention

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- Underpinned by psychological theory (control theory and social cognitive theory)
  - Graded, SMART goals, self-monitoring, provision of feedback, problem solving of barriers, social support and social comparison
- Baseline (~17 weeks' gestation): one-to-one visit with health trainer
- Weekly group sessions with HT (8 weeks)
  - Dietary advice – consumption of low GI foods, reduction of saturated fats
  - PA advice – increase daily steps walked incrementally, monitored by pedometer
- Data collection by study midwife at 28 and 35 weeks' gestation

UPBEAT measurement

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- Outcomes for pilot trial:
  - Diet: GI, GL and energy from SFA
  - PA: MVPA (mins per day, assessed objectively)
- Diet – 24 hour recall and short FFQ
- PA – objectively by Actigraph accelerometer and self-report (modified RPAQ)

UPBEAT - results of pilot RCT

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Participants

- 183 obese pregnant women recruited (666 eligible invited –27% response)
  - mean BMI 36.3kg/m^2
  - mean age 30.5 years
  - 56% white; 38% black
  - 56% multips
  - 29 women (15.8%) lost to follow-up

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- Self-report PA outcomes

	Baseline (n=159)	28 weeks (n=109)	35 weeks (n=89)
Sedentary*†	1008 (197)	1050 (198)	1118 (189)
Active*†	412 (184)	382 (193)	306 (189)
Light activity*†	355 (172)	332 (183)	259 (165)
MVPA*	**57 (93)**	**51 (67)**	**47 (78)**

Figures are mean minutes (SD) per day

* Significant difference between baseline and 28 weeks
† Significant difference between 28 and 35 weeks

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- Objective PA outcomes

	Baseline (n=133)	28 weeks (n=75)	35 weeks (n=54)
Sedentary*	592 (133)	588 (117)	572 (98)
Active*	221 (61)	202 (75)	203 (64)
Light activity*	181 (52)	168 (72)	176 (58)
MVPA†	**41 (20)**	**34 (17)**	**27 (15)**

Figures are mean minutes (SD) per day

* Significant difference between baseline and 28 weeks
† Significant difference between 28 and 35 weeks

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- Self-report PA outcomes

	Control (n=54)	Intervention (n=56)	Difference (95% CI)
Sedentary	1068 (177)	1020 (226)	-50 (-115,16)
Active	367 (175)	410 (219)	45 (-16, 106)
Light activity	333 (165)	340 (204)	11 (-46, 68)
MVPA	**34** (52)	**70** (78)	**34 (9, 59)**

Figures are mean minutes (SD) per day
Differences are adjusted for baseline activity

Poston et al *BMC Preg & Childbirth* 2013

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- Objective PA outcomes

	Control (n=39)	Intervention (n=36)	Difference (95% CI)
Sedentary	1175 (86)	1197 (77)	21 (-13, 55)
Active	209 (82)	194 (68)	-11 (-42, 19)
Light activity	175 (81)	161 (61)	-9 (-38, 19)
MVPA	**34** (18)	**33** (15)	**-1 (-9, 5)**

Figures are mean minutes per day
Differences are adjusted for baseline activity

Poston et al *BMC Preg & Childbirth* 2013

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- Conclusions

- Following intervention
  - Self-reported MVPA was higher
  - Objectively measured MVPA was the same
  - Agreement between accelerometer and RPAQ was very poor (at 28 weeks, r= -0.069 [-0.296 to 0.165])
  - Very difficult to intervene to increase/maintain PA in obese pregnant women

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PA and offspring health

Objectively measured PA and newborn abdominal circumference

	Baseline (n=61)	28 weeks (n=43)	35 weeks (n=34)
Sedentary (mins/d)	**-0.287***	-0.92	**0.435***
MVPA (mins/d)	-0.101	-0.011	**-0.466***

Figures are Pearson correlations

Conclusions

- Danger of concluding that PA unrelated to outcomes in pregnancy – rather than failure of intervention to increase PA level
- Evidence that more active women have improved glucose metabolism
- Evidence that PA associated with favourable offspring health in obese pregnancy
- Difficulty of supporting obese women to be sufficiently active during pregnancy
- More work needed around supporting obese pregnant women to achieve appropriate level of PA – an appropriate target for intervention
- Potential to impact on health of future generations

Acknowledgements

Many thanks to all the staff and participants in **UPBEAT**

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Thank you!

Resources

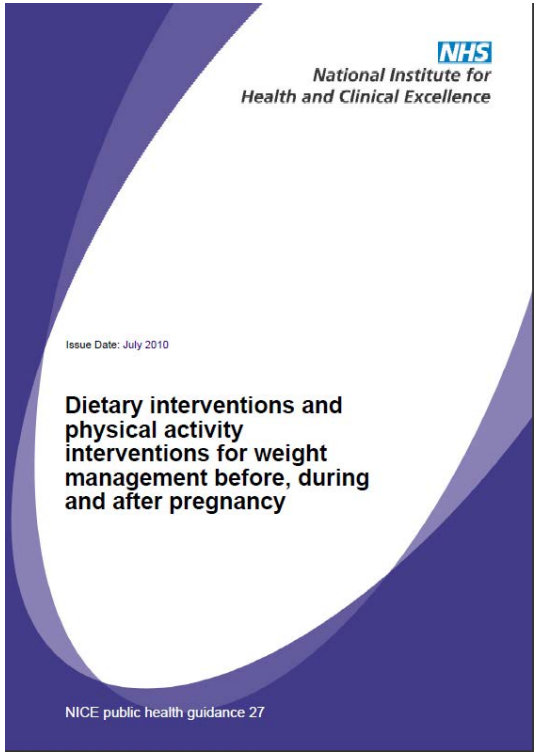
- RCOG guidelines - http://www.rcog.org.uk/womens-health/clinical-guidance/exercise-pregnancy
- ACOG guidelines - *Clin Obstet Gyn*. 2003;**46**(2):469-99
- Canadian guidelines - http://www.sogc.org/guidelines/public/129E-JCPG-June2003.pdf

When not to exercise in pregnancy

		
Cardiac disease	Severe anaemia	Vaginal bleeding
Restrictive lung disease	Unevaluated arrhythmia	Dizziness
Incompetent cervix	Chronic bronchitis	Excess shortness of breath
Multiple gestation at risk of premature labour	Poorly controlled DM, HT, seizures, hypothyroidism	Headache Chest pain
Persistent bleeding	**Morbid obesity (BMI 40+)**	Muscle weakness
Placenta previa (> 26 wks)	Extreme underweight	Calf pain or swelling
Premature labour	IUGR	Preterm labour
Ruptured membranes	Extremely sedentary	Decreased foetal movement
Preeclamspia/HT	Heavy smoker	Amniotic fluid leakage

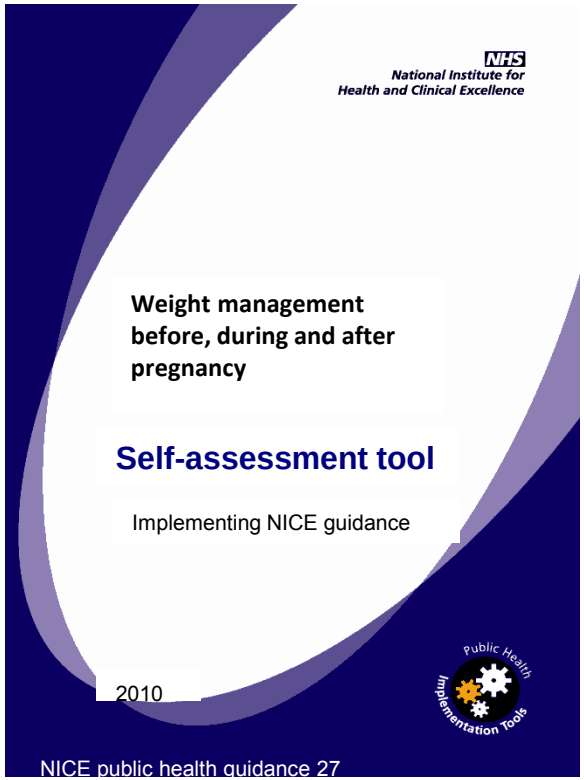
Taken from ACOG guidelines

Resources



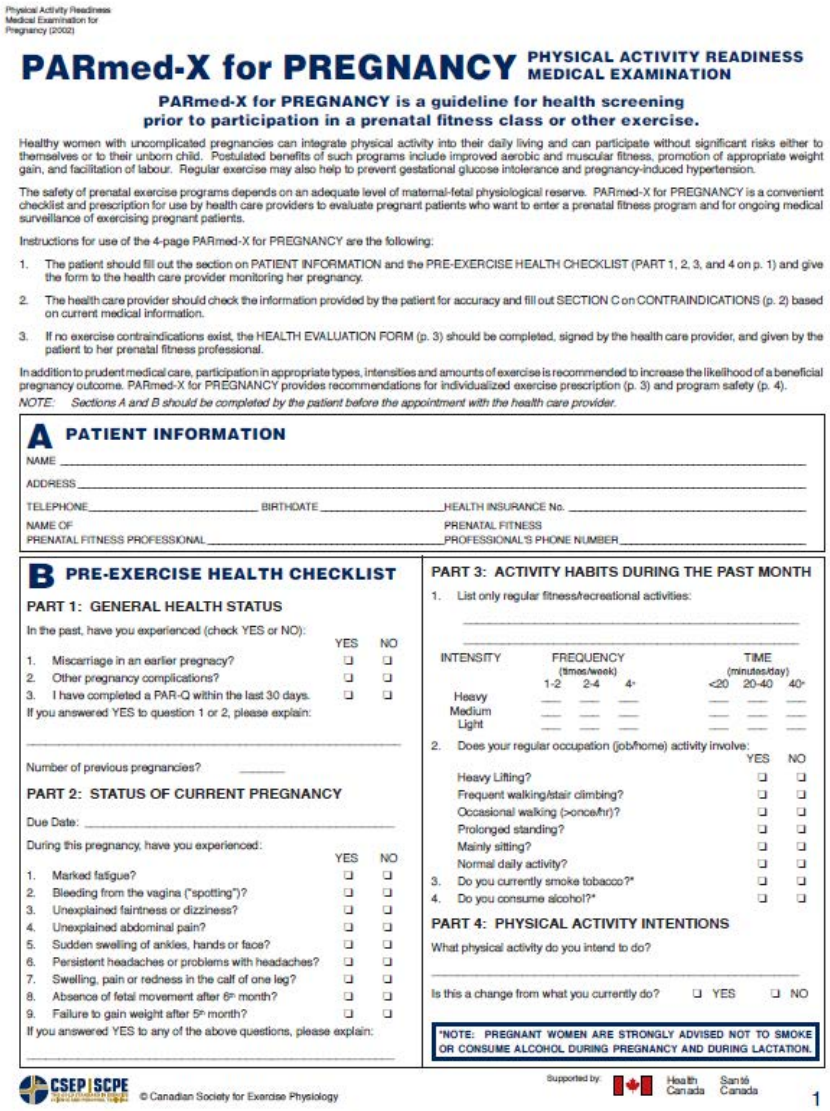
- http://www.nice.org.uk/guidance/PH27/Guidance/pdf

Resources



- http://guidance.nice.org.uk/index.jsp?action=download&o=51119

Resources



Physical Activity Readiness Medical Examination for Pregnancy (2002)

PARmed-X for PREGNANCY PHYSICAL ACTIVITY READINESS MEDICAL EXAMINATION

PARmed-X for PREGNANCY is a guideline for health screening prior to participation in a prenatal fitness class or other exercise.

Healthy women with uncomplicated pregnancies can integrate physical activity into their daily living and can participate without significant risks either to themselves or to their unborn child. Postulated benefits of such programs include improved aerobic and muscular fitness, promotion of appropriate weight gain, and facilitation of labour. Regular exercise may also help to prevent gestational glucose intolerance and pregnancy-induced hypertension.

The safety of prenatal exercise programs depends on an adequate level of maternal-fetal physiological reserve. PARmed-X for PREGNANCY is a convenient checklist and prescription for use by health care providers to evaluate pregnant patients who want to enter a prenatal fitness program and for ongoing medical surveillance of exercising pregnant patients.

Instructions for use of the 4-page PARmed-X for PREGNANCY are the following:

1. The patient should fill out the section on PATIENT INFORMATION and the PRE-EXERCISE HEALTH CHECKLIST (PART 1, 2, 3, and 4 on p. 1) and give the form to the health care provider monitoring her pregnancy.
2. The health care provider should check the information provided by the patient for accuracy and fill out SECTION C on CONTRAINDICATIONS (p. 2) based on current medical information.
3. If no exercise contraindications exist, the HEALTH EVALUATION FORM (p. 3) should be completed, signed by the health care provider, and given by the patient to her prenatal fitness professional.

In addition to prudent medical care, participation in appropriate types, intensities and amounts of exercise is recommended to increase the likelihood of a beneficial pregnancy outcome. PARmed-X for PREGNANCY provides recommendations for individualized exercise prescription (p. 3) and program safety (p. 4).

NOTE: Sections A and B should be completed by the patient before the appointment with the health care provider.

A PATIENT INFORMATION

NAME _____

ADDRESS _____

TELEPHONE _____ BIRTHDATE _____ HEALTH INSURANCE No. _____

NAME OF PRENATAL FITNESS PROFESSIONAL _____ PRENATAL FITNESS PROFESSIONAL'S PHONE NUMBER _____

B PRE-EXERCISE HEALTH CHECKLIST

PART 1: GENERAL HEALTH STATUS

In the past, have you experienced (check YES or NO):

	YES	NO
1. Miscarriage in an earlier pregnacy?	❑	❑
2. Other pregnancy complications?	❑	❑
3. I have completed a PAR-Q within the last 30 days.	❑	❑

If you answered YES to question 1 or 2, please explain:

_____

Number of previous pregnancies? _____

PART 2: STATUS OF CURRENT PREGNANCY

Due Date: _____

During this pregnancy, have you experienced:

	YES	NO
1. Marked fatigue?	❑	❑
2. Bleeding from the vagina ("spotting")?	❑	❑
3. Unexplained faintness or dizziness?	❑	❑
4. Unexplained abdominal pain?	❑	❑
5. Sudden swelling of ankles, hands or face?	❑	❑
6. Persistent headaches or problems with headaches?	❑	❑
7. Swelling, pain or redness in the calf of one leg?	❑	❑
8. Absence of fetal movement after 6th month?	❑	❑
9. Failure to gain weight after 5th month?	❑	❑

If you answered YES to any of the above questions, please explain:

_____

PART 3: ACTIVITY HABITS DURING THE PAST MONTH

1. List only regular fitness/recreational activities:

_____

_____

INTENSITY	FREQUENCY (times/week) 1-2	2-4	4+	TIME (minutes/day) <20	20-40	40+
Heavy	___	___	___	___	___	___
Medium	___	___	___	___	___	___
Light	___	___	___	___	___	___

2. Does your regular occupation (job/home) activity involve:

	YES	NO
Heavy Lifting?	❑	❑
Frequent walking/stair climbing?	❑	❑
Occasional walking (>once/hr)?	❑	❑
Prolonged standing?	❑	❑
Mainly sitting?	❑	❑
Normal daily activity?	❑	❑
3. Do you currently smoke tobacco?*	❑	❑
4. Do you consume alcohol?*	❑	❑

PART 4: PHYSICAL ACTIVITY INTENTIONS

What physical activity do you intend to do?

_____

Is this a change from what you currently do? ❑ YES ❑ NO

***NOTE: PREGNANT WOMEN ARE STRONGLY ADVISED NOT TO SMOKE OR CONSUME ALCOHOL DURING PREGNANCY AND DURING LACTATION.**

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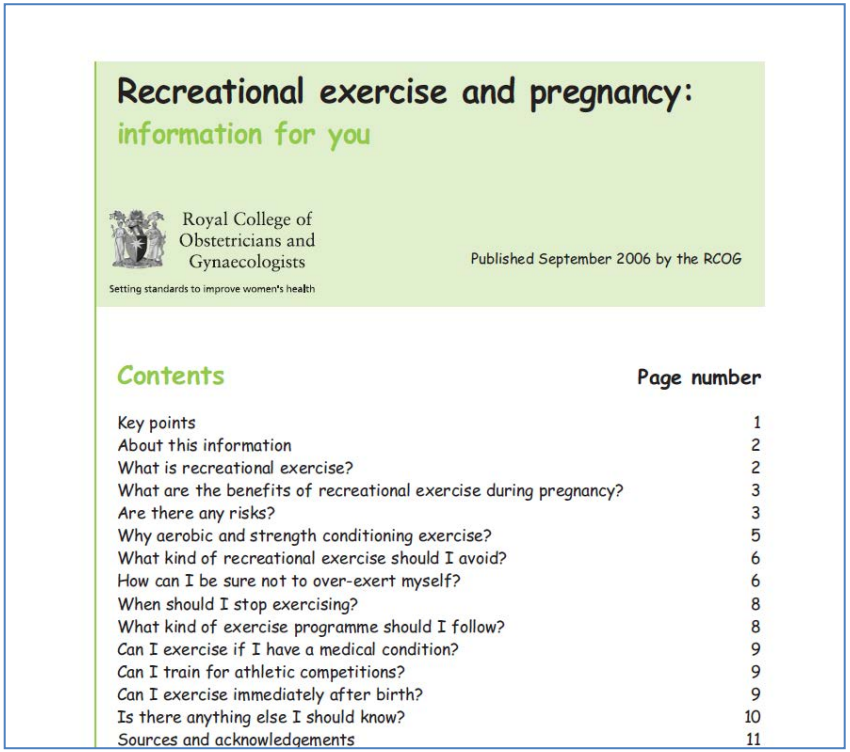
Supported by: Health Canada Santé Canada

- http://www.csep.ca/cmfiles/publications/parq/parmed-xpreg.pdf

Resources



Recreational exercise and pregnancy:
information for you

Royal College of Obstetricians and Gynaecologists

Setting standards to improve women's health

Published September 2006 by the RCOG

Contents

- http://www.rcog.org.uk/files/rcog-corp/uploaded-files/PIRecreationalExercise2006.pdf

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