

# Potential benefits, rules and safety considerations of physical activity during pregnancy, Including prenatal High Intensity Interval Training (based on HIIT Mama project)

## & how to incorporate pelvic floor muscle training and birth preparation into exercise programme

Anna Szumilewicz, PhD, associate professor at GUPES

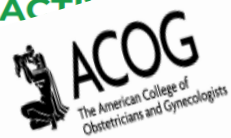




International Olympic Committee

AT A GLANCE

WHO GUIDELINES ON PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR



ACOG COMMITTEE OPINION

Number 804  
Committee on Obstetric Practice  
This Committee Opinion was developed by the Committee on Obstetric Practice with the assistance of committee members Margie H Davenport, PhD and Cynthia Gyamfi-Bannerman, MD, MS.

Physical Activity and Exercise during the Postpartum Period



Exercise and pregnancy in recreational and elite athletes: 2016/2017 evidence summary from the IOC expert group meeting, Lausanne. Part 5. Recommendations for health professionals and active women

Consensus statement

- Kari Bø,<sup>1,2</sup> Raul Artal,<sup>3</sup> Ruben Barakat,<sup>4</sup> Wendy J Brown,<sup>5</sup> Gregory A L Davies,<sup>6</sup> Michael Dooley,<sup>7</sup> Kelly R Evenson,<sup>8</sup> Lene A H Haakstad,<sup>9</sup> Bengt Kayser,<sup>10</sup> Tarja I Kinnunen,<sup>11</sup> Karin Larsen,<sup>12</sup> Michelle F Mottola,<sup>13</sup> Ingrid Nygaard,<sup>14</sup> Mireille van Poppel,<sup>15</sup> Britt Stuge,<sup>16</sup> Karim M Khan<sup>17</sup>



JOINT SOGC/CSEP CLINICAL PRACTICE GUIDELINE Part 1: Guideline and Systematic reviews 1-6



World Health Organization

Br J Sports Med: first published as 10.1136/bjsports



PROGRAM SPINAKER



Rzeczpospolita Polska



Unia Europejska Europejski Fundusz Społeczny



## Background

1. Current guidelines published by credible obstetrics, gynecology and sports medicine institutions, including the World Health Organization, are in agreement that physical activity in pregnancy is safe and desirable in the absence of obstetrics and medical complications or contraindications.
2. Recommendations on the potential continuation of a physical activity exceeding the recommended minimum level of 150-minute moderate-to-vigorous physical activity per week or of high intensity **have been much more popular for around 5 years.**
3. **There is no information on prenatal high intensity interval training (HIIT) programs in the above-mentioned documents.**



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**How to HIIT while pregnant? The protocol characteristics and effects of high intensity interval training implemented during pregnancy – A systematic review**

Anna Szumilewicz

*Gdansk University of Physical Education and Sport, Gdansk, Poland, anna.szumilewicz@awf.gda.pl*

Rita Santos-Rocha

*Polytechnic Institute of Santarém, Sport Sciences School of Rio Maior (ESDRM), Portugal, ritasantosrocha@esdrm.ipsantarem.pt*

Aneta Worska

*Gdansk University of Physical Education and Sport, Gdansk, Poland, aneta.worska@awf.gda.pl*


Magdalena Piernicka

*Gdansk University of Physical Education and Sport, Gdansk, Poland, magdalena.piernicka@awf.gda.pl*

Hongli Yu

*Gdansk University of Physical Education and Sport, Gdansk, Poland, hongli.yu@awf.gda.pl*

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["HIIT implemented during pregnancy" by Anna Szumilewicz, Rita Santos-Rocha et al. \(bepress.com\)](#)





We want to respond to the needs of the fitness market...

## EUROPEAN SURVEY OF FITNESS TRENDS FOR 2020

by Alexios Batrakoulis, M.S., ACSM-EP, ACSM-CPT, EIM II, CSCS, CSPS

**TABLE 1: Top 20 European Fitness Trends for 2020**

Rank	Trend
1	Personal training
2	High intensity interval training (HIIT)
3	Body weight training
4	Functional fitness training
5	Small group personal training
6	Exercise for weight loss
7	Exercise is Medicine®
8	Health/wellness coaching
9	Boutique fitness studios
10	Circuit training
11	Fitness programs for older adults
12	Clinical integration/medical fitness
13	Group training
14	Employing certified fitness professionals
15	Licensure for fitness professionals
16	Postrehabilitation classes
17	Training with free weights
18	Wearable technology
19	Children and exercise
20	Yoga



# Worldwide Survey of Fitness Trends for 2022

by Walter R. Thompson, Ph.D., FACSM

HIIT has been one of the ten top fitness trends  
all over the world in the last decade.



There is a variety of HIIT protocols:  
they are based on short work intervals (<60 s - 8 min)  
of **vigorous** (70-90% maximal heart rate or 14-16 of  
the 6-20 Borg's rate of perceived exertion scale - RPE)  
**to high intensity** ( $\geq 90\%$  maximal heart rate or  $\geq 17$  of the 6-20 RPE)  
interspersed with **active** (40-70% maximal heart rate or 8-13 of the 6-20 RPE)  
or **passive** (cessation of movement) recovery periods (of 1-5 min)  
(Wood et al. 2019)

Review > [BMJ Open Sport Exerc Med. 2019 Dec 17;5\(1\):e000647.](#)

doi: [10.1136/bmjsem-2019-000647](#). eCollection 2019.

## HIIT is not superior to MICT in altering blood lipids: a systematic review and meta-analysis

Gina Wood <sup>1</sup>, Anna Murrell <sup>2</sup>, Tom van der Touw <sup>1</sup>, Neil Smart <sup>1</sup>

Affiliations + expand

PMID: [31921439](#) PMCID: [PMC6937112](#) DOI: [10.1136/bmjsem-2019-000647](#)

[Free PMC article](#)

### Conclusion:

1. Neither HIIT nor MICT is superior for altering TC, TRG, or LDL-C, or TC-HDL-C ratio.
2. Compared with MICT, HIIT appeared to significantly improve HDL-C.
3. Clinicians may prescribe either protocol to encourage participation in exercise and reduce cardiovascular risk.
4. To raise HDL-C, HIIT may result in a larger effect size compared with MICT.





Meta-Analysis > J Sports Sci. 2021 Dec;39(24):2829-2846. doi: 10.1080/02640414.2021.1964800.

Epub 2021 Aug 17.

## Effects and dose-response relationship of high-intensity interval training on cardiorespiratory fitness in overweight and obese adults: a systematic review and meta-analysis

Kangle Wang <sup>1</sup>, Yuxin Zhu <sup>1</sup>, Stephen Heung-Sang Wong <sup>2</sup>, Yajun Chen <sup>3</sup>, Parco Ming-Fai Siu <sup>4</sup>, Julien S Baker <sup>5</sup>, Fenghua Sun <sup>1</sup>

Meta-analysis showed that HIIT was a highly effective approach for improving cardiorespiratory fitness in overweight and obese adults.



› Med Sci Sports Exerc. 2019 Jun;51(6):1220-1226. doi: 10.1249/MSS.0000000000001934.

## High-Intensity Interval Training for Cardiometabolic Disease Prevention

Wayne W Campbell <sup>1</sup>, William E Kraus <sup>2</sup>, Kenneth E Powell <sup>3</sup>, William L Haskell <sup>4</sup>, Kathleen F Janz <sup>5</sup>, John M Jakicic <sup>6</sup>, Richard P Troiano <sup>7</sup>, Kyle Sprow <sup>7</sup>, Andrea Torres <sup>8</sup>, Katrina L Piercy <sup>9</sup>, David B Bartlett <sup>2</sup>, 2018 PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE\*

**Conclusions:** HIIT by adults, especially those with overweight and obesity classification, can improve insulin sensitivity, blood pressure, and body composition, comparable with those resulting from moderate-intensity continuous training.



Meta-Analysis > Clin Rehabil. 2021 Feb;35(2):169-181. doi: 10.1177/0269215520961637.

Epub 2020 Oct 11.

## High-intensity functional exercise in older adults with dementia: A systematic review and meta-analysis

Shu-Wei Yeh<sup>1 2</sup>, Li-Fong Lin<sup>3 4</sup>, Hung-Chou Chen<sup>4 5 6</sup>, Li-Kai Huang<sup>7 8 9</sup>,  
Chaur-Jong Hu<sup>7 8 9</sup>, Ka-Wai Tam<sup>5 10 11 12</sup>, Yi-Chun Kuan<sup>5 7 8 9 12 13</sup>,  
Chien-Hsiung Hong<sup>2 14</sup>

**Conclusions:** High-intensity functional exercise is generally safe and is recommended for older individuals with mild or moderate dementia to provide benefits in motor performance and daily functioning.



Meta-Analysis > Scand J Med Sci Sports. 2021 Feb;31(2):265-294. doi: 10.1111/sms.13861.

Epub 2020 Nov 5.

## High-intensity exercise to improve cardiorespiratory fitness in cancer patients and survivors: A systematic review and meta-analysis

Ana Myriam Lavín-Pérez <sup>1 2 3</sup>, Daniel Collado-Mateo <sup>2</sup>, Xián Mayo <sup>2</sup>, Liam Humphreys <sup>4</sup>, Gary Liguori <sup>5</sup>, Robert James Copeland <sup>4</sup>, Fernando Del Villar Álvarez <sup>2</sup>, Alfonso Jiménez <sup>2 3 4</sup>

Affiliations + expand

PMID: 33098219 DOI: 10.1111/sms.13861

1. Improving cardiorespiratory fitness (CRFit) significantly improved with HIT in comparison with a control group ( $P < .00001$ , SMD = 0.44 and a 95% confidence interval from 0.25 to 0.64).
2. The results showed that higher effects could be achieved in: patients starting to exercise before treatment, interventions longer than eight weeks, programs including exclusively cardiovascular training and with a high-intensity part of session duration of at least 20 minutes.





> *BMJ Open*. 2020 Feb 20;10(2):e034733. doi: 10.1136/bmjopen-2019-034733.

**Improving reproductive function in women with polycystic ovary syndrome with high-intensity interval training (IMPROV-IT): study protocol for a two-centre, three-armed randomised controlled trial**

Ida Almenning Kiel <sup>1 2</sup>, Sofie Lionett <sup>1 2 3</sup>, Evelyn Maria Aurora Hernandez Røset <sup>2 5</sup>, Øyvind Salvesen <sup>1 2 3</sup>, Trine Moholdt <sup>7 2</sup>, Helen Jones <sup>4</sup>, ...

Randomized Controlled Trial > *J Obstet Gynaecol Can*. 2017 Jul;39(7):545-558.  
doi: 10.1016/j.jogc.2017.03.097.

**High-Intensity Exercise Training for Improving Reproductive Function in Infertile Patients: A Randomized Controlled Trial**

Behzad Hajizadeh Maleki <sup>1</sup>, Bakhtyar Tartibian <sup>2</sup>

Randomized Controlled Trial > *Cytokine*. 2020 Jan;125:154861. doi: 10.1016/j.cyto.2019.154861.  
Epub 2019 Sep 27.

**High-intensity interval training modulates male factor infertility through anti-inflammatory and antioxidative mechanisms in infertile men: A randomized controlled trial**

Behzad Hajizadeh Maleki <sup>1</sup>, Bakhtyar Tartibian <sup>2</sup>

Promising outcomes of HIIT interventions on the improvement of reproductive functions have been observed both in women and men with infertility.



However, to date little reliable data are available  
on HIIT performed during pregnancy.

The question appears, whether pregnant women will enjoy similar benefits from HIIT participation as do non-pregnant populations, and is this type of training safe for them?



The lack of popularity of HIIT programs for pregnant women may be a consequence of conservative guidelines, issued 30 years ago, suggesting that exercising women should reduce their habitual levels of exertion in pregnancy and refrain from initiating strenuous exercise programs.

In the 1990s, it was widely believed that pregnant women should avoid anaerobic training like sprinting or interval work.

Such recommendations were based, among others, on the results of scientific studies demonstrating the negative effects of hard physical work, **combined with undernutrition**, on the development of pregnancy **in laboratory animals**.



## Influence of prenatal physical activity on the course of labour and delivery according to the new Polish standard for perinatal care

Anna Szumilewicz<sup>1</sup>, Andrzej Wojtyła<sup>2,3</sup>, Aleksandra Zarębska<sup>1</sup>, Izabela Drobnik-Kozakiewicz<sup>1</sup>, Michał Sawczyn<sup>1</sup>, Anna Kwitniewska<sup>1</sup>

physical benefits, which is of course one of the priority, but the physical and emotional preparation to the act of giving birth and motherhood [69]. The development of an exercise program requires individual adaptation. Appropriate level of the individual training components should be regularly monitored and evaluated according to the observed progress [64]. The most significant effects are typically observed during the first 6–8 weeks of an exercise program [69]. In working with pregnant women it should be taken into account that the body is additionally burdened by the development of pregnancy, which significantly determines its response to exercise, manifested, among others in faster gains and larger fluctuations in heart rate and increased work of breathing [6, 64, 71]. It significantly alters the management of the intensity of each training session, which sometimes requires extended warm-up and/or cancellation of interval exercises. It should be also considered that due to weight gain, the woman at the same exercise has greater burden and carries out more work in the same unit of time. Therefore, reducing the time for physical activity is not always associated with limiting physical effort. Changing of the body biomechanics





> [Perspect Public Health](#). 2021 Mar;141(2):81-88. doi: 10.1177/1757913920985898. Epub 2021 Feb 12.

## To HIIT or not to HIIT? The question pregnant women may be searching for online: a descriptive observational study

T S Nagpal <sup>1</sup>, C Everest <sup>2</sup>, A D Goudreau <sup>2</sup>, M Manicks <sup>3</sup>, K B Adamo <sup>2</sup>

Affiliations + expand

PMID: 33579178 DOI: [10.1177/1757913920985898](#)

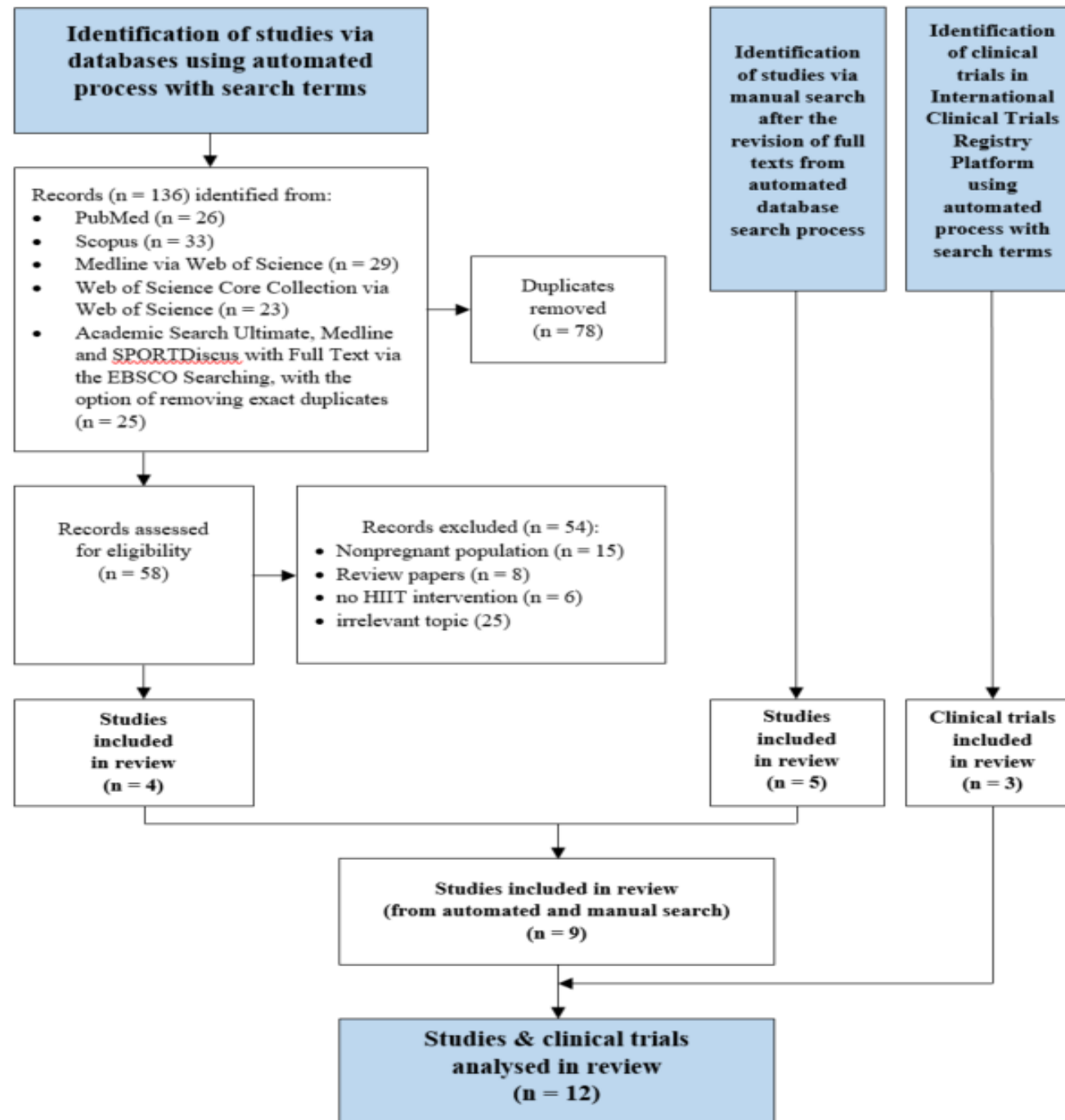


[pregnant women during HIIT class - Bing images](#)

**Aims:** An increasingly popular exercise modality for women is high-intensity interval training (HIIT). **Limited research has assessed HIIT during pregnancy, and as a result, pregnant women may inquire about HIIT on their own through online searches.** The purpose of this study was to systematically search and critically evaluate online resources that women may access when inquiring about performing HIIT during pregnancy.

**Conclusion:** Publicly accessible information online on HIIT during pregnancy does not routinely adhere to evidence-based safety recommendations for prenatal exercise. Further research on HIIT during pregnancy and public dissemination of findings is required.





We included nine papers presenting outcomes from seven experiments in the review analysis of HIIT protocols during pregnancy. The HIIT interventions were implemented in 114 women aged 24 to 41 years and in 80 female rats aged 8 to 11 weeks.



Table 1. The characteristics of studies included in the analysis

Author, year	Population subjected to HIIT					Study arms/ interventions	Primary outcome of the study	Adverse effects
	Type	Total (n)	Exp (n)	Con (n)	WG			
Kardel & Kase [31], 1998 <sup>1</sup> Kardel [32] 2005 <sup>1</sup>	Women, athletes	42	20	21	17	Two arms: high- volume exercise vs. medium- volume exercise groups	Maternal pregnancy and postpartum body weight and skin fold, resting and working HR, oxygen consumption, blood lactate and fatigue	None observed
		41		20				
Salvesen et al. [33], 2012	Women, athletes	6	6	N/A	23-29	One arm: high intensity interval treadmill running	Fetal wellbeing and uteroplacental blood flow during and post-exercise	None observed
Halse et al. [34], 2014 <sup>2</sup> Halse et al. [35], 2015 <sup>2</sup>	Women	40	20	20	29 ± 1	Two arms: continuous moderate- intensity, vigorous interval cycling exercise combined with conventional management of GDM vs. conventional management of GDM alone	Maternal glucose metabolism  Maternal aerobic fitness, weight gain, self-reported mobility, attitude toward prenatal exercise, obstetric and neonatal outcomes	None observed

<u>Songstad et al. [27], 2015</u>	Female rats	48	24	24	3 weeks before pregnancy	Two arms: HIIT vs. sedentary groups	Maternal cardiac function, development of fetuses and placentas, gene expression, oxidative stress and total antioxidant capacity	None observed
Ong et al. [28], 2016	Women	12	The same group underwent two subsequent interventions		30 ± 1	Two interventions: high intensity interval cycling vs. continuous cycling	Maternal energy expenditure and enjoyment of exercise	Not reported
<u>Mohammadkhani et al. [29], 2020</u>	Female rats	32	24	8	7 weeks before pregnancy	Four arms: three exercise groups (who exercised 1. only before pregnancy, 2. both before and during pregnancy, 3. only during pregnancy vs. control, sedentary group)	Cardiac gene expression, serum lipid profile, and running performance in offspring	None observed
Anderson et al. [30], 2021	Women	14	14	N/A	29 ± 1	One arm: HIIT group	Fetal heart rate and umbilical artery Doppler indices pre- and post-exercise	None observed

HIIT – high intensity interval training, Exp – experimental group, Con – control group, wg – week of gestation at recruitment; HR – heart rate; GDM – gestational diabetes mellitus; N/A – not applicable; <sup>1</sup> – two paper presented data from the same experiment in pregnant elite athletes; <sup>2</sup> – two paper presented data from the same experiment in women with GDM.



Author, year	HIIT protocol (the main part of the training session)									Frequency & duration of the entire intervention
	Workout intervals			Recovery intervals			Sets/repetitions (n)	Cycles (n)	Rest between cycles	
	Type	I	T	Type	I	T				
<u>Kardel &amp; Kase</u> [31], 1998 <sup>1</sup> <u>Kardel</u> [32], 2005 <sup>1</sup>	Stationary cycling, running, walking fast uphill or cross-country skiing	170-180 HR	15 s or 45 s	N/R		15 s	repeated for 10 min in the medium-volume exercise group and for 15 min in the high-volume exercise group	2	5 min	Three parts: muscle strength training, aerobic interval training and aerobic endurance training; each part two sessions per week from 17 wg until birth and from 7 until 12 weeks postpartum
<u>Salvesen et al.</u> [33], 2012	Running on a treadmill	60-90% VO <sub>2max</sub>	5 min	Semi-supine position for USG screening	N/A	4 min	3-5 <sup>3</sup>	1	N/A	One session
<u>Halse et al.</u> [34], 2014 <sup>2</sup> <u>Halse et al.</u> [35], 2015 <sup>2</sup>	Stationary upright cycling	75-85% HR <sub>max</sub> ; 15-16 RPE	15 - 60 s	Stationary cycling	55-65% HR <sub>max</sub> ; 9-11 RPE	2 min	Not reported, the sessions lasted from 25 to 45 min, with the duration progressively increased			Three supervised session and two unsupervised sessions per week; 6 weeks, up the 34 wg;

Author, year	HIIT protocol (the main part of the training session)									Frequency & duration of the entire intervention
	Workout intervals			Recovery intervals			Sets/repetitions (n)	Cycles (n)	Rest between cycles	
	Type	I	T	Type	I	T				
Songstad et al. [27], 2015	Uphill running on a treadmill	85-90% VO <sub>2max</sub>	4 min	Running	50-60% VO <sub>2max</sub>	2 min	10	1	N/A	Five sessions per week; 3 weeks before and 3 weeks in pregnancy
Ong et al. [28], 2016	Stationary cycling	Max.	15 s	Cycling	65% HR <sub>max</sub>	3 min	6	1	N/A	One session of 30-min stationary continuous cycling at 65% HR <sub>max</sub> with six 15-second maximal intervals



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Ong et al. [28], 2016	Stationary cycling	Max.	15 s	Cycling	65% HR <sub>max</sub>	3 min	6	1	N/A	One session of 30-min stationary continuous cycling at 65% HR <sub>max</sub> with six 15-second maximal intervals

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	Workout intervals			Recovery intervals			Sets/repetitions (n)	Cycles (n)	Rest between cycles	
	Type	I	T	Type	I	T				
Mohammadkhani et al. [29], 2020	Running on treadmill	85-95% VO <sub>2max</sub>	3 min	Running on treadmill	65% VO <sub>2max</sub>	N/R	10-15	1	N/A	Five sessions per week; 6 weeks before pregnancy and 3 weeks during pregnancy; the speed and number of bouts increased every week
Anderson et al. [30], 2021	Resistance circuit training	Max.	20 s	Marching	Self-regulated	60 s	3 cycles		2 min	One session

HIIT – high intensity interval training; I – intensity of training, T – time; HR – Heart Rate; VO<sub>2max</sub>; wg – week of gestation; Max. – maximal intensity according to participants’ individual assessment of physical exertion; N/R – not reported; N/A – not applicable; <sup>1</sup> – two paper-presented data from the same experiment in pregnant elite athletes; <sup>2</sup> – two paper-presented data from the same experiment in women with GDM; <sup>3</sup> – the number of running bouts based on individual women’s and fetuses’ well-being

1. The prenatal HIIT interventions differed substantially in terms of the structure of intervals.
2. The workout intervals lasted from 15 seconds to 5 minutes with the intensity of 60-95% of  $HR_{max}$  or  $VO_{2max}$ .
3. The recovery intervals, apart from one study, were implemented in an active form with the intensity of 50-65% of  $HR_{max}$  or  $VO_{2max}$  and went on from 15 seconds to 3 minutes.
4. Such intervals structure is in line with the definition of HIIT directed for other population.
5. The participants performed 1, 2 or 3 cycles of intervals.
6. Also, other training components: type, intensity, frequency, duration and progression of exercise varied between studies, giving different exercise stimuli in the studied groups.



RESEARCH ARTICLE

## Effects of High Intensity Interval Training on Pregnant Rats, and the Placenta, Heart and Liver of Their Fetuses

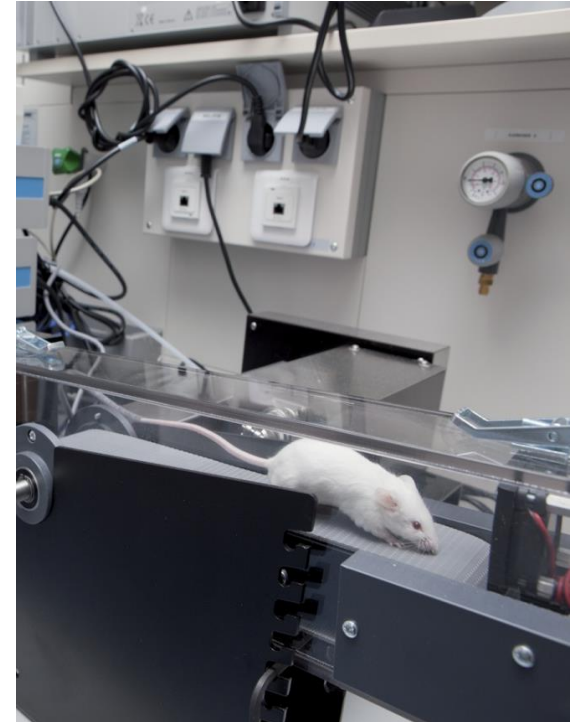
Nils Thomas Songstad<sup>1,2\*</sup>, Knut-Helge Frostmo Kaspersen<sup>2,3\*</sup>, Anne Dragey Hafstad<sup>4</sup>, Purusotam Basnet<sup>1,5</sup>, Kirsti Ytrehus<sup>4</sup>, Ganesh Acharya<sup>1,5</sup>

**1** Women's Health and Perinatology Research Group, Department of Clinical Medicine, Faculty of Health Sciences, UiT–The Arctic University of Norway, Tromsø, Norway, **2** Department of Pediatrics, University Hospital of Northern Norway, Tromsø, Norway, **3** Pediatric Research Group, Department of Clinical Medicine, Faculty of Health Sciences, UiT–The Arctic University of Norway, Tromsø, Norway, **4** Cardiovascular Research Group, Department of Medical Biology, Faculty of Health Science, UiT–The Arctic University of Norway, Tromsø, Norway, **5** Department of Obstetrics and Gynecology, University Hospital of Northern Norway, Tromsø, Norway

© These authors contributed equally to this work.  
\* [nilsthomass@gmail.com](mailto:nilsthomass@gmail.com)



- Rat females responded well to HIIT throughout pregnancy.
- The program consisted of performing 5 training sessions per week, consisting of ten 4-minute intervals with an intensity of 85-90% of the VO<sub>2</sub> max.
- The authors did not record side effects of such an HIIT program on pregnancy and fetal development.
- Interestingly, **the HIIT program modified some of the genes associated with oxidative stress in fetal livers and hearts.** This indicates that adaptive mechanisms to intense physical exertion can be activated already in the fetal period.



## Abstract

The susceptibility to cardiovascular disease in offspring could be reduced prior to birth through maternal intervention, before and during pregnancy. We evaluated whether the initiation periods of maternal exercise in preconception and pregnancy periods induce beneficial effects in the adult male offspring. Thirty-two female rats were divided into control and exercise groups. The exercise groups involve exercise before pregnancy or the preconception periods, exercise during pregnancy, and exercise before and during pregnancy. The mothers in the exercise groups were run on the treadmill in different periods. Then the birth weight and weekly weight gain of male offspring were measured, and the blood and left ventricle tissue of samples were collected for analysis of the **Sirtuin 6 (Sirt6) and insulin growth factor-2 (IGF-2) gene expression, serum levels of low-density lipoprotein (LDL), high-density lipoprotein (HDL), cholesterol (Cho), and triglycerides (TG)**. There was no significant difference in the birth weight of offspring groups ( $P = 0.246$ ) while maternal HIIT only during pregnancy leads to reduce weekly weight gain of offspring. Our data showed that Sirt6 and IGF-2 gene expression was increased ( $P = 0.017$ ) and decreased ( $P = 0.047$ ) by maternal exercise prior to and during pregnancy, respectively. Also, the serum level of LDL ( $p = 0.002$ ) and Cho ( $P = 0.007$ ) were significantly decreased and maternal exercise leads to improves the running speed of the adult male offspring ( $p = 0.0176$ ). **This study suggests that maternal HIIT prior to and during pregnancy have positive intergenerational consequence in the health and physical readiness of offspring.**

## RESEARCH ARTICLE

# Influence of the maternal high-intensity-interval-training on the cardiac *Sirt6* and lipid profile of the adult male offspring in rats

Reihaneh Mohammadkhani<sup>1</sup>, Neda Khaledi<sup>1\*</sup>, Hamid Rajabi<sup>1</sup>, Iraj Salehi<sup>2</sup>, Alireza Komaki<sup>2</sup>

<sup>1</sup> Department of Exercise Physiology, Faculty of Physical Education & Sports Science, Kharazmi University, Tehran, Iran, <sup>2</sup> Neurophysiology Research Center, Hamadan University of Medical Sciences, Hamadan, Iran



HIIT significantly reduced maternal weight gain and increased running speed in the offspring.

RESEARCH ARTICLE

Open Access



# Enhancing energy expenditure and enjoyment of exercise during pregnancy through the addition of brief higher intensity intervals to traditional continuous moderate intensity cycling

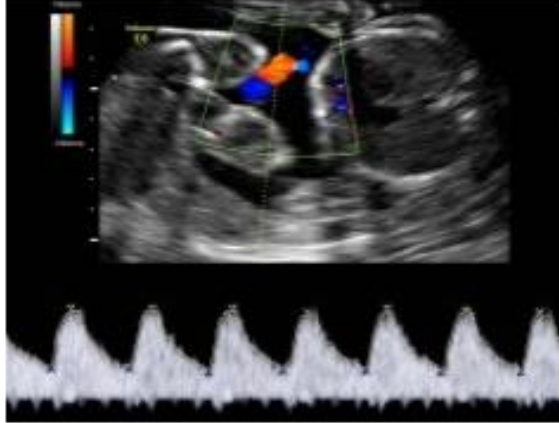
Ming Jing Ong<sup>1\*</sup>, Karen E. Wallman<sup>1</sup>, Paul A. Fournier<sup>1</sup>, John P. Newnham<sup>2</sup> and Kym J. Guelfi<sup>1</sup>



[pregnant women during spinning - Bing images](#)

- Ong et al. (20) analyzed the effectiveness of a one-time interval session in a group of women in the third trimester, with an average level of activity before and during pregnancy.
- They observed that adding six 15-second intervals of subjectively maximum intensity to traditional moderate-intensity continuous training increased its energy expenditure by 28%.
- In addition, based on the PACES scale, the authors found that intensive intervals increased women's satisfaction with doing exercises.





› Appl Physiol Nutr Metab. 2021 Aug 25;1-7. doi: 10.1139/apnm-2020-1086. Online ahead of print.

## Acute fetal response to high-intensity interval training in the second and third trimesters of pregnancy

Julie Anderson<sup>1</sup>, Jessica Pudwell<sup>1</sup>, Colin McAuslan<sup>2</sup>, Logan Barr<sup>1</sup>, Jessica Kehoe<sup>3</sup>, Gregory A Davies<sup>1 3</sup>

- Fourteen active, healthy women with an uncomplicated single pregnancy between 28 and 32 wg participated in high-intensity interval training (at 80% -90% of the mother's maximum heart rate)
- Fetal well-being was assessed continuously by fetal heart rate and umbilical artery Doppler measurements before and after training. Fetal heart rate records were normal throughout the exercise session.
- **The authors concluded that in the active pregnant group of pregnant women, high-intensity interval training at the end of the second and beginning of the third trimester seems to be a safe method of exercise without acute, adverse effects on the fetus, but more research is required.**

*The HIIT effects on fetal well-being and childbirth outcomes*

1. In two experiments, fetal wellbeing and uteroplacental blood flow during and after one-time session were analyzed
2. In the study by Salvesen et al., fetuses kept their heart rate (FHR) within the normal range (110–160 bpm) as long as the mother exercised below 90% of maximal maternal heart rate (MHR)
3. After warm up the mean uterine artery volume blood flow was lower by 60–80% of the initial value and during exercise by 40–75%.
4. FHR dropped below the minimum reference value and high umbilical artery pulsatility index (PI) occurred when the woman exercised above 90% of maximal MHR and the mean uterine artery volume blood flow was less than 50% of the initial value.
5. However, FHR and umbilical artery PI normalized quickly after the mother stopped exercise.
6. Anderson et al. also used continuous fetal heart rate tracings and the pre- and post-exercise umbilical artery Doppler indices: systolic/diastolic ratio (S/D ratio), resistance index (RI) and PI. They observed normal FHR throughout the circuit HIIT session. After exercise, umbilical artery end-diastolic flow was normal and the mean S/D ratios, RI and PI decreased.



*The HIIT effects on fetal well-being and childbirth outcomes*

1. The birth outcomes were assessed in four studies.
2. In the experiment in pregnant athletes by Kardel & Kase, high- and moderate-volume exercise groups didn't differ significantly in terms of the following birth parameters: onset, duration and mode of delivery, pain control, frequency of perinatal medical complications, 1- and 5-min Apgar scores, infant birth weight and placental weight.
3. There were no preterm deliveries, NICU admissions or fetal complications amongst participants of this study.
4. Similarly, Halse et al. didn't find substantial differences between women with GDM participating and not participating in HIIT intervention in the following obstetric outcomes: onset, duration and mode of delivery, gestational age at delivery, incidence of preterm birth, newborn anthropometrics (weight, length, and head circumference) and 1- and 5-min Apgar scores.

Our most important finding was that HIIT programs, regardless of their training components and intervals structure were well tolerated by pregnant participants and safe in terms of obstetric outcomes.



## The main benefits of HIIT for pregnant women

1. HIIT programs, providing a strong training stimulus in a short time, may overcome the barriers of not having enough time for exercise.
2. Pregnant women found HIIT training to be more enjoyable than traditional aerobic training.
3. In the experiment by Anderson, the studied women stated that HIIT session was more “interesting”, “challenging”, provided a “better workout” and made time “go faster” because the exercise was “broken up”.
4. Halse et al. observed that participation in the HIIT cycling program enhanced pregnant women’s attitudes and intentions toward exercise. Training enjoyment is of particular importance because it significantly predicts exercise adherence, which consequently may determine desired health benefits.

## The main benefits of HIIT for pregnant women

1. In the analyzed studies, the researchers observed a positive effect of prenatal HIIT programs on maternal cardiopulmonary parameters.
2. Interestingly, based on the study by Halse et al, prenatal HIIT programs seem to be a useful measure also for the prevention of gestational diabetes mellitus. Better glucose metabolism was observed in women with GDM participating in HIIT compared to the control group receiving the conventional diabetes management.
3. In the reviewed studies, HIIT interventions either led to the improvement in selected maternal or fetal health parameters (including metabolism, cardiopulmonary system indices and physical fitness) or had no impact compared to control groups. The differentiated effectiveness of HIIT may result from their diversity in terms of the training components (type, intensity, frequency, duration and progression) and the structure of intervals (intensity and time of workout and recovery intervals).

Randomized Controlled Trial > [Physiol Rep. 2022 Sep;10\(18\):e15454. doi: 10.14814/phy2.15454.](#)

# Glycemic response to acute high-intensity interval versus moderate-intensity continuous exercise during pregnancy

Jenna B Wowdzia <sup>1</sup>, Tom J Hazell <sup>2</sup>, Margie H Davenport <sup>1</sup>

Affiliations + expand

PMID: 36117457 PMID: [PMC9483614](#) DOI: [10.14814/phy2.15454](#)

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The present study investigated the glycemic response to an acute high-intensity interval training (HIIT) session (10 one-minute intervals  $\geq 90\%$  HR<sub>max</sub> interspersed with one-minute of active recovery) versus a moderate-intensity continuous training (MICT) session (30 min at 64%-76% HR<sub>max</sub>) during pregnancy.





Randomized Controlled Trial > [Physiol Rep. 2022 Sep;10\(18\):e15454. doi: 10.14814/phy2.15454.](#)

## Glycemic response to acute high-intensity interval versus moderate-intensity continuous exercise during pregnancy

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Affiliations + expand

PMID: 36117457 PMID: [PMC9483614](#) DOI: [10.14814/phy2.15454](#)

[Free PMC article](#)

The majority of participants preferred HIIT (87.5%) and **had greater perceived enjoyment** compared to MICT (HIIT:  $7.8 \pm 1.5$ ; MICT:  $6.6 \pm 2.0$ ;  $p = 0.015$ ). Sleep duration was  $52 \pm 73$  min longer after participating in HIIT compared with the night prior (main effect for time  $p = 0.017$ ); no significant changes for MICT.

**Overall, an acute session of HIIT appears to be well tolerated and demonstrates no adverse effects on maternal glycemic response.**



 NIH U.S. National Library of Medicine

# ClinicalTrials.gov

Row	Saved	Status	Study Title	Conditions	Interventions	Locations
1	<input type="checkbox"/>	Not yet recruiting	<a href="#">Acute Effects of High Intensity Training in Pregnancy on Fetal Well-being and Blood Flow Distribution</a>	<ul style="list-style-type: none"> <li>Pregnancy</li> </ul>	<ul style="list-style-type: none"> <li>Behavioral: Single high-intensity interval training session</li> </ul>	<ul style="list-style-type: none"> <li>Dept Circulation and Medical Imaging, EXCAR Exercise Lab Trondheim, Norway</li> </ul>
2	<input type="checkbox"/>	Completed	<a href="#">Insulin Sensitivity Response to High-Intensity Training in Insulin Resistance During Pregnancy</a>	<ul style="list-style-type: none"> <li>High Intensity Interval Training</li> <li>Diet, Healthy</li> </ul>	<ul style="list-style-type: none"> <li>Dietary Supplement: moderate restricted diet (1800-2000 kcal/day) for four weeks</li> </ul>	<ul style="list-style-type: none"> <li>Ghada Elrefaye Giza, Egypt</li> </ul>
3	<input type="checkbox"/>	Recruiting	<a href="#">HIIT vs MICT During Pregnancy and Health and Birth Outcomes in Mothers and Children</a>	<ul style="list-style-type: none"> <li>Pregnancy</li> <li>Postpartum</li> <li>Childbirth</li> <li>(and 15 more...)</li> </ul>	<ul style="list-style-type: none"> <li>Behavioral: High intensity interval training program for pregnant women</li> <li>Behavioral: Moderate intensity continuous training program for pregnant women</li> <li>Behavioral: Standard obstetric care with extended education on healthy lifestyle</li> <li>(and 3 more...)</li> </ul>	<ul style="list-style-type: none"> <li>Laboratory of Physical Effort and Genetics in Sport at Gdansk University of Physical Education and Sport Gdańsk, Pomorskie, Poland</li> </ul>

We are entering a new era of pregnancy exercise research ...



[https://a57.foxnews.com/media2.foxnews.com/2015/10/16/0/0/pregant\\_running\\_1280.jpg?ve=1](https://a57.foxnews.com/media2.foxnews.com/2015/10/16/0/0/pregant_running_1280.jpg?ve=1)



We've just started a new project HIIT Mama  
High Intensity Interval Training during Pregnancy





Pregnant women need sufficiently high exercise intensity.



Fot. Beata Zarach

≠






[https://www.gala.pl/media/cache/gallery\\_view/uploads/media/default/0004/78/maja-hyzy-w-ciazy-na-spacerze.jpeg](https://www.gala.pl/media/cache/gallery_view/uploads/media/default/0004/78/maja-hyzy-w-ciazy-na-spacerze.jpeg)



Article

# Gestational Exercise and Maternal and Child Health: Effects until Delivery and at Post-Natal Follow-up

María Perales <sup>1,2</sup>, Pedro L. Valenzuela <sup>3</sup> , Ruben Barakat <sup>4</sup>, Yaiza Cordero <sup>5</sup> , Mireia Peláez <sup>6</sup> ,  
Carmen López <sup>7</sup>, Luis M. Ruilope <sup>8</sup>, Alejandro Santos-Lozano <sup>1,9</sup> and Alejandro Lucia <sup>1,10,\*</sup>

Perales et al., subjecting pregnant women to a moderate intensity exercise program, observed **in the group of women inactive before pregnancy** compared to the control group a significant reduction in the risk of pregnancy hypertension, gestational diabetes, fetal macrosomia as well as metabolic disorders and overweight or obesity in their children.

However, in the group of women active before pregnancy, these results were not statistically significant. This may indicate that the applied training stimulus was too weak for this group.



22:17

HIIT Mama

Uczestnicy

Wpisz nazwę

Udostępnij zaproszenie

Podczas tego spotkania (31)

- Anna Szumilewicz Organizator
- HM HIITMama Adamkiewicz Moni...
- HM HIITMama Anzelewicz Marta
- HM HIITMama Basińska Marta
- HA HIITMama Białobok Anna
- HM HIITMama Boczerska Monika
- HM HIITMama Cisek Małgorzata
- HA HIITMama Ciszewska Anna
- HM HIITMama Czyżnikiewicz Ma...
- HD HIITMama Drewek Dorota
- HR HIITMama Dumara Hanna
- HD HIITMama Durka Monika
- HK HIITMama Górska-Rusak Kata...
- HP HIITMama Grudnik Paulina

Wpisz tu wyszukiwane słowa

09:14 10.03.2021



NEPPE

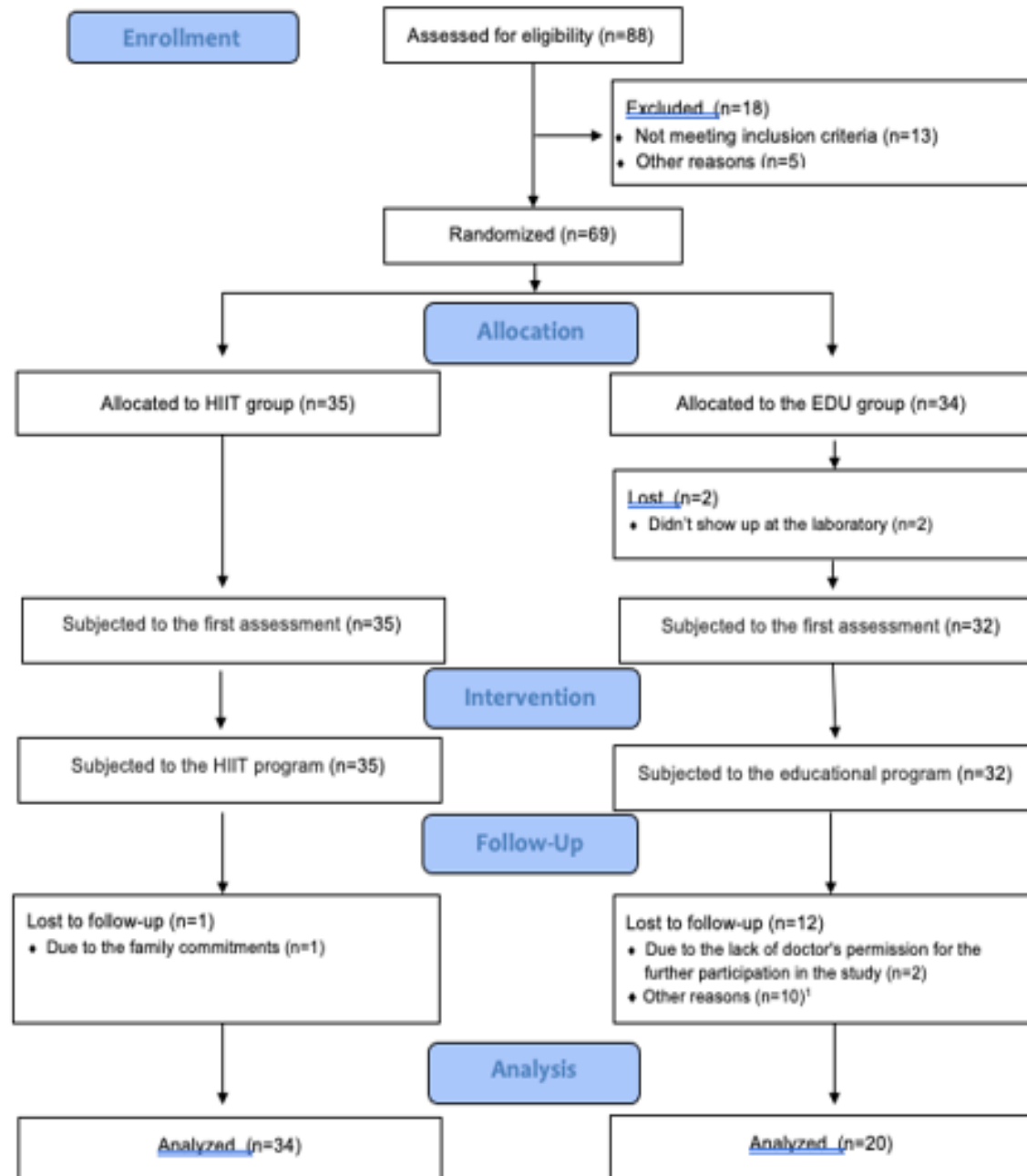


26  
Mar 2021

**HIIT Mama - AWFIS zaprasza kobiety w ciąży do bezpłatnego programu diagnostyczno-edukacyjnego**



The flow of participants through the study.

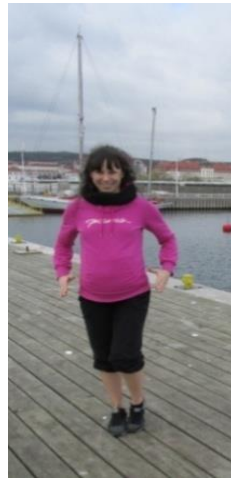


# The structure of the HIIT and MICT exercise sessions:

## The structure of a single exercise session (60') in the first and third stage of exercise intervention

Time	High Intensity Interval Training	Moderate Intensity Continues Training	
5-10'	Warm up		
30-35'	High intensity intervals, approx. 85-90% of maximum exercise capacity. The intervals will consist of performing exercises for 30-60 seconds, alternating with a 30-60 second rest break, in the ratio of exercise time to rest 1:2, 1:1 or 2:1	20'	Aerobic, continues exercise with moderate intensity (approx. 65-75% $VO_{2max}$ ), e.g. in a form of low-impact or high-low impact aerobics choreography with music
		10-15'	Resistance, postural and neuromotor exercises
5'	Stretching exercises		
5'	Pelvic floor exercises		
5'	Cooldown, including breathing and relaxation exercises. In the first stage of intervention this part will also include birth position		
5'	Visualization of pregnancy, childbirth or breast feeding (depending on the stage of intervention)		

# „low impact” vs. „high impact” exercise



Fot. Maria Pankanin

Szumilewicz A, Santos-Rocha R. Exercise selection and adaptation during pregnancy. In: Santos-Rocha R, editor. Exercise and sporting activity during pregnancy Evidence-based guidelines. Cham: Springer International Publishing; 2019. p. 231-308.



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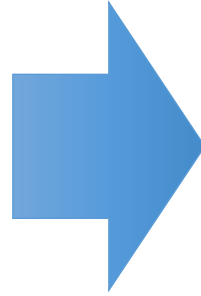
## Exercise and Sporting Activity During Pregnancy

Evidence-Based Guidelines

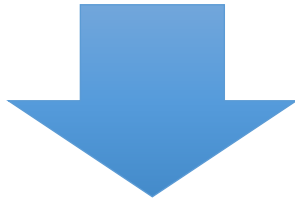
Editors: **Santos-Rocha**, Rita (Ed.)



# Inactivity in pregnancy



**Obesity and metabolic disorders  
in children**



**Non-communicable diseases  
during and after pregnancy**



# Insulin resistance and gestational diabetes mellitus (GDM)

- Healthy pregnancy can be associated with resistance to the action of insulin on glucose uptake and utilization.
- This leads to more use of fats than carbohydrates for energy by mother and saves carbohydrates for the growing fetus.
- In 1–14% of pregnant women, this condition develops into gestational diabetes mellitus (GDM), which increases the risk of macrosomia, birth complications, and maternal diabetes after pregnancy.
- It may also increase the risk of obesity and type 2 diabetes in offspring later in life.
- Active women are at lower risk of GDM

## Prenatal exercise for the prevention of gestational diabetes mellitus and hypertensive disorders of pregnancy: a systematic review and meta-analysis

Margie H Davenport <sup># 1</sup>, Stephanie-May Ruchat <sup># 2</sup>, Veronica J Poitras <sup>3</sup>, Alejandra Jaramillo Garcia <sup>3</sup>, Casey E Gray <sup>4</sup>, Nick Barrowman <sup>5</sup>, Rachel J Skow <sup>1</sup>, Victoria L Meah <sup>6</sup>, Laurel Riske <sup>1</sup>, Frances Sobierajski <sup>1</sup>, Marina James <sup>1</sup>, Amariah J Kathol <sup>1</sup>, Megan Nuspl <sup>7</sup>, Andree-Anne Marchand <sup>8</sup>, Taniya S Nagpal <sup>9</sup>, Linda G Slater <sup>10</sup>, Ashley Weeks <sup>11</sup>, Kristi B Adamo <sup>12</sup>, Gregory A Davies <sup>13</sup>, Ruben Barakat <sup>14</sup>, Michelle F Mottola <sup>9</sup>



Exercise during pregnancy  
by about 60% lower  
the risk of gestational diabetes  
and gestational hypertension and  
pre-eclampsia.

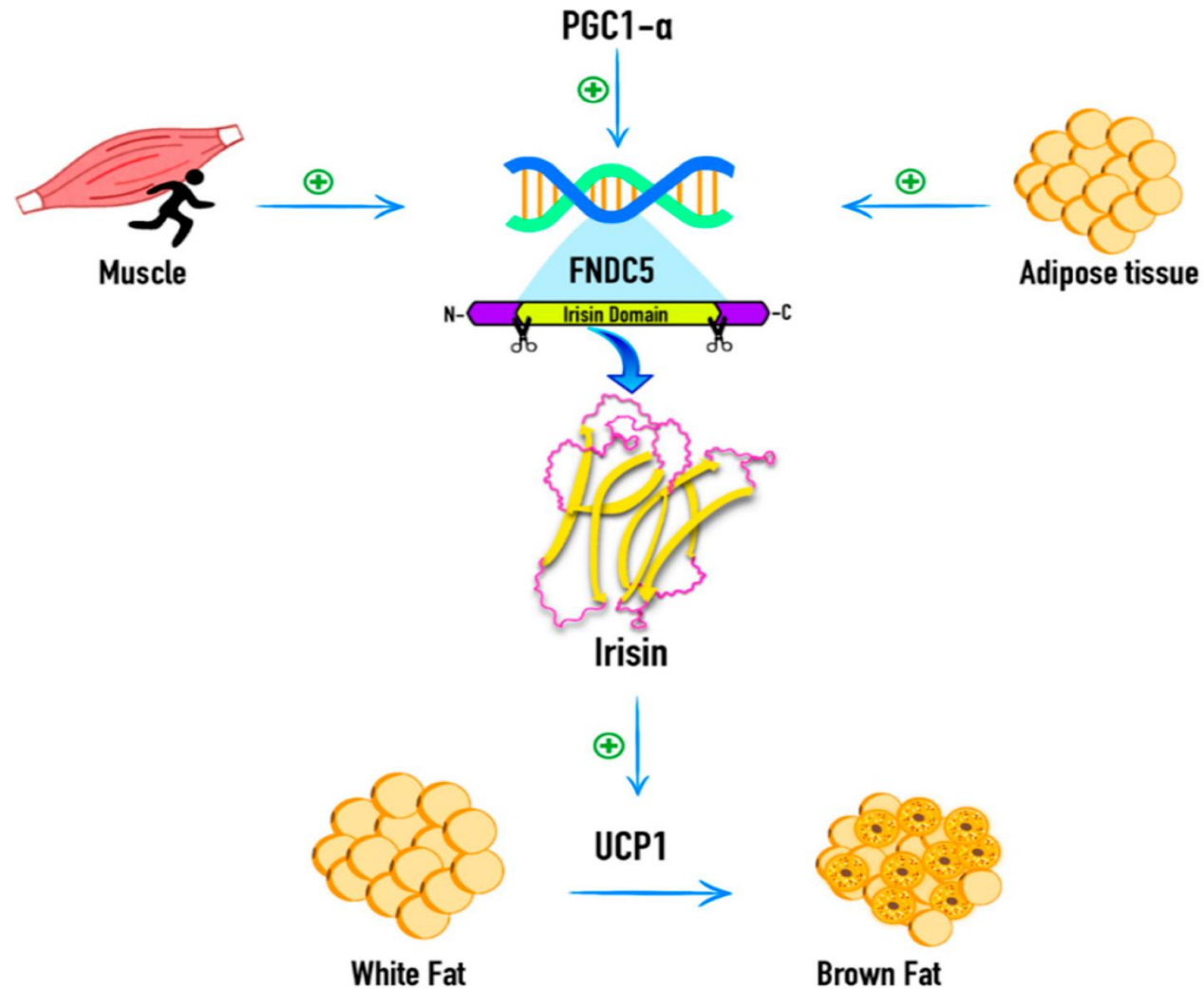
[https://diabdis.com/wp-content/uploads/2017/03/czym\\_ro\\_CS\\_BCni\\_sie\\_fakt\\_od\\_prawdy-1024x384.jpg](https://diabdis.com/wp-content/uploads/2017/03/czym_ro_CS_BCni_sie_fakt_od_prawdy-1024x384.jpg)

*Research Article*

# **The Exercise-Induced Irisin Is Associated with Improved Levels of Glucose Homeostasis Markers in Pregnant Women Participating in 8-Week Prenatal Group Fitness Program: A Pilot Study**

**Anna Szumilewicz,<sup>1</sup> Aneta Worska,<sup>1</sup> Magdalena Piernicka,<sup>1</sup> Agnieszka Kuchta,<sup>2</sup> Jakub Kortas,<sup>3</sup> Zbigniew Jastrzębski,<sup>4</sup> Łukasz Radzimiński,<sup>4</sup> Joanna Jaworska,<sup>5</sup> Katarzyna Micielska,<sup>6</sup> and Ewa Ziemann<sup>5</sup>**

Irisin is an exercise-inducible myokine that regulates the differentiation of adipose tissue, increasing the energy expenditure and reducing weight and insulin resistance





The more frequent exercise in pregnancy the more amount of irisin pregnant women produce (Szumilewicz et al. 2017).

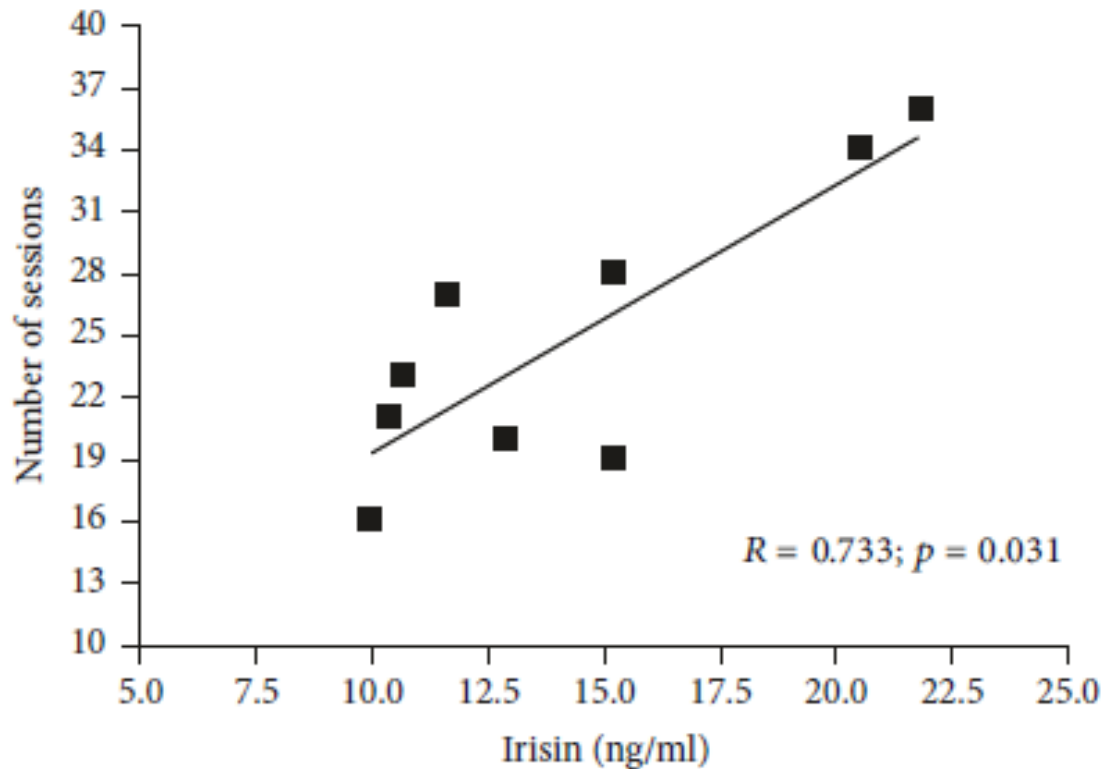


FIGURE 3: Correlations between irisin concentration and number of exercise sessions performed by pregnant women ( $n = 9$ ) during 8 weeks of exercise program.

# The Exercise-Induced Irisin Is Associated with Improved Levels of Glucose Homeostasis Markers in Pregnant Women Participating in 8-Week Prenatal Group Fitness Program: A Pilot Study

Anna Szumilewicz,<sup>1</sup> Aneta Worska,<sup>1</sup> Magdalena Piernicka,<sup>1</sup> Agnieszka Kuchta,<sup>2</sup> Jakub Kortas,<sup>3</sup> Zbigniew Jastrzębski,<sup>4</sup> Łukasz Radzimiński,<sup>4</sup> Joanna Jaworska,<sup>5</sup> Katarzyna Micielska,<sup>6</sup> and Ewa Ziemann<sup>5</sup>

TABLE 3: Correlations between irisin, lipids, and glucose homeostasis markers in physically active pregnant women ( $n = 9$ ).

Irisin ( $\text{ng}\cdot\text{ml}^{-1}$ )	Before exercise program 21st week of gestation	After exercise program 29th week of gestation
Glucose ( $\text{mg}\cdot\text{dl}^{-1}$ )	$R = -0.068; p = 0.861$	$R = -0.922; p = 0.001^*$
HbA1c (%)	$R = 0.093; p = 0.811$	$R = -0.784; p = 0.012^*$
Insulin ( $\mu\text{IU}\cdot\text{ml}^{-1}$ )	$R = 0.166; p = 0.668$	$R = -0.845; p = 0.004^*$
TG ( $\text{mg}\cdot\text{dl}^{-1}$ )	$R = -0.161; p = 0.460$	$R = -0.503; p = 0.204$
TC ( $\text{mg}\cdot\text{dl}^{-1}$ )	$R = -0.500; p = 0.170$	$R = -0.385; p = 0.306$
LDL ( $\text{mg}\cdot\text{dl}^{-1}$ )	$R = -0.617; p = 0.077$	$R = -0.300; p = 0.432$
HDL ( $\text{mg}\cdot\text{dl}^{-1}$ )	$R = -0.083; p = 0.831$	$R = 0.250; p = 0.516$

Univariate correlations were assessed using standardized Spearman coefficients; \* the  $p$  value obtained of less than 0.05 was considered statistically significant; HbA1c: glycated hemoglobin; TG: triglycerides; TC: total cholesterol; LDL: low density-lipoproteins; HDL: high density-lipoproteins.



*Research Article*

# **Acute Postexercise Change in Circulating Irisin Is Related to More Favorable Lipid Profile in Pregnant Women Attending a Structured Exercise Program and to Less Favorable Lipid Profile in Controls: An Experimental Study with Two Groups**

Anna Szumilewicz <sup>1</sup>, Aneta Worska,<sup>1</sup> Magdalena Piernicka,<sup>1</sup> Agnieszka Kuchta,<sup>2</sup> Zbigniew Jastrzębski,<sup>3</sup> Łukasz Radzimiński,<sup>3</sup> Marta Kozłowska,<sup>4</sup> Katarzyna Micielska,<sup>5</sup> and Ewa Ziemann<sup>4</sup>


# Dyslipidemia

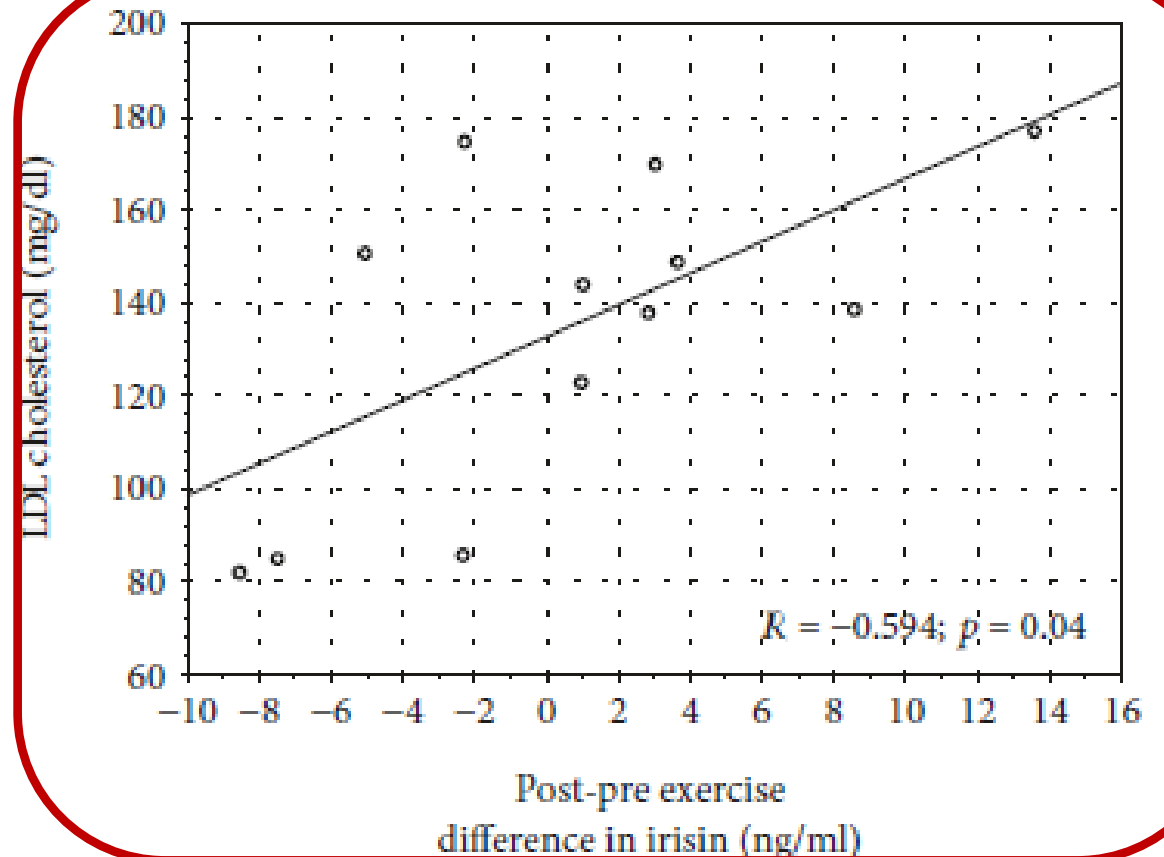
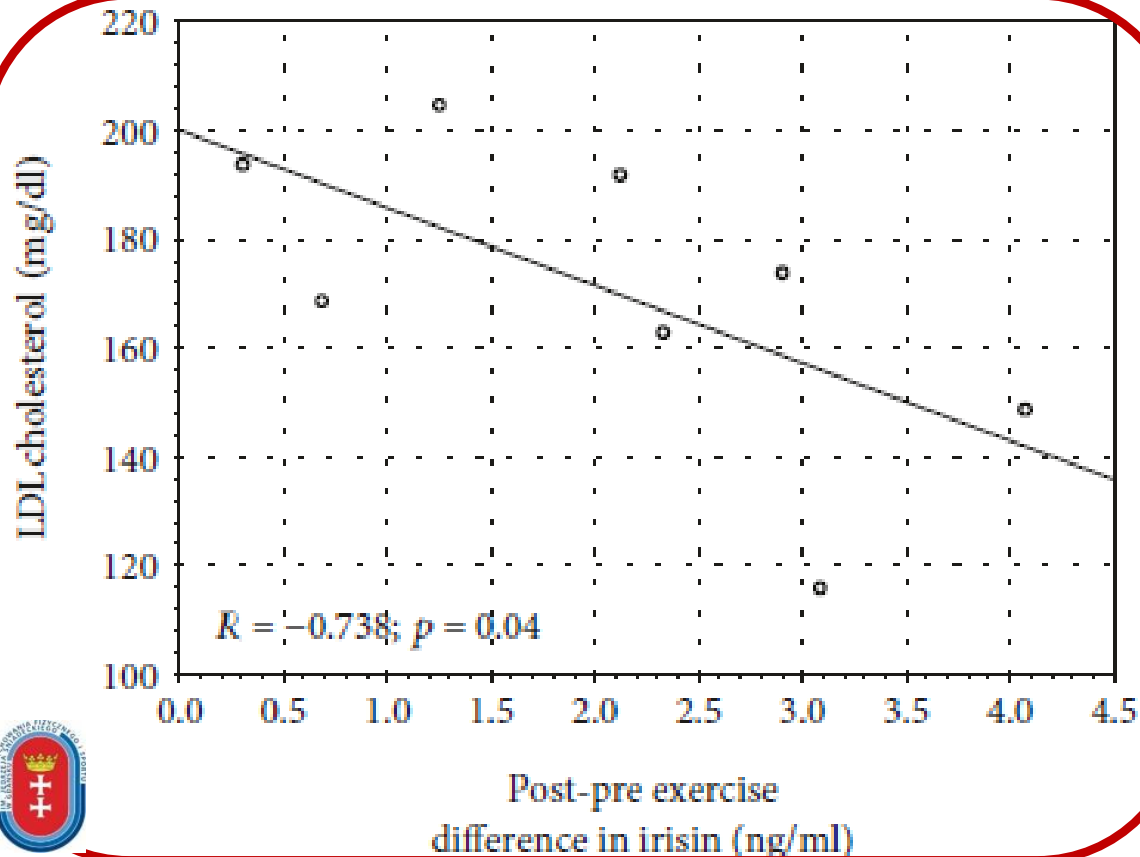
1. The increase in lipids in pregnancy is a physiological condition, principally because of changes in hormones during the trimesters of gestation.
2. However, pathological levels of cholesterol and triglycerides, **called dyslipidemia**, are associated with gestational diabetes mellitus, preeclampsia, preterm birth and other adverse outcomes such as low birth weight, or risk of macrosomia.
3. Several authors have found that supervised physical exercise during pregnancy **had positive effect on maternal lipids**. In turn, sedentary behavior in pregnant women was associated with unfavorable lipid profile.

# Acute Postexercise Change in Circulating Irisin Is Related to More Favorable Lipid Profile in Pregnant Women Attending a Structured Exercise Program and to Less Favorable Lipid Profile in Controls: An Experimental Study with Two Groups

Hindawi  
International Journal of Endocrinology  
Volume 2019, Article ID 1932503, 11 pages  
<https://doi.org/10.1155/2019/1932503>



Anna Szumilewicz <sup>1</sup>, Aneta Worska,<sup>1</sup> Magdalena Piernicka,<sup>1</sup> Agnieszka Kuchta,<sup>2</sup> Zbigniew Jastrzębski,<sup>3</sup> Łukasz Radzimiński,<sup>3</sup> Marta Kozłowska,<sup>4</sup> Katarzyna Micielska,<sup>5</sup> and Ewa Ziemann<sup>4</sup>





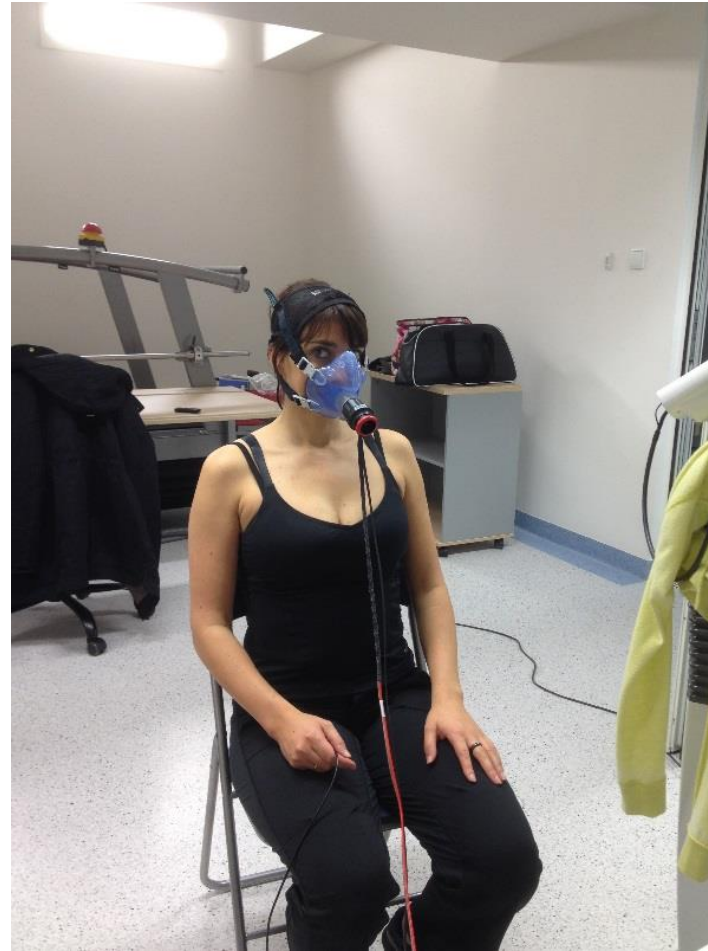
# FemFit babies😊



# The exercise intensity in our projects



## Cardiopulmonary exercise testing with the use of gas analyzer before and at selected stages of the programme



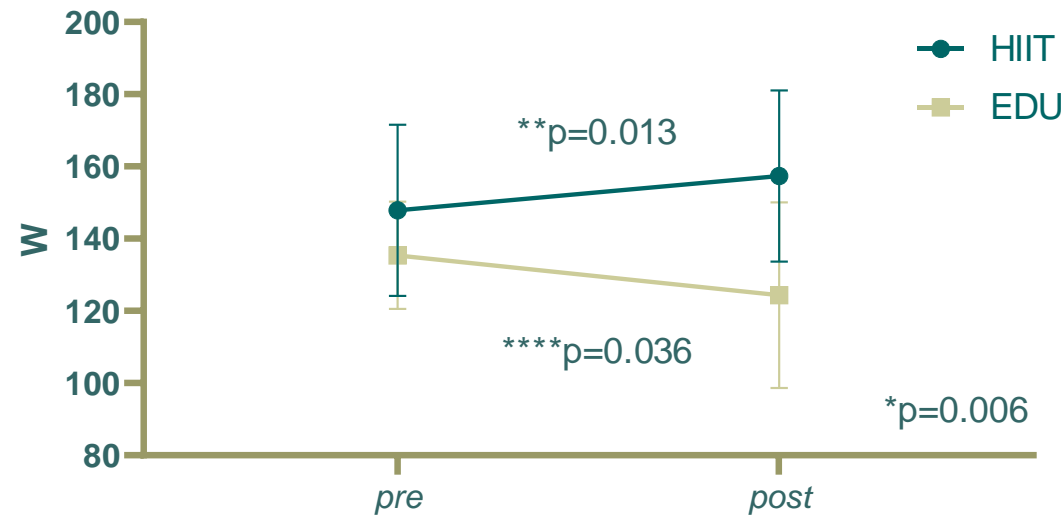
- 5-minutes pre-test time



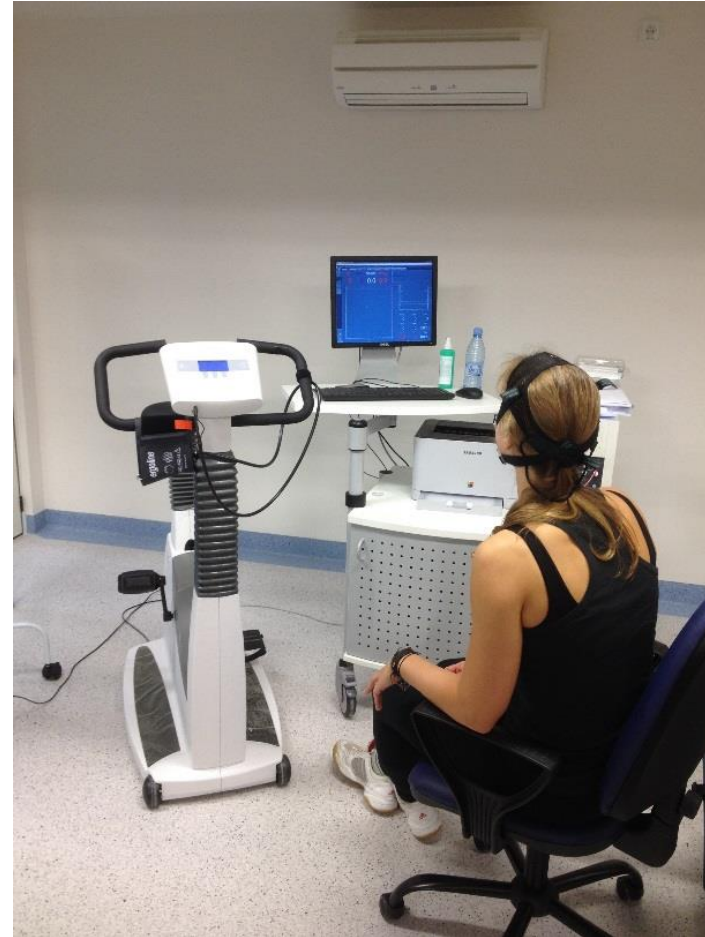
- 4-minutes warm up with the load 0.4 W/kg.
  - The load increases 0.2 W/kg at every minute till the woman can't continue the test (up to refusal).
- (at the beginning of the study till the HR is 170/min).

The changes in the maximal load pre and post 8-week HIIT programme.

LOAD pre and post intervention

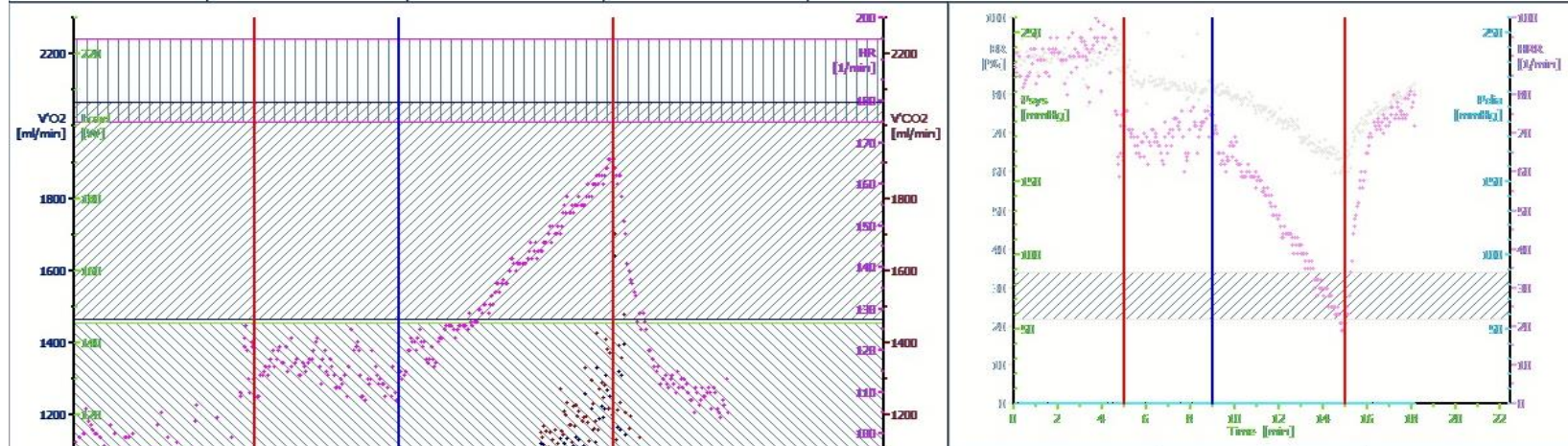


## 5-minutes rest sitting in the chair





HR	HRR	O2/HR	VO2/kg	
<b>105</b>	<b>80</b>	<b>3.1</b>	<b>5.6</b>	



VO2	Psys	Load
<b>324</b>	<b>0</b>	<b>0</b>
VCO2	Pdia	t-ph
<b>476</b>	<b>0</b>	<b>00:12</b>
RER	VE	Time
<b>1.47</b>	<b>19</b>	<b>18:11</b>

Name	Pre test rest HR	HR/o2	HR/AT	HRmax during the test	Post test rest HR
Participant 1	93	122	130	164	110
Participant 2	94	136	148	162	98
Participant 3	91	122	142	160	92
Participant 4	68	118	141	169	103
Participant 5	71	122	144	166	118
Participant 6	92	123	148	169	109
Participant 7	79	126	146	169	74
Participant 8	96	125	144	162	104
Participant 9	93	105	133	171	96
Participant 10	90	123	144	164	113

**Table 1.** Characteristics of the study participants

<b>Variable at baseline</b>	<b>All pregnant women n=97 (M ± SD)</b>	<b>Experimental group n=70 (M ± SD)</b>	<b>Control group n=27 (M ± SD)</b>	<b>P-value*</b>
Age, y	30 ± 4	30 ± 4	29 ± 3	0.08
Gestational age, wk	21 ± 5	21 ± 5	19 ± 5	0.07
BMI, kg·m <sup>-2</sup>	23 ± 2.7	22.9 ± 2.8	23.5 ± 2.7	0.49
VO <sub>2 max</sub> , ml·kg <sup>-1</sup> ·min <sup>-1</sup>	23.3 ± 3.9	23.3 ± 4.0	23.4 ± 3.8	0.87
<b>HR zones for exercise sessions:</b>				
HR lower limit (b·min <sup>-1</sup> )	127 ± 12	126 ± 11	129 ± 12	0.25
HR upper limit (b·min <sup>-1</sup> )	149 ± 12	147 ± 11	152 ± 12	0.08

BMI – Body Mass Index; VO<sub>2 max</sub> – maximal oxygen capacity; HR – heart rate;  
 \*Mann-Whitney test; P ≤ 0.05 was considered statistically significant.



Badana	70% HRmax	HR/AerT sk/min	HR/AT
1/HM/1/21	110	140	148
2/HM/1/21	118	132	139
3/HM/1/21	101	131	135
4/HM/1/21	118	148	153
5/HM/1/21	125	150	157
6/HM/1/21	123	139	148
7/HM/1/21	123	143	148
8/HM/1/21	116	157	162
9/HM/1/21	123	148	157
10/HM/1/21	120	148	157
11/HM/1/21	125	142	155
12/HM/1/21	109	137	146
13/HM/1/21	110	137	148
14/HM/1/21	115	137	153
15/HM/1/21	113	140	155
16/HM/1/21	121	144	155
17/HM/1/21	112	137	142
18/HM/1/21	118	146	160
19/HM/1/21	115	137	153
20/HM/1/21	113	134	149
21/HM/1/21	118	128	135
22/HM/1/21	116	150	158
23/HM/1/21	120	139	158
24/HM/1/21	125	169	174

The anaerobic threshold set based on „V-slope method” (Beaver et al., 1985)

The aerobic threshold set based on the  $V_E/VO_2$  ratio (Emerenziani et al., 2015; Baldari and Guidetti, 2001).



# Monitoring of the exercise intensity with pulsometers





### Exercise Monitoring Card

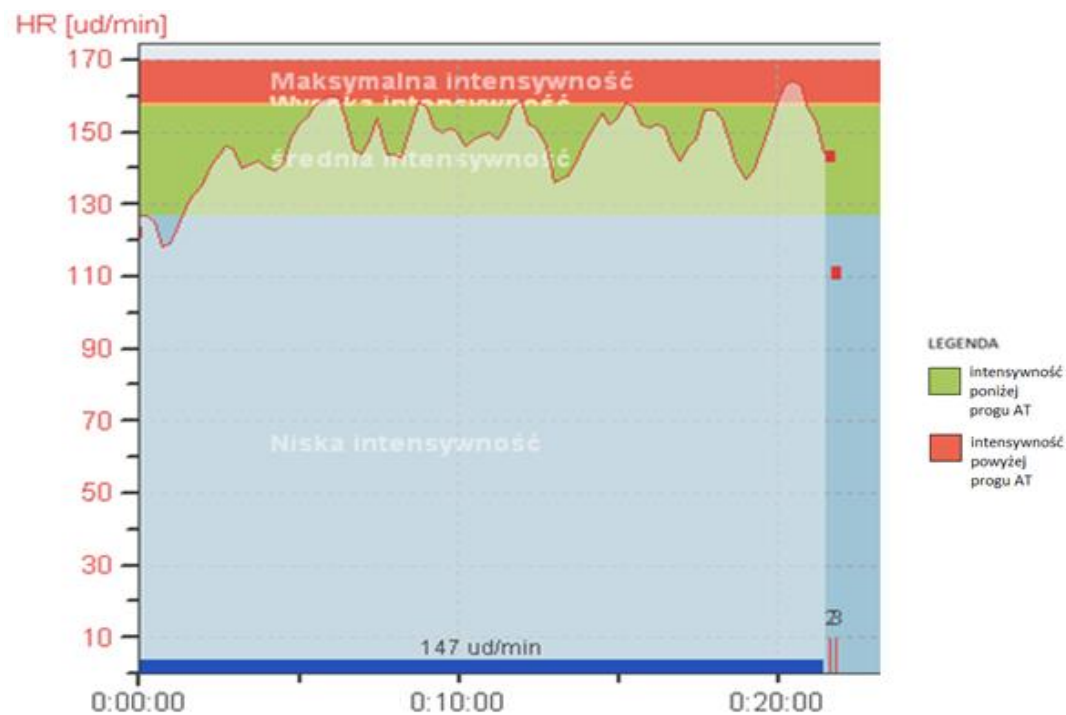
<u>Name and surname:</u>					Date of the first classes:			
<u>Date</u>	<u>Form of physical activity*</u>	The duration of exercise	Subjective intensity perception at RPE scale**		Rest time after exercise ***	Well-being during or after classes /Comments	The reason for absence	<u>Participant's signature</u>
			Aerobic part	Resistance part				
<u>Example</u>	<u>Total Body Condition class</u>	60 min.	7	6	60 min.	Good or e.g. <u>backpain after exercise</u>		

\* You should enter all forms of physical activity, also individually taken, e.g. walking, cycling

\*\* A women should use the RPE scale from 0-10 or 6-20, according to exercise specialist's instructions

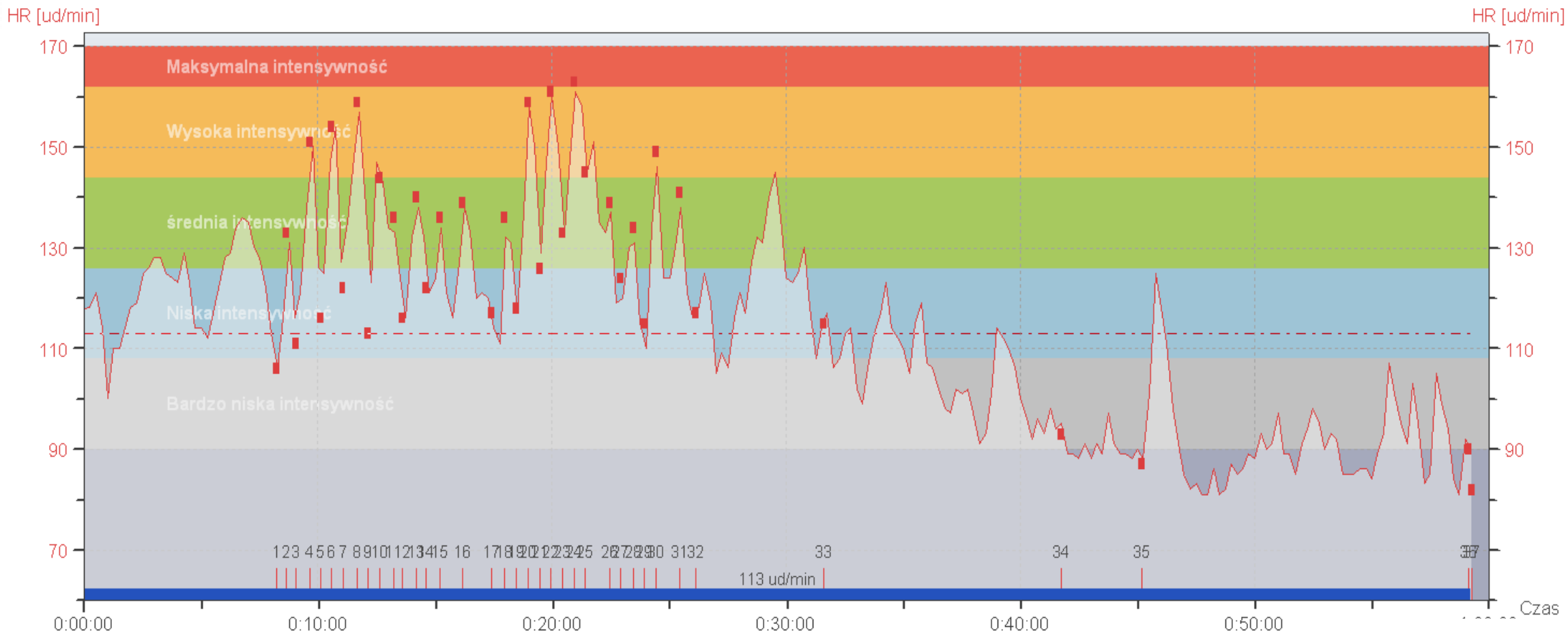
\*\*\* Rest time after exercises (entered at the next class)

## An example of a recording of the heart rate during a FemFit session in pregnancy

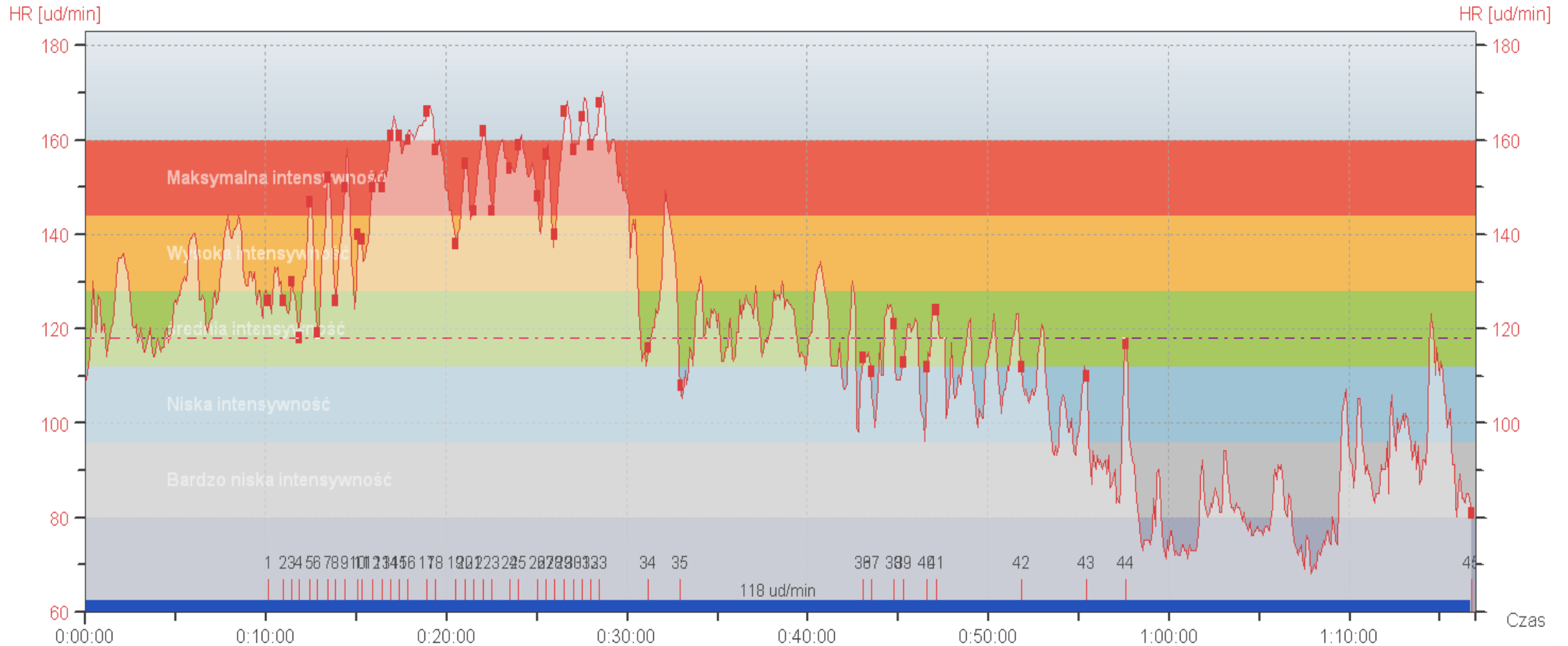




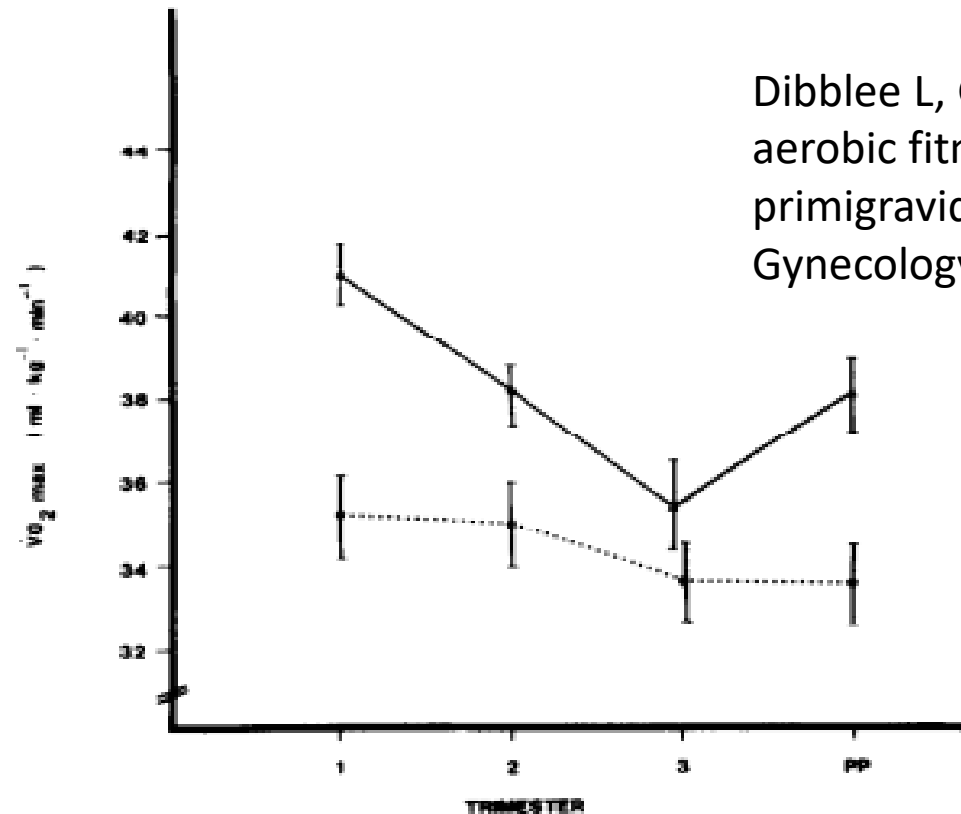
# An example of a recording of the heart rate during a HIIT session in pregnancy - the predominant intensity between the aerobic and anaerobic threshold



# An example of a recording of the heart rate during a HIIT session in pregnancy- predominant intensity above the anaerobic threshold





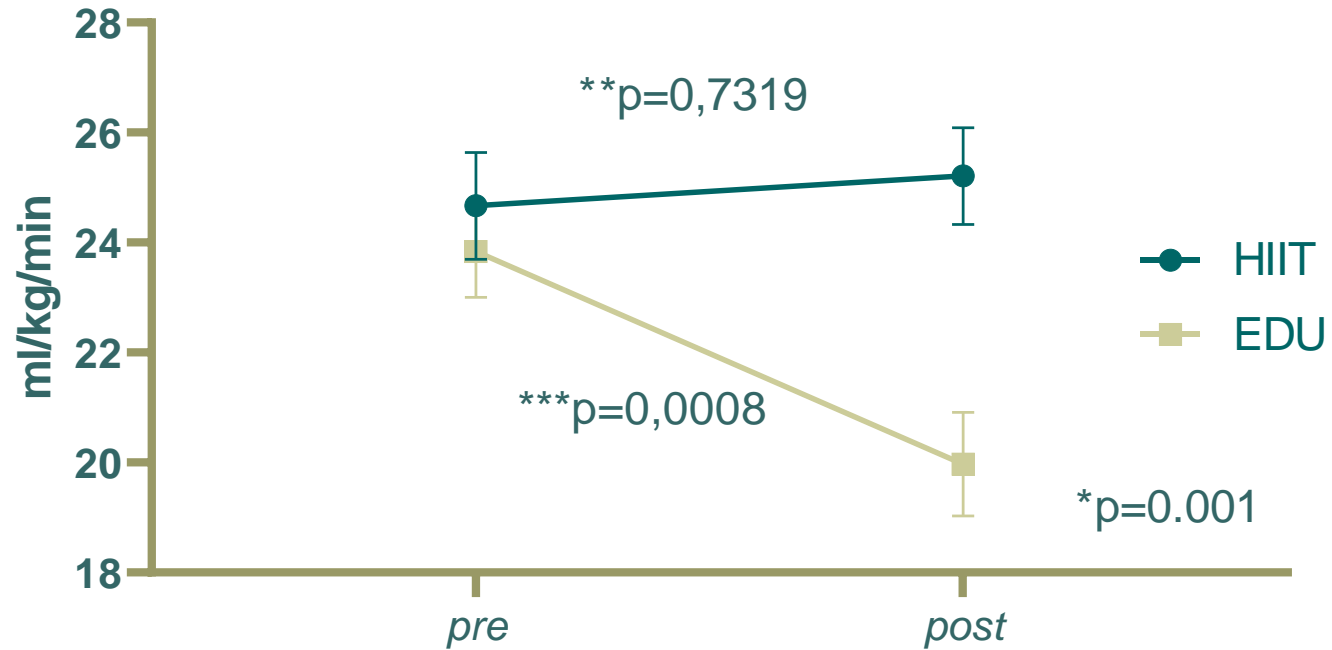


Dibblee L, Graham TE. A longitudinal study of changes in aerobic fitness, body composition, and energy intake in primigravid patients. American Journal of Obstetrics & Gynecology. 1983;147(8):908-14.

**Fig. 2.** Aerobic fitness levels of the fit and unfit women. The mean  $\dot{V}O_2$  max ( $\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ ) data are organized as in Fig. 1. Values in the fit group were significantly ( $P < 0.05$ ) greater than those in the unfit group at all except the third-trimester test. The pooled data for all 16 women (the group) declined significantly ( $p < 0.05$ ) each trimester, and the postpartum data for both the group and for the fit women were significantly lower ( $p < 0.05$ ) than those of the first trimester.

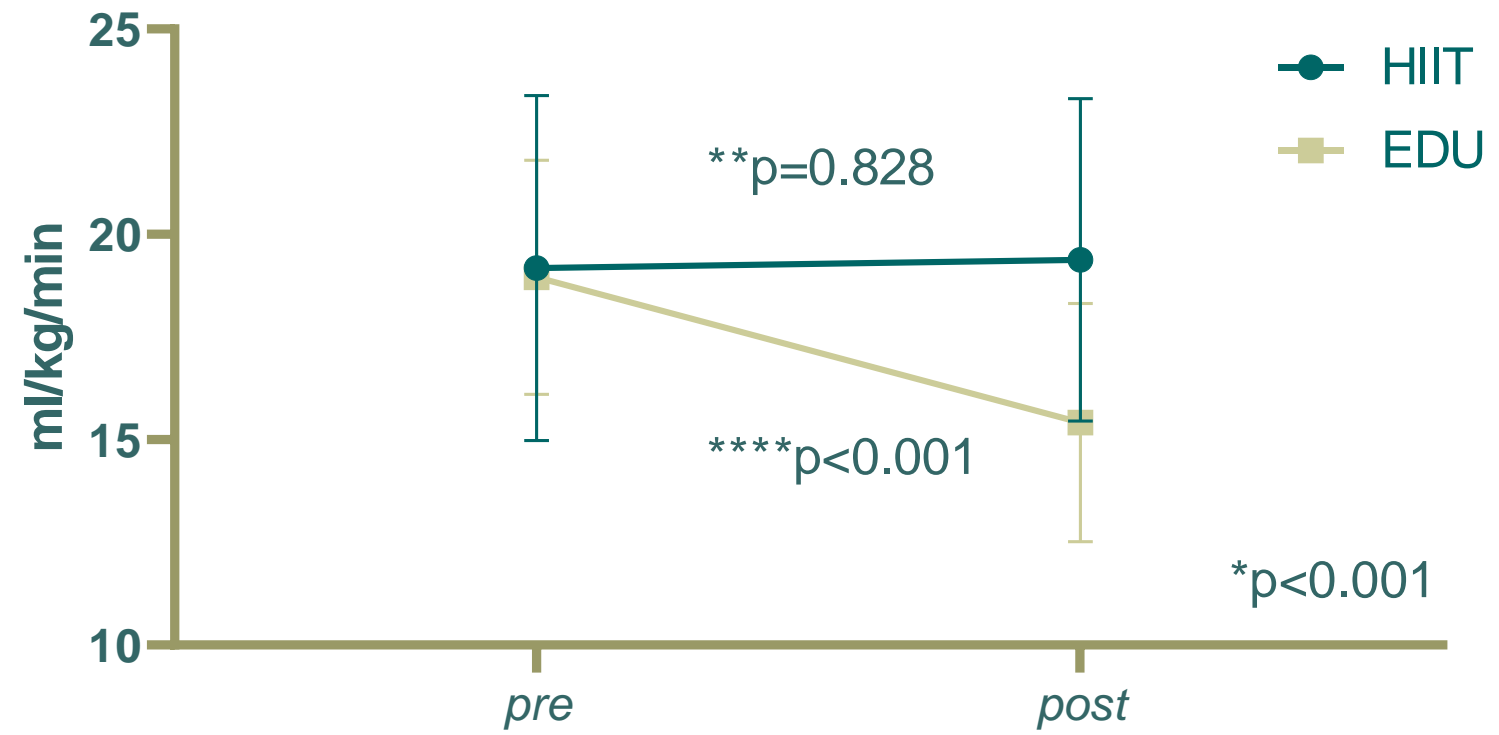
# Changes in the maximum oxygen uptake level after the 8-week program

### VO<sub>2</sub> pre and post intervention



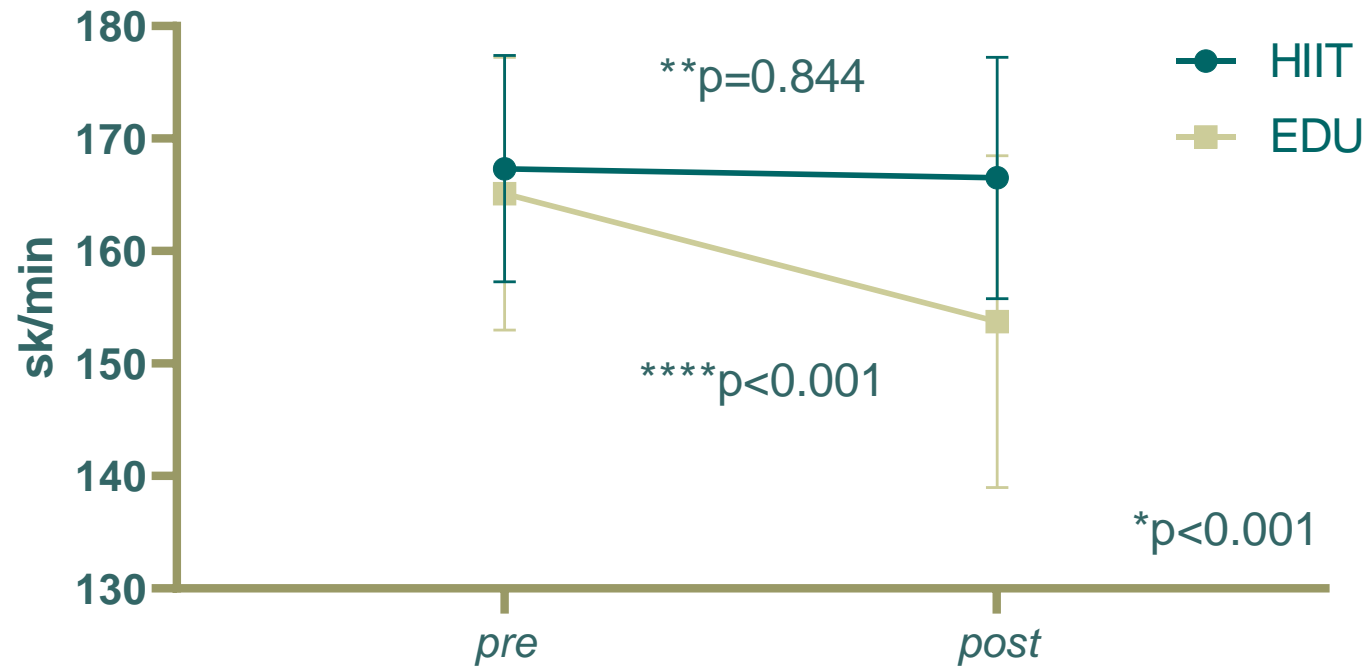
# Changes in $VO_2/AT$ after the 8-week program

## $VO_2/AT$ pre and post intervention



# Changes in maximum heart rate level after the 8-week program

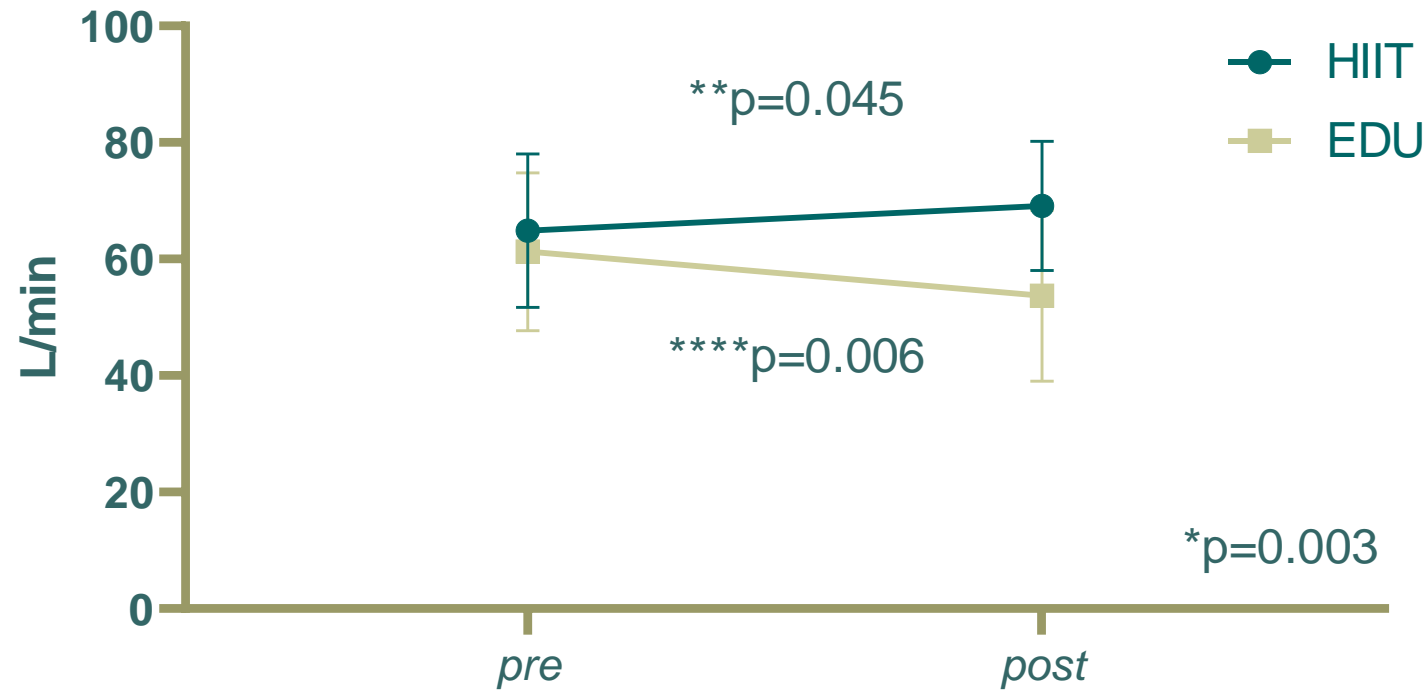
### HR pre and post intervention





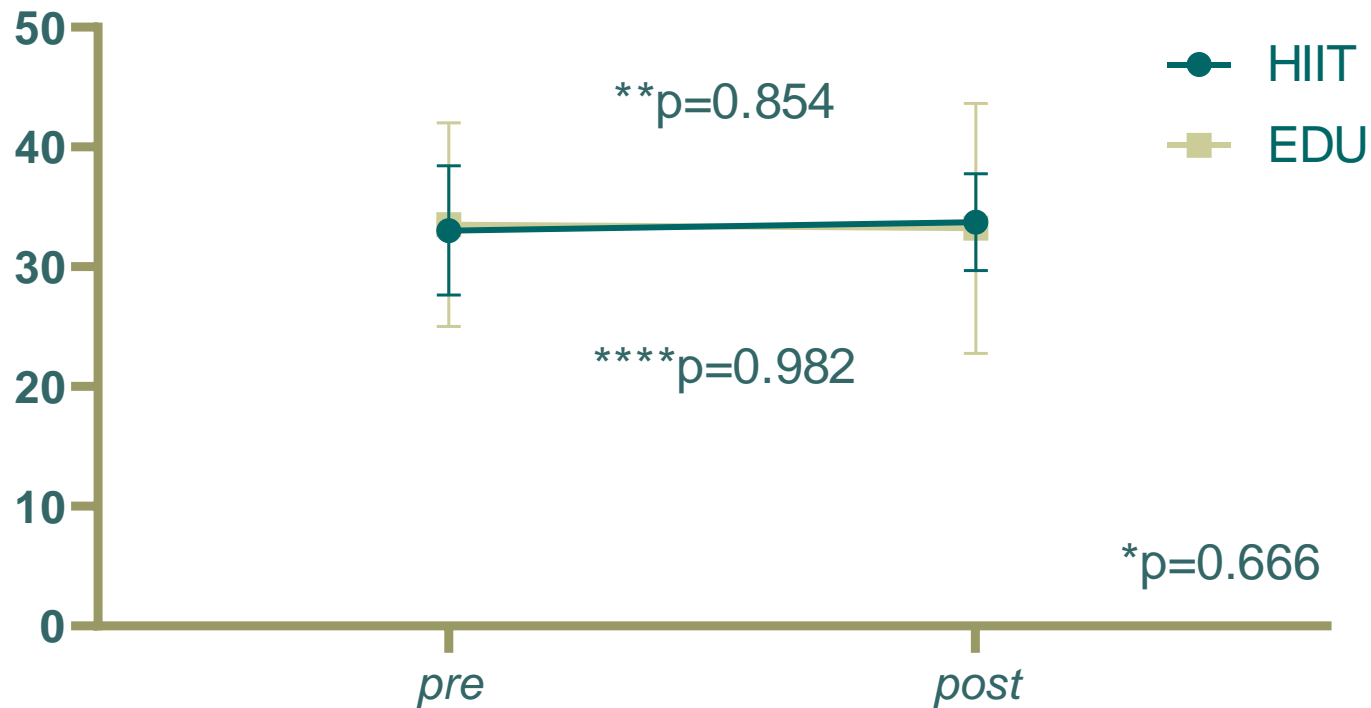
# Changes in the maximum minute ventilation level after the 8-week program

### VE pre and post intervention



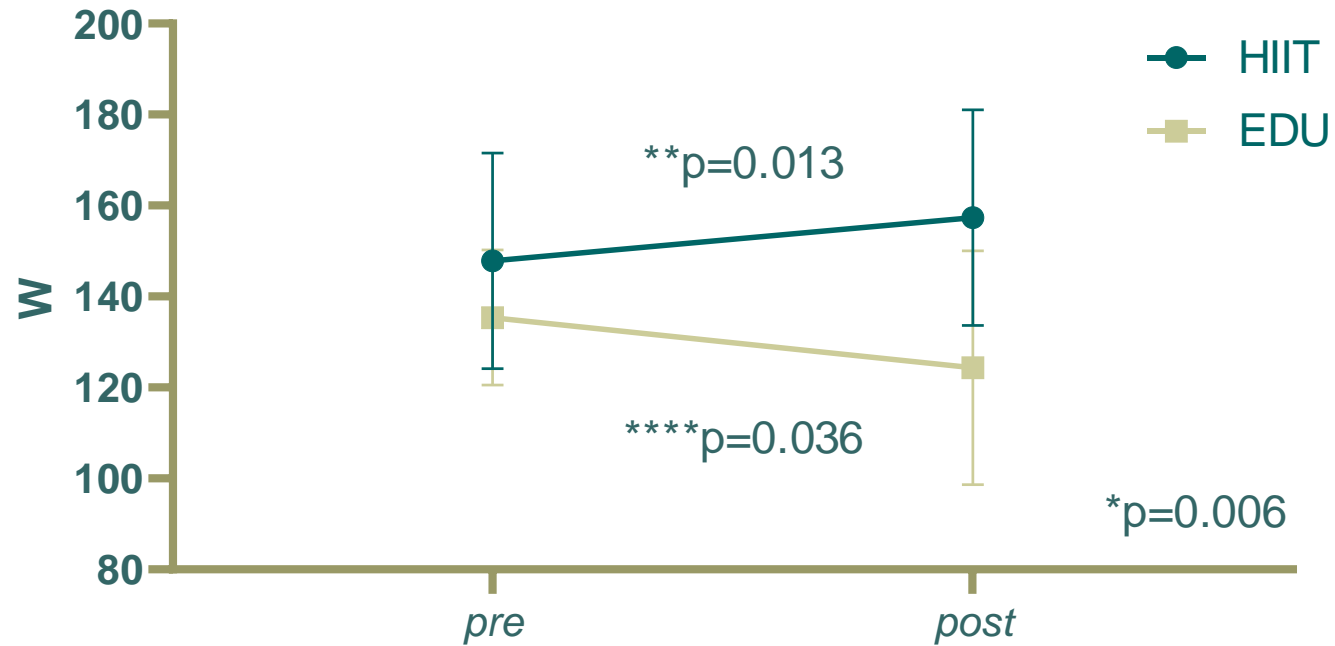
# Changes in the maximal breathing frequency after the 8-week program

### BF pre and post intervention

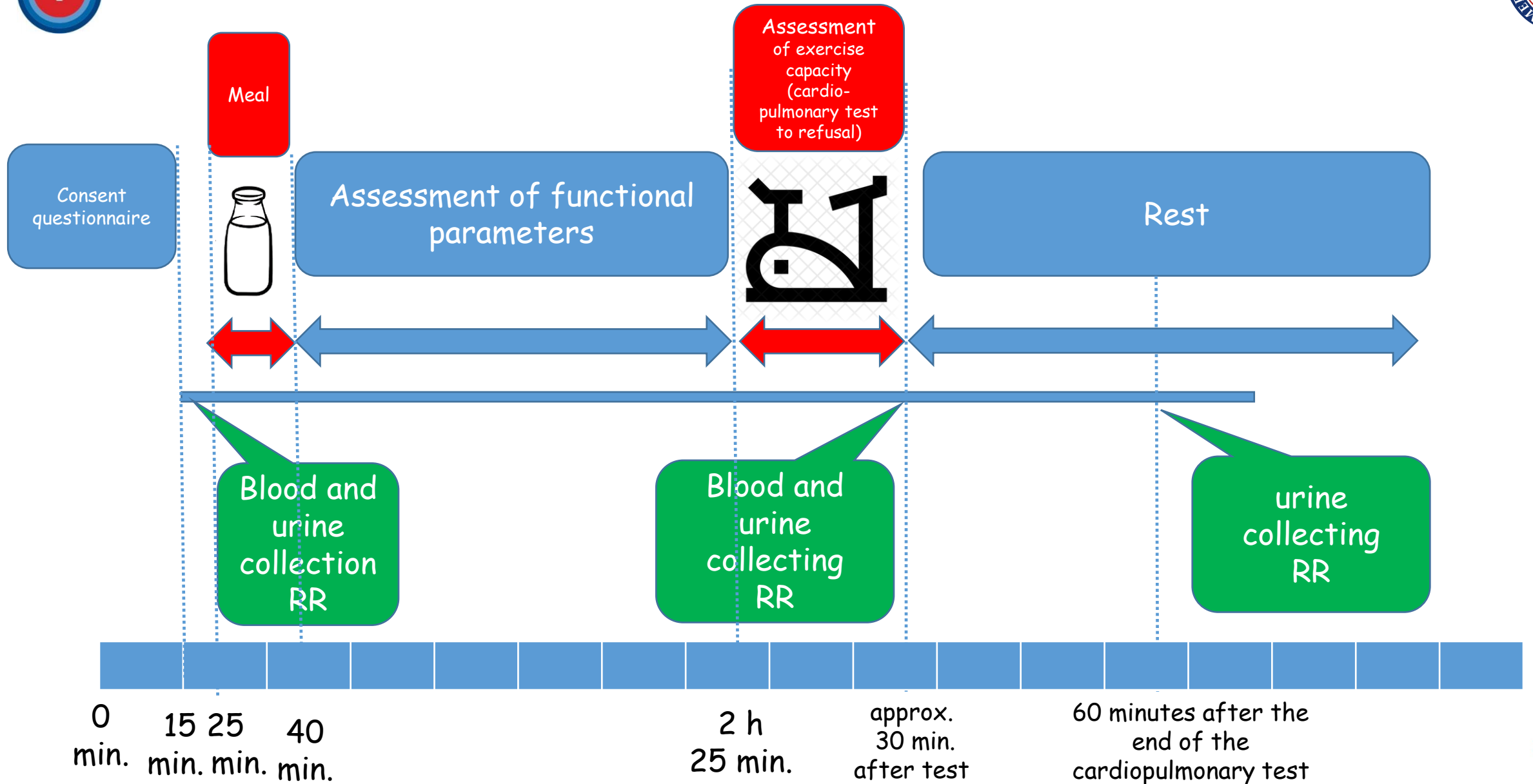


# Changes in the minute ventilation level after the 8-week program

### LOAD pre and post intervention



# Blood, urine and blood pressure assessment before and after 8-week intervention



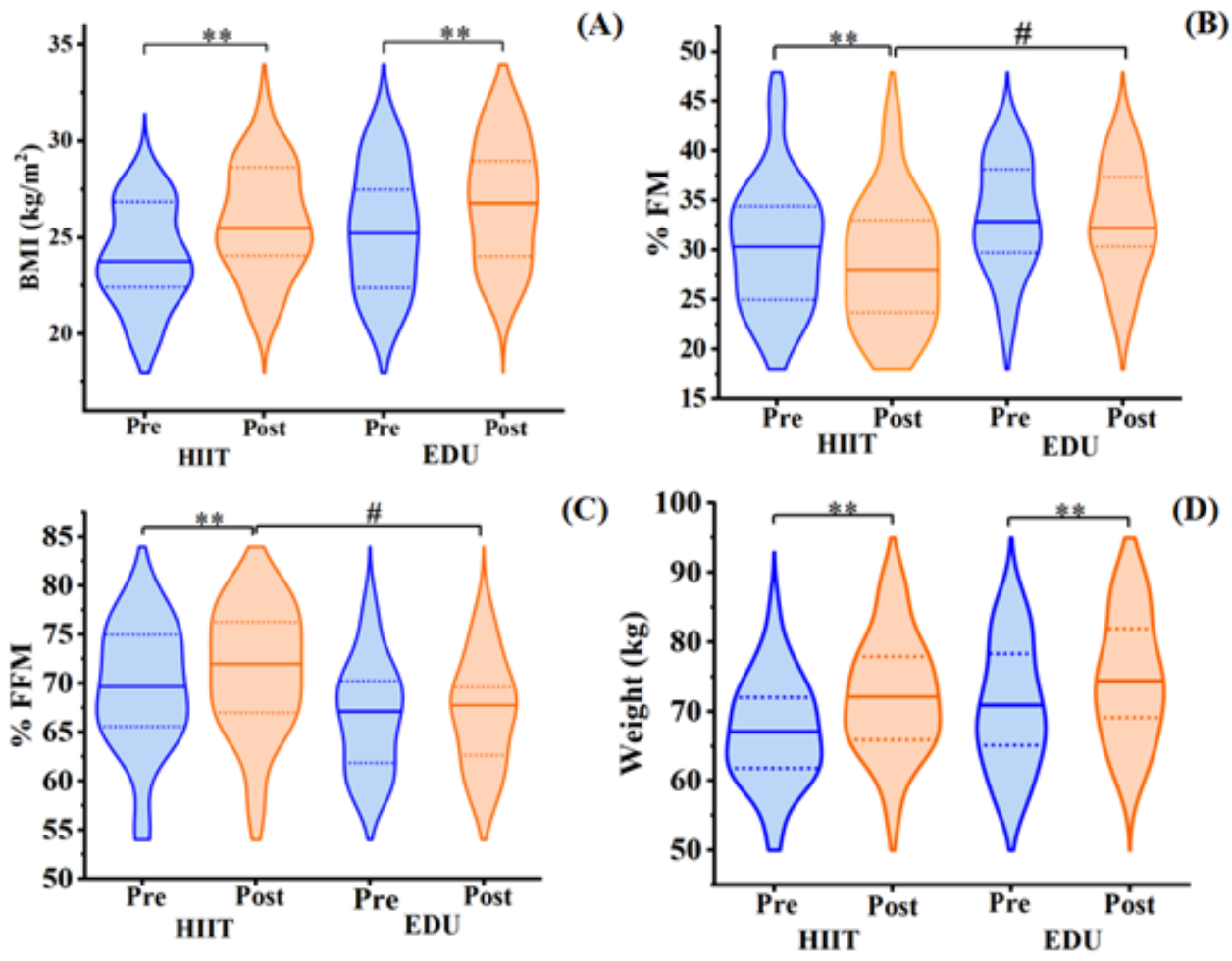
# Changes in the the selected glucose and lipid metabolism markers in serum after 8 weeks of HIIT programme

Variable	HIIT Group (n = 34)		p-value **	EDU Group (n = 19)		p-value ***
	Pre-intervention (mean ± SD)	Post-intervention (mean ± SD)		Pre-intervention (mean ± SD)	Post-intervention (mean ± SD)	
fasting blood glucose level [mg/dL]	80.1±4.4	80.8 ±6.8	0.812	80.8±5.5	76.7±10.8	0.023
glycated hemoglobin (HbA1c)[%]	4.8±0.2	5.0±0.2	0.004	4.9±0.2	5.0±0.2	0.015
Total cholesterol	232±47	265±45	<0.001	234±32	248±33	0.014
HDL-Cholesterol	89± 17	85±16	0.386	85±11	86±32	0.959
LDL- Cholesterol	141±46	169±46	<0.001	139±31	150±28	0.040
Not HDL-Cholestorol	143±46	179±48	<0.001	150±28	165±33	0.001
Triglicerides	137±46	187±63	<0.001	153±52	183±54	0.004

Results are presented as mean ± SE and statistical significance of differences between groups were determined using two-way ANOVA for repeated measures (\*p) with Sidak's multiple comparisons test for determined significance of changes after 8 weeks of interventions for HIIT (\*\*p) or educational (\*\*\*p) group



The violin plots (A-D) show a full distribution of the median (central line) and interquartile range (lower and upper lines) of body composition before and after 8 weeks of high-intensity interval training (HIIT) and education (EDU). Abbreviations: BMI, body mass index; %FM, fat mass percentage; %FFM, fat-free mass percentage. Analysis via ANOVA (# =  $p < 0.01$  and paired Wilcoxon tests (\*\* =  $P < 0.01$ ).



# How to protect pelvic floor muscles in HITT?



## Electromyography...



*"..is the study of muscle function through the inquiry of the electrical signal the muscles emanate."*

Fig. 2: Basmajian & DeLuca: Definition Muscles Alive (2 - p. 1)

ISRCTN92265528 DOI 10.1186/ISRCTN92265528

Pelvic floor muscle training with surface electromyography

Electromyography (EMG) is an experimental technique concerned with the development, recording and analysis of myoelectric signals. Myoelectric signals are formed by physiological variations in the state of muscle fiber membranes (Basmajian & De Luca, 1985).

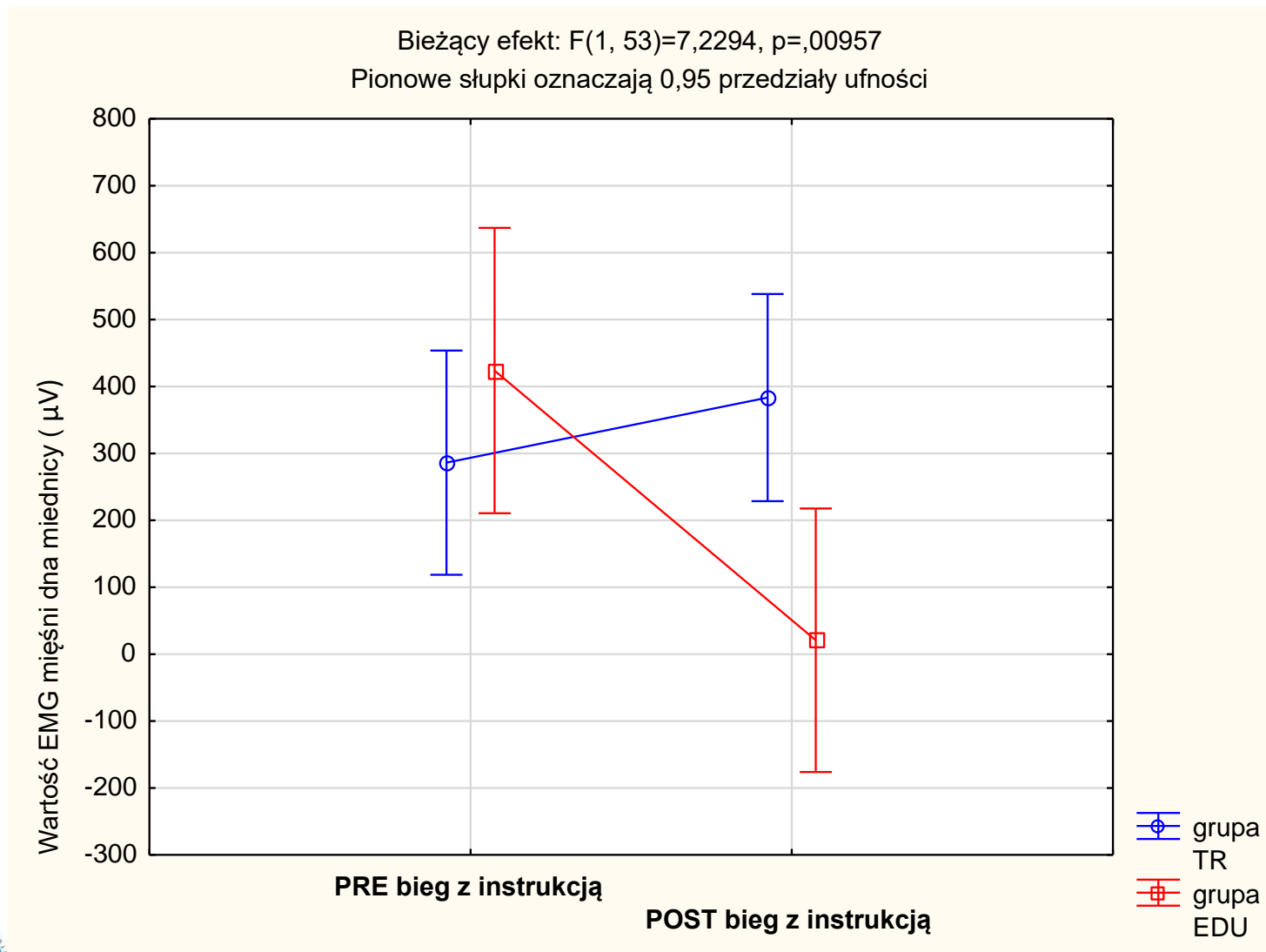
EMG pelvic floor muscles evaluation with the NORAXON EMG & Sensors System, using vaginal probes.



Internet, :2013.07.04



# The EMG level of PFM during running after HIIT Mama intervention



[https://a57.foxnews.com/media2.foxnews.com/2015/10/16/0/0/pregant\\_running\\_1280.jpg?ve=1](https://a57.foxnews.com/media2.foxnews.com/2015/10/16/0/0/pregant_running_1280.jpg?ve=1)



## RESEARCH

## Open Access

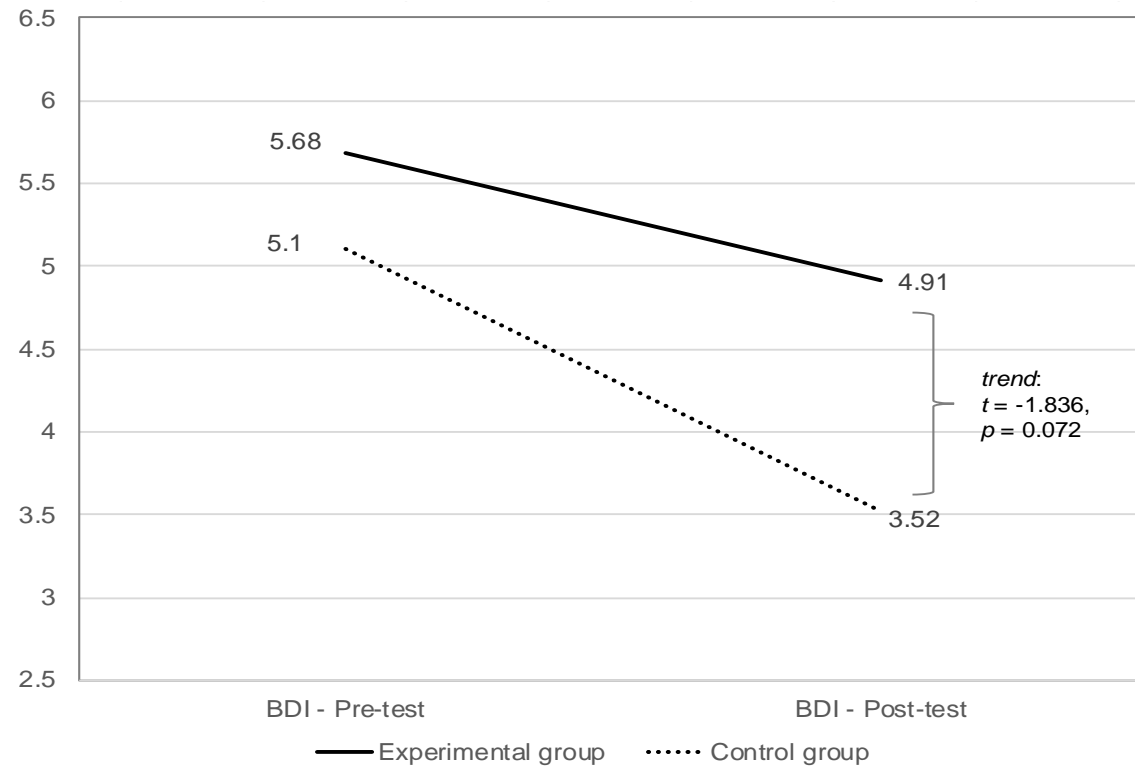
# Can we hit prenatal depression and anxiety through HIIT? The effectiveness of online high intensity interval training in pregnant women during the COVID-19 pandemic: a randomized controlled trial



Dominika Wilczyńska<sup>1\*</sup>, Tamara Walczak-Kozłowska<sup>2</sup>, Łukasz Radzimiński<sup>1</sup>, Miguel Ángel Oviedo-Caro<sup>3</sup>, Rita Santos-Rocha<sup>4,5</sup> and Anna Szumilewicz<sup>1</sup>

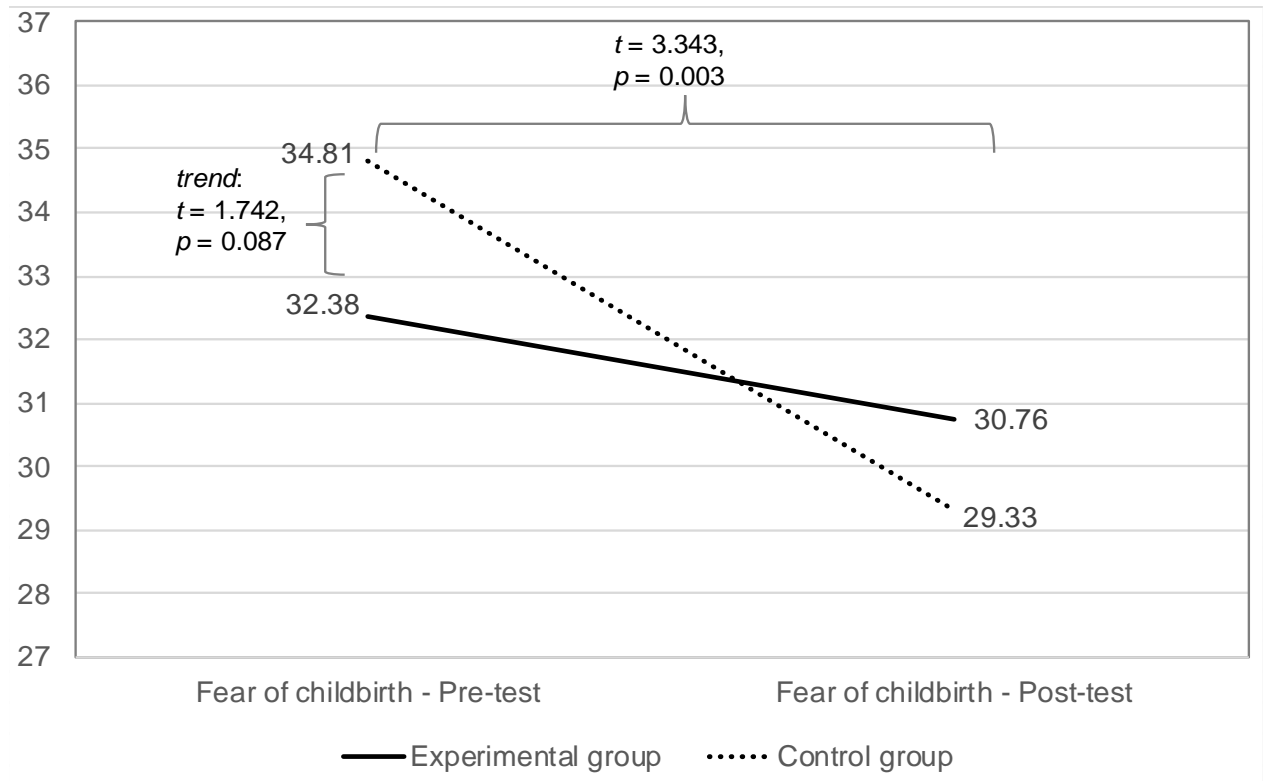
<https://www.sensity.pl/wp-content/uploads/2017/06/depresja-w-ciazy.jpg>

The differences in the severity of depressive symptoms (measured with the BDI) between HIIT and control group before and after the intervention.

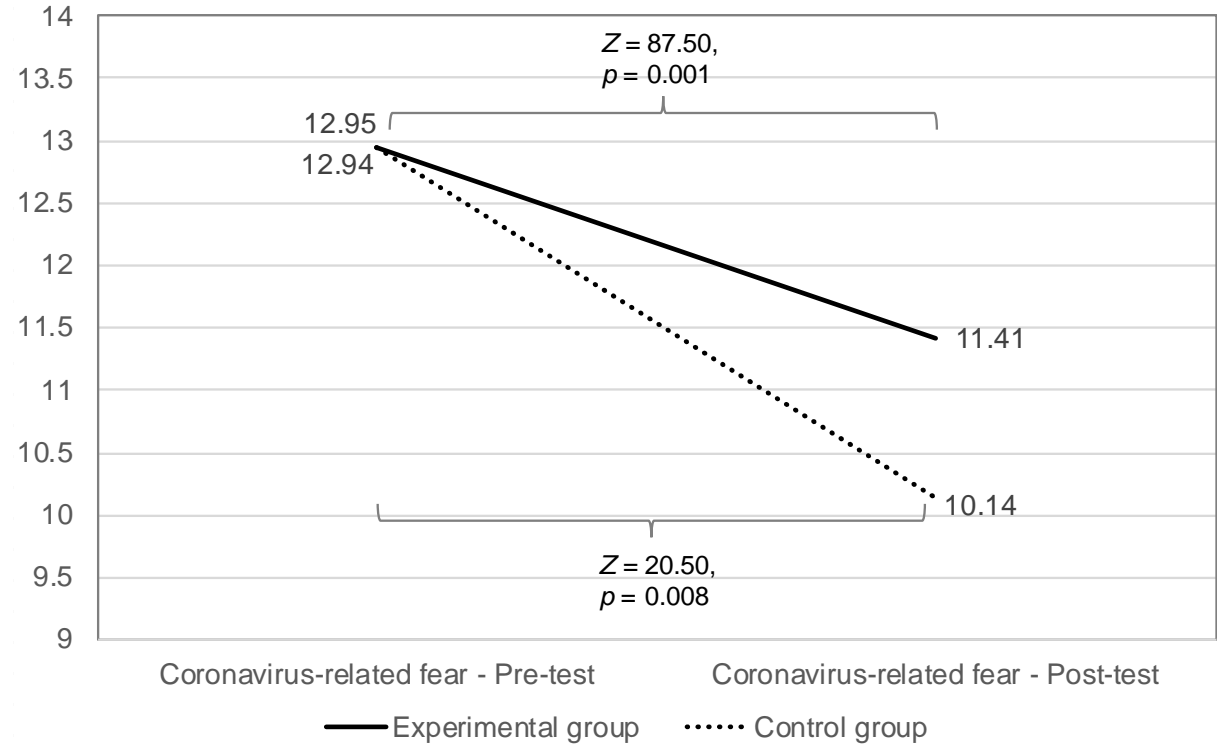




*The differences in the severity of fear of childbirth between HIIT and control group before and after the intervention.*



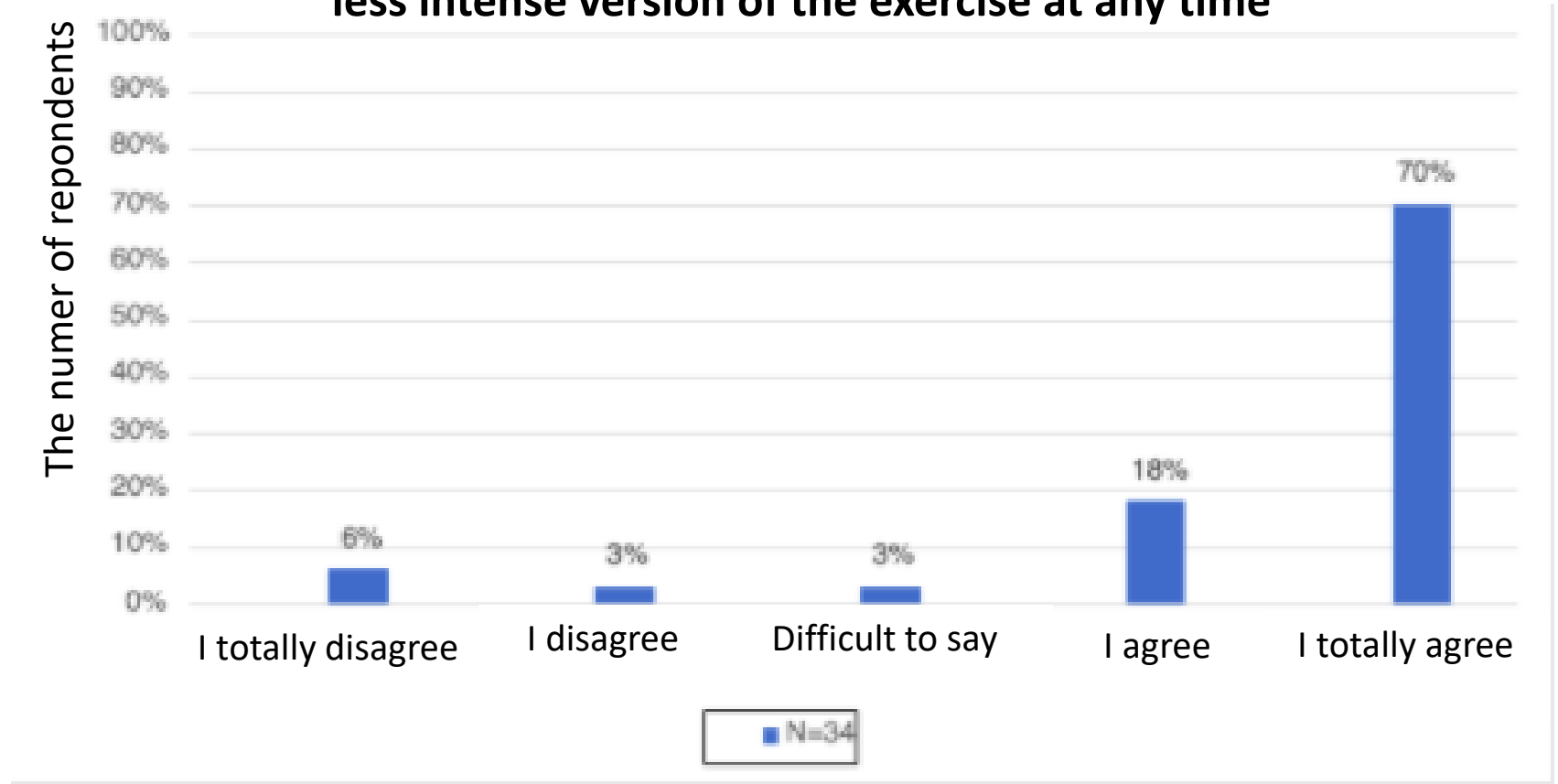
*The differences in the severity of the coronavirus-related fear between experimental and control group before and after the intervention.*



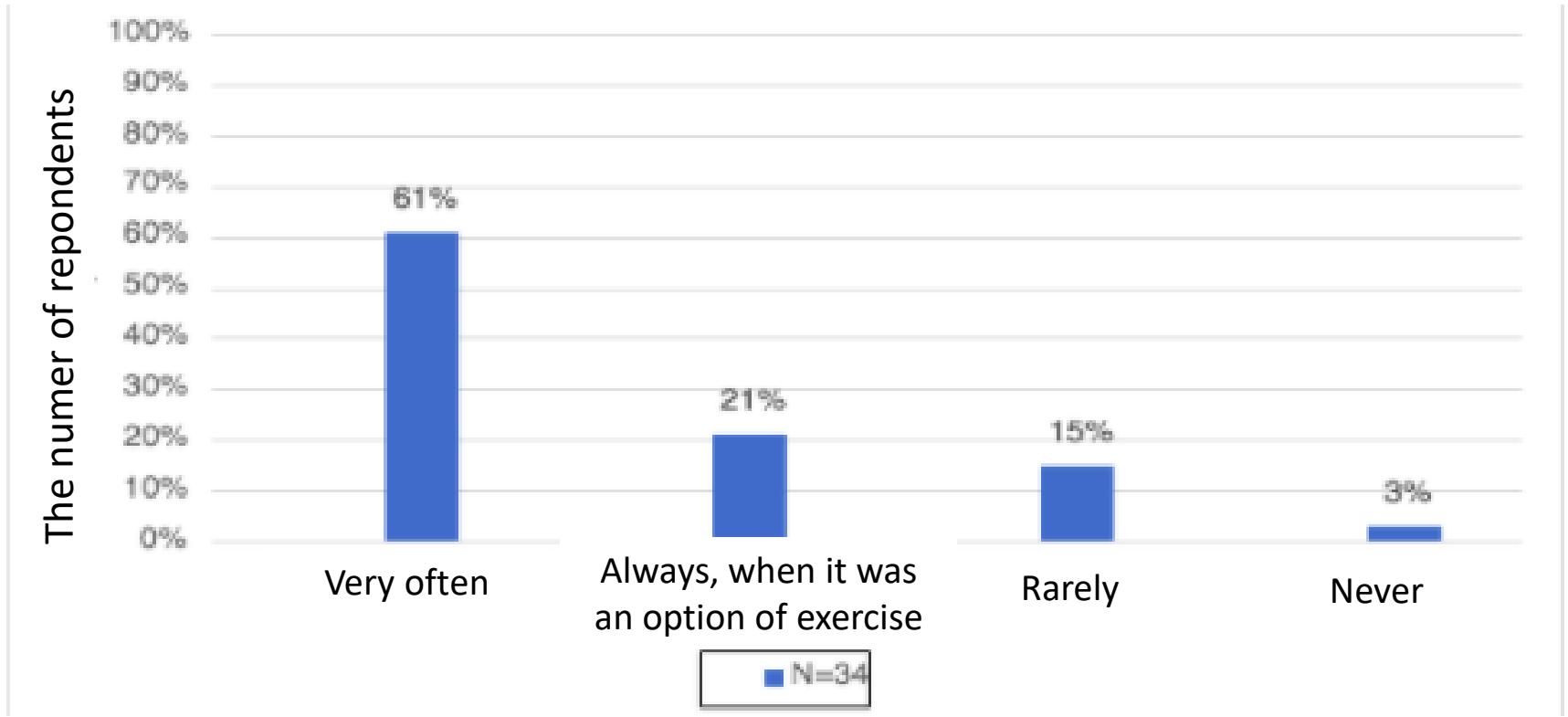
## The opinions of the HIIT Mama project participants



The program was very intense, but I could switch to the less intense version of the exercise at any time

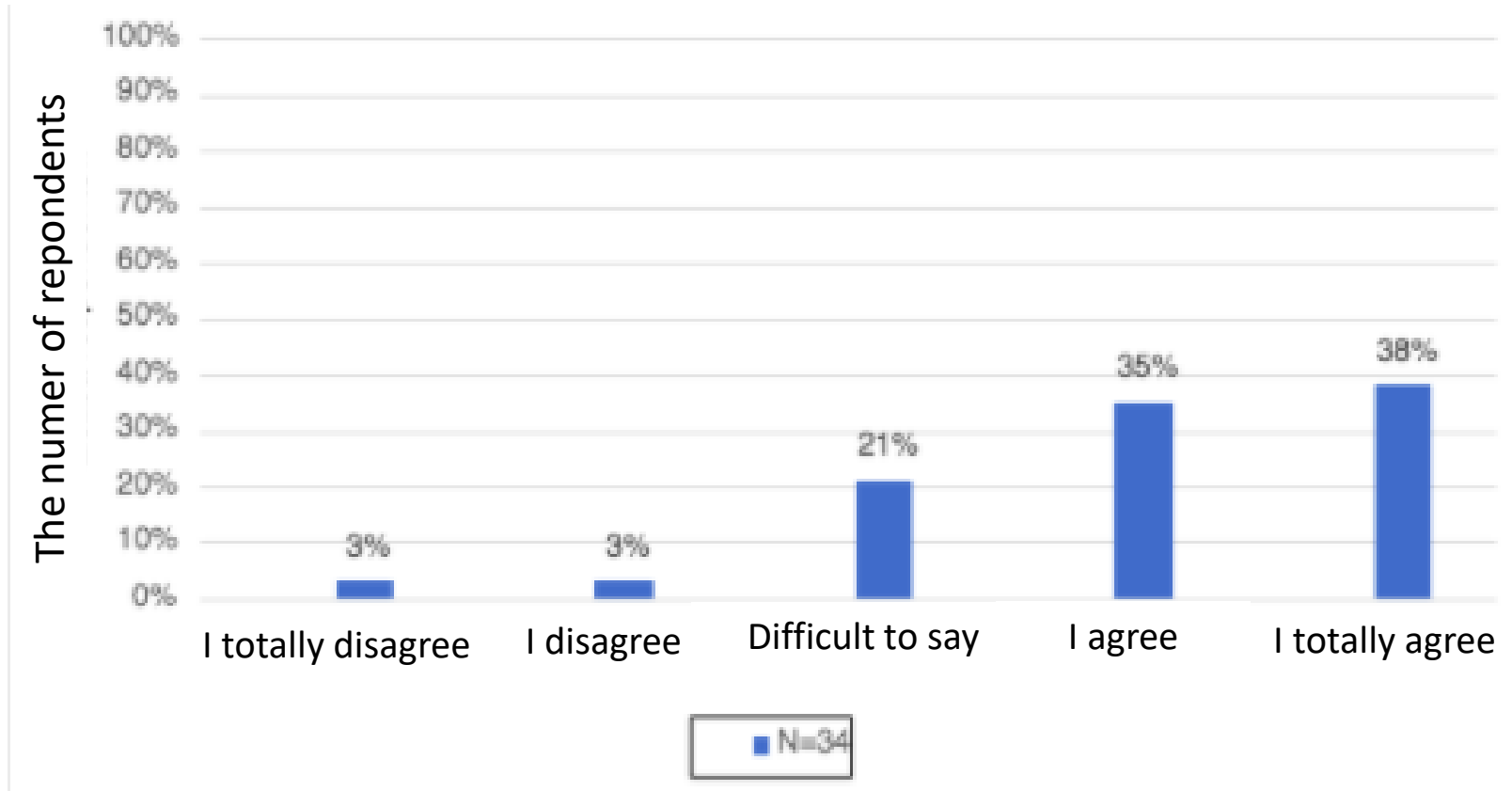


### During the classes you performed versions of exercises with running and jumping





### I felt as comfortable during online classes as during traditional classes







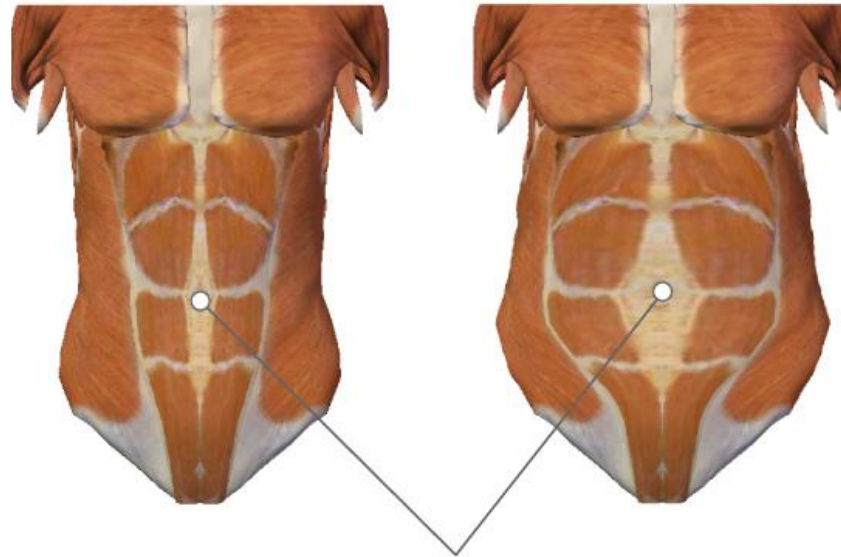
**Thank you for your attention**





# Abdominal muscle exercises

## Diastasis Recti

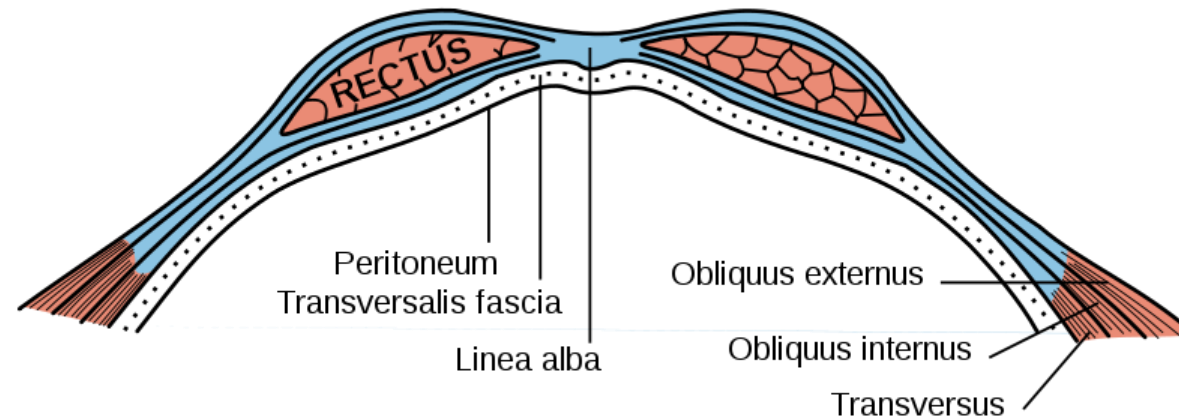


Separation of the Rectus Abdominis  
as the abdomen expands

source: visiblebody & core concepts

<http://www.coreconcepts.com.sg/mcr/pregnancy-changes-and-aches/> 22.06.2013

Both before and during the exercise program, pregnant women should control the condition of their abdomen in terms of diastasis recti abdominis (DRA). It is a separation of the two rectus abdominis muscles along the linea alba, which appears in 66 to 100% of women in third trimester (Benjamin et al., 2014) and in 39% women at 6 months postpartum (Mota et al. 2018).





Diastasis recti abdominis test should be performed as follows: lying back, legs bent, head and shoulder blades raised (as in abdominal crunch).



1. Some years ago, the test was considered positive with palpation **of  $\geq 2$  fingerbreadths** 4.5 cm above, at, or 4.5 cm below the umbilicus (Boissonnault & Blaschak, 1988; Kari Bø, Hilde, Tennfjord, Sperstad, & Engh, 2017).

2. According to the recent study (Mota, Pascoal, Carita, & Bo, 2018) evaluating the normal width of the linea alba in first-time pregnant women the researchers found: during pregnancy at the 35-41 week of gestation, the 20th and the 80th percentile corresponded to:

- **49-79 mm at 2 cm below the umbilicus,**
- **54-86 mm at 2 cm above the umbilicus,**
- **44-79 mm at 5 cm above the umbilicus.**

At 6 months postpartum, the 20th and the 80th percentile corresponded to

- **9-21 mm at 2 cm below the umbilicus**
- **17-28 mm at 2 cm above the umbilicus**
- **12-24 mm at 5 cm above the umbilicus.**

3. Woman require consultation with a doctor or physiotherapist when they observe **hernia** or **feel pain** in the abdomen area even if the separation is smaller than above numbers.



# What exercises are recommended for DRA?

[J Orthop Sports Phys Ther. 2015 Oct;45\(10\):781-8. doi: 10.2519/jospt.2015.5459. Epub 2015 Aug 24.](#)

## The Immediate Effects on Inter-rectus Distance of Abdominal Crunch and Drawing-in Exercises During Pregnancy and the Postpartum Period.

[Mota P<sup>1</sup>](#), [Pascoal AG](#), [Carita AI](#), [Bø K](#).

The acute response on inter-rectus distance (IRD) produced by **drawing-in exercise** was a widening of the IRD in postpartum, while **the abdominal crunch exercise** induced an acute narrowing response of the IRD in pregnancy and in postpartum (Mota, Pascoal, Vaz, et al., 2018).



# Immediate Effect of Abdominal and Pelvic Floor Muscle Exercises on Interrecti Distance in Women With Diastasis Recti Abdominis Who Were Parous

Sandra B Gluppe<sup>1</sup>, Marie Ellström Engh<sup>2</sup>, Kari Bø<sup>3</sup>



Original paper

### Diastasis of rectus abdominis muscles: patterns of anatomical variation as demonstrated by ultrasound

Antonio Corvino<sup>1A,B,C,D,E,F,G</sup>, Dario De Rosa<sup>2B</sup>, Carolina Sbordone<sup>3B</sup>, Antonio Nunziata<sup>2D</sup>, Fabio Corvino<sup>4A,F</sup>, Carlo Varelli<sup>2G</sup>, Orlando Catalano<sup>2A,B,C,D,E,F,G</sup>

<sup>1</sup>Department of Motor Science and Wellness, University of Naples "Parthenope", Naples, Italy

<sup>2</sup>Radiology Unit, Istituto Diagnostico Varelli, Naples, Italy

<sup>3</sup>Department of Medicine and Health Science, "Vincenzo Tiberio" Molise University, Campobasso, Italy

<sup>4</sup>Department of Vascular and Interventional Radiology, Cardarelli Hospital, Naples, Italy

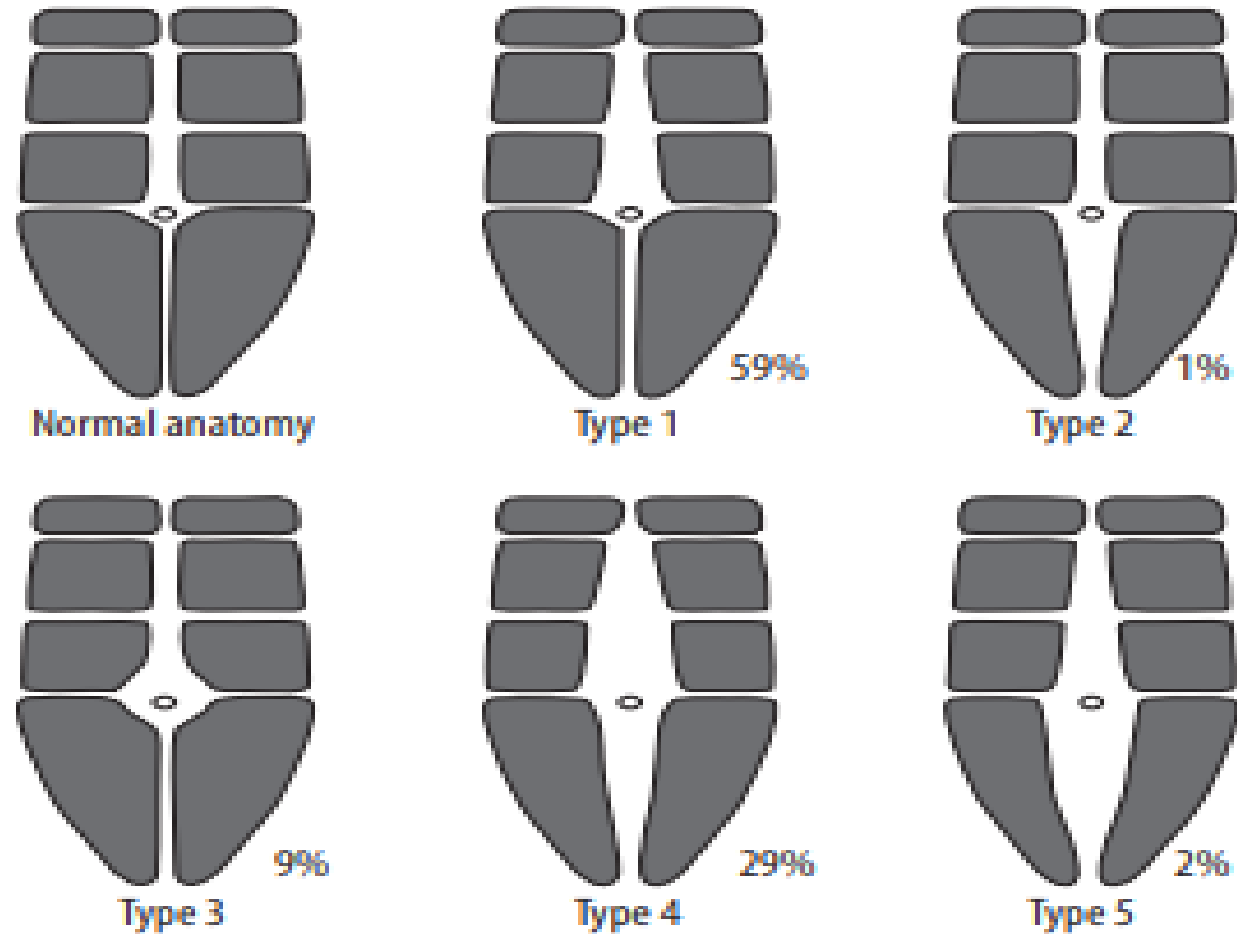


Figure 2. Schematic drawing of the prevalence of recti muscle diastasis according to the five anatomical patterns categorised in this study



Original paper

## Diastasis of rectus abdominis muscles: patterns of anatomical variation as demonstrated by ultrasound

Antonio Corvino<sup>1A,B,C,D,E,F,G</sup>, Dario De Rosa<sup>2B</sup>, Carolina Sbordone<sup>3B</sup>, Antonio Nunziata<sup>2D</sup>, Fabio Corvino<sup>4A,F</sup>, Carlo Varelli<sup>2G</sup>, Orlando Catalano<sup>2A,B,C,D,E,F,G</sup>

<sup>1</sup>Department of Motor Science and Wellness, University of Naples "Parthenope", Naples, Italy

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<sup>3</sup>Department of Medicine and Health Science, "Vincenzo Tiberio" Molise University, Campobasso, Italy

<sup>4</sup>Department of Vascular and Interventional Radiology, Cardarelli Hospital, Naples, Italy

„Crunches” decrease IRD...

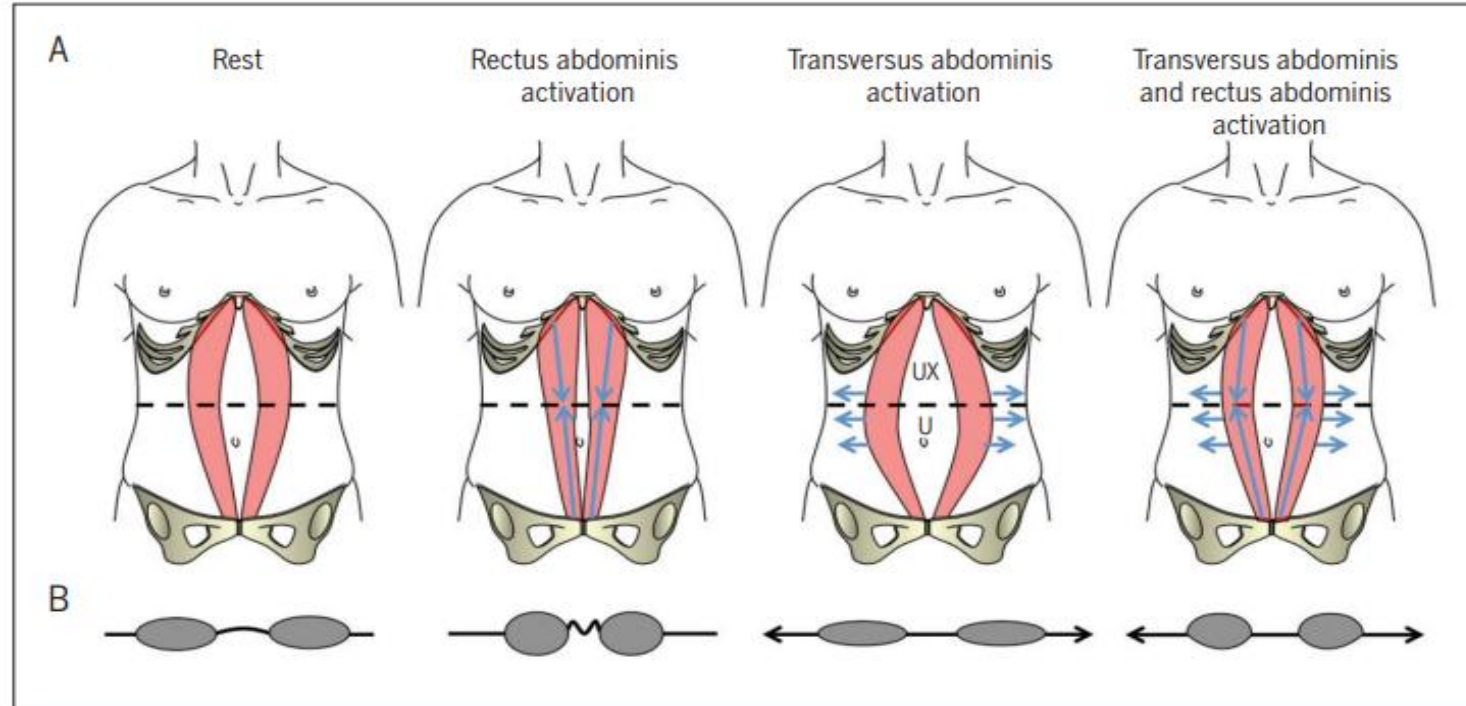
As proven through US observations, the inter-rectus distance can be reduced by isometric contraction of the abdominal muscles, with the subject actively performing an abdominal crunch (crook lying position) [22]. Conversely, the drawing-in exercise, which mainly activates the transverse abdominal and internal oblique muscles, seems to be ineffective in improving diastasis [21]. Surgical repair is mostly done due to aesthetic reasons, and it is basically reserved for severe cases, larger than 5 cm, or when there is an associated hernia [1].

# Behavior of the Linea Alba During a Curl-up Task in Diastasis Rectus Abdominis: An Observational Study

Diane Lee, Paul W Hodges

PMID: 27363572 DOI: 10.2519/jospt.2016.6536

The role of tissue strain in collagen matrix production/healing requires consideration. Although exercise that narrows the IRD is recommended in DRA,<sup>20,26</sup> this may be counterproductive, as decreased mechanical strain reduces fibroblast activity.<sup>9</sup> Increased collagen synthesis to strengthen the LA may be enhanced by stretch.<sup>16</sup>



**FIGURE 1.** Proposed effect of abdominal muscle activation on the inter-rectus distance. (A) Anatomical representation of the rectus abdominis muscle at rest (left panel) and during contraction (middle left panel), contraction of the transversus abdominis (middle right panel), and combined contraction of both transversus abdominis and rectus abdominis muscles (right panel). (B) Cross-sectional representation of the rectus abdominis and interposed linea alba at the location of the dashed lines in (A) during the tasks shown in (A). Note the slackening of the linea alba with narrowing of the inter-rectus distance as the rectus abdominis muscles straighten from the resting curved alignment on contraction. Note the tension of the linea alba from transversus abdominis contraction, and the reduced narrowing of the inter-rectus distance during rectus abdominis contraction combined with transversus abdominis contraction. Abbreviations: U point, just above the umbilicus; UX point, halfway between the U point and the xiphoid.





The effects of a 6 week dynamic core stability plank exercise program compared to a traditional supine core stability strengthening program on diastasis recti abdominis closure, pain, Oswestry disability index (ODI) and pelvic floor disability index scores (PFDI)

Walton et al. Physical Therapy and Rehabilitation 2016,  
<http://www.hoajonline.com/journals/pdf/2055-2386-3-3.pdf>

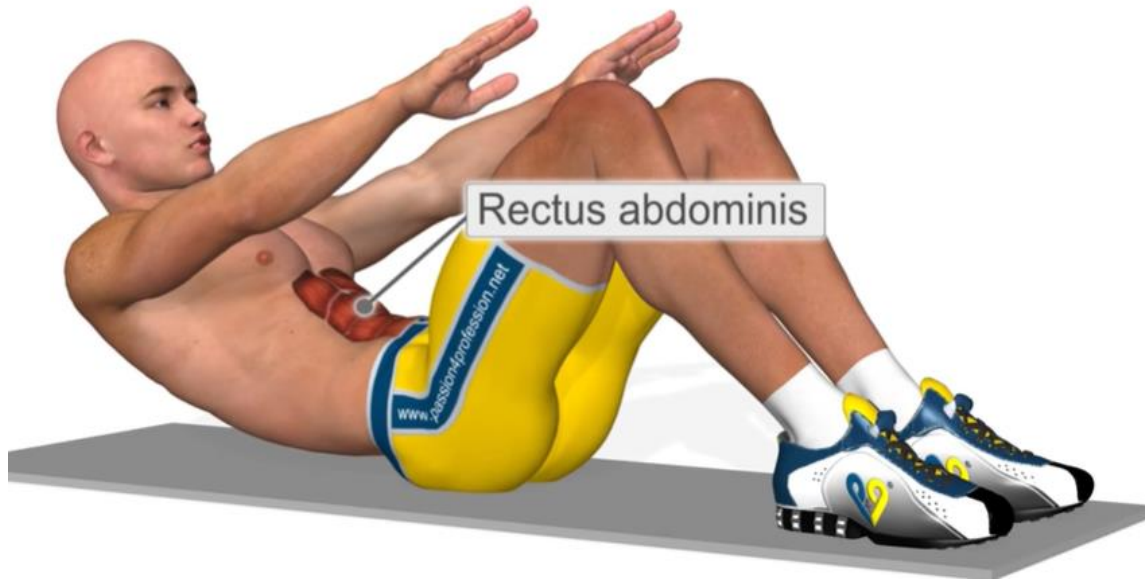
The traditional treatment group	The experimental treatment group
<ul style="list-style-type: none"> <li>- abdominal crunch</li> <li>- posterior pelvic tilt in supine position</li> <li>- kegels</li> <li>- Russian twist</li> </ul>	<ul style="list-style-type: none"> <li>- plank</li> <li>- posterior pelvic tilt in supine position</li> <li>- kegels</li> <li>- Russian twist</li> </ul>
DRA decreased by 2.01 cm	DRA decreased by 1.65 cm
A statistically significant reduction in DRA was observed in both groups	
Both programs significantly reduced the back problems reflected by a lower Oswestry disability index score	



# DO NOT EXCLUDE CRUNCHES FROM THE EXERCISE PROGRAMS FOR PREGNANT AND POSTPARTUM WOMEN!!!



Passion4Profession  
2,58 mln subskrybentów



+ „abdominal bracing”  
(external mechanical assistance to reduce IRD, e.g. with a hand or a piece of cloth)





**Sent:** Monday, June 14, 2021 2:02 PM

**To:** Anna Szumilewicz <anna.szumilewicz@awf.gda.pl>

**Subject:** Rozejście mięśni prostych

Witam Pani Aniu,

Byłam dzisiaj u fizjoterapeutki, żeby obejrzała mój brzuch. W rozluźnieniu mam co najmniej 5 cm rozejścia mięśni prostych natomiast przy aktywacji mięśnie pięknie się schodzą na 1 cm! I to 6 dni po porodzie. Pani fizjoterapeutka mówiła, że to bardzo rzadka sytuacja żeby przy tak dużym rozejściu mięśnie tak ładnie się aktywowały. Dobrze to wróży na przyszłość :-)) to kolejna zasługa programu HIIT mama 🙏 🙏 🙏 Dziękuję jeszcze raz, za cały program!!!

Pozdrawiam serdecznie,





## Chapter 9

### Exercise selection and adaptations during pregnancy

Anna Szumilewicz<sup>1</sup> and Rita Santos-Rocha<sup>2</sup>



## Chapter 9

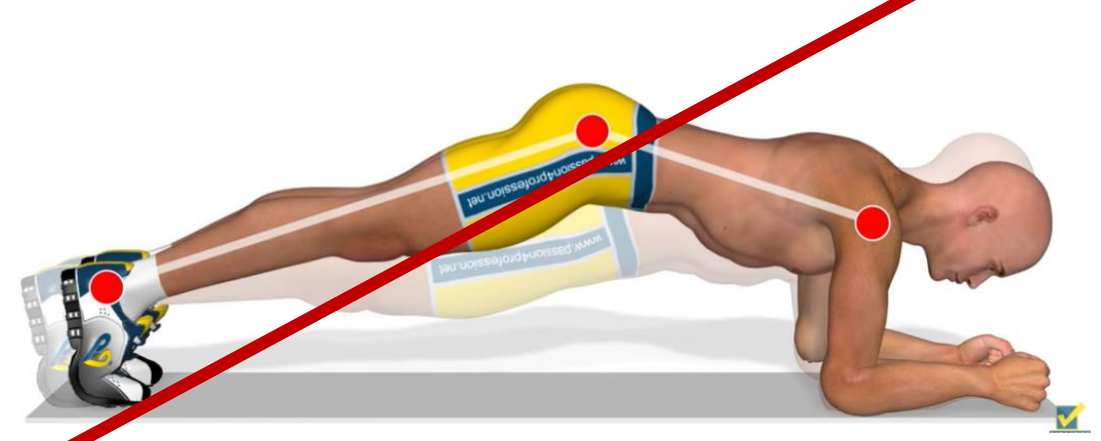
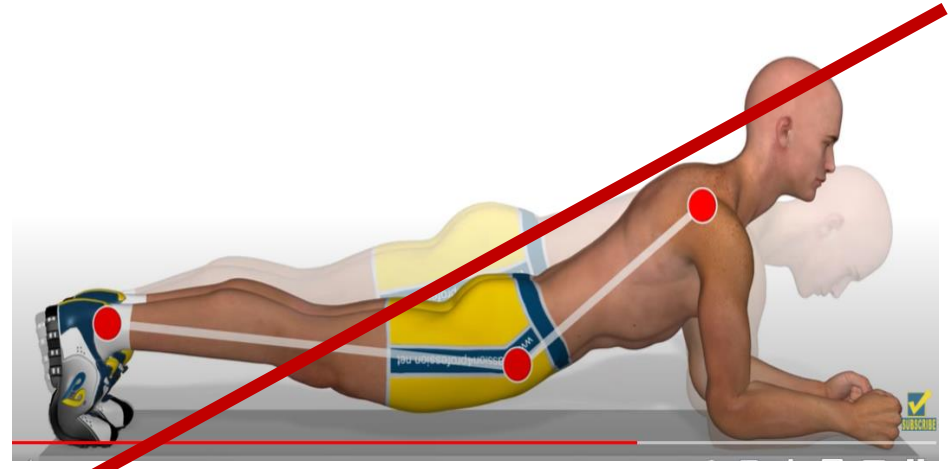
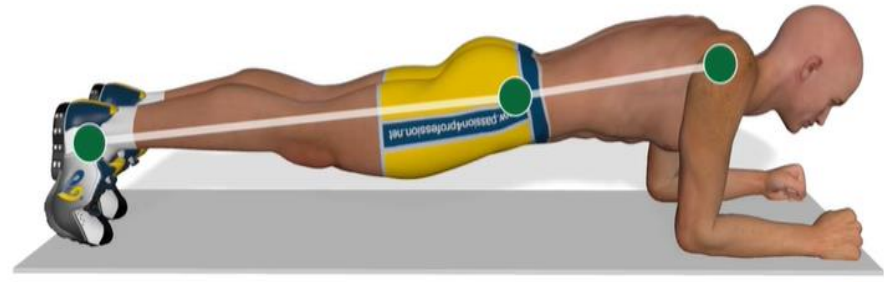
### Exercise selection and adaptations during pregnancy

Anna Szumilewicz<sup>1</sup> and Rita Santos-Rocha<sup>2</sup>



# CO Z PLANKAMI W CIĄŻY I PO PORODZIE?

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[Strong abs exercises: Plank - YouTube](#)




# What about the planks during pregnancy and postpartum..?



**Maintain proper abdominal muscles activation, body alignment, and observe the IRD.**

**GUIDELINES**

## An exercise program throughout pregnancy: Barakat model

Ruben Barakat 



Supported knee position in pregnancy...



## Oswestry Low Back Pain Disability Questionnaire

---

Sources: Fairbank JCT & Pynsent, PB (2000) The Oswestry Disability Index. *Spine*, 25(22):2940-2953.

Davidson M & Keating J (2001) A comparison of five low back disability questionnaires: reliability and responsiveness. *Physical Therapy* 2002;82:8-24.

The Oswestry Disability Index (also known as the Oswestry Low Back Pain Disability Questionnaire) is an extremely important tool that researchers and disability evaluators use to measure a patient's permanent functional disability. The test is considered the 'gold standard' of low back functional outcome tools <sup>[1]</sup>.

## Interpretation of scores

<b>0% to 20%: minimal disability:</b>	The patient can cope with most living activities. Usually no treatment is indicated apart from advice on lifting sitting and exercise.
<b>21%-40%: moderate disability:</b>	The patient experiences more pain and difficulty with sitting, lifting and standing. Travel and social life are more difficult and they may be disabled from work. Personal care, sexual activity and sleeping are not grossly affected and the patient can usually be managed by conservative means.
<b>41%-60%: severe disability:</b>	Pain remains the main problem in this group but activities of daily living are affected. These patients require a detailed investigation.
<b>61%-80%: crippled:</b>	Back pain impinges on all aspects of the patient's life. Positive intervention is required.
<b>81%-100%:</b>	These patients are either bed-bound or exaggerating their symptoms.

# Pelvic floor exercises (5-10 min)

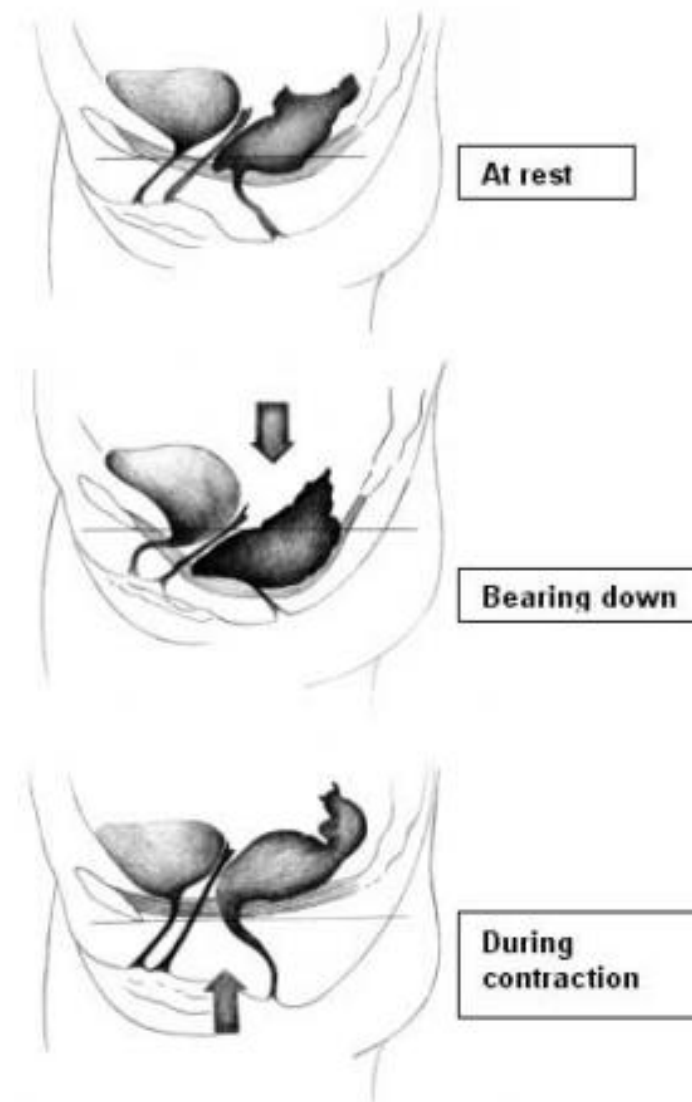
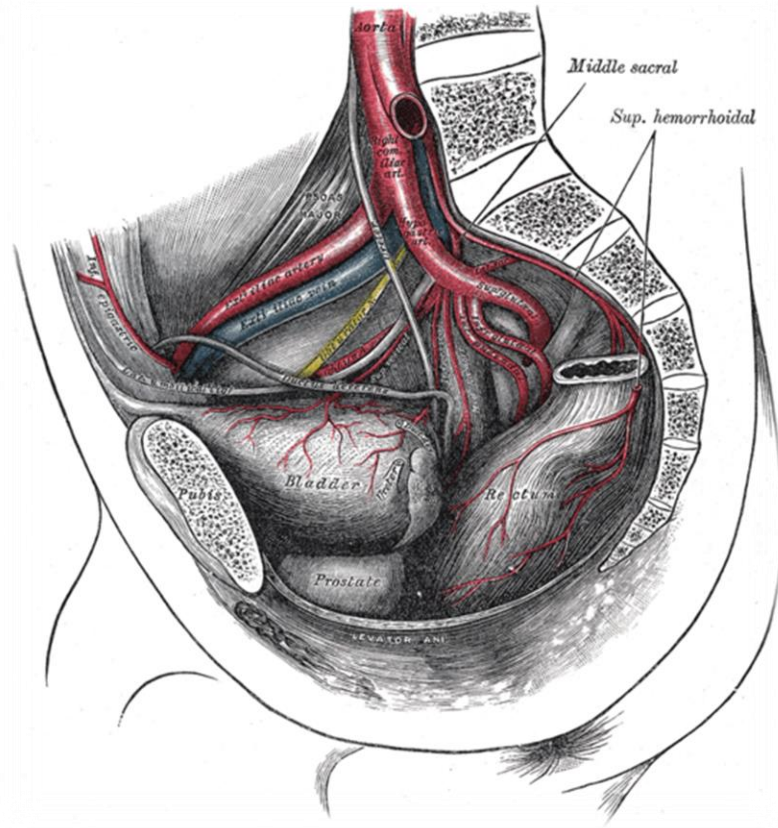
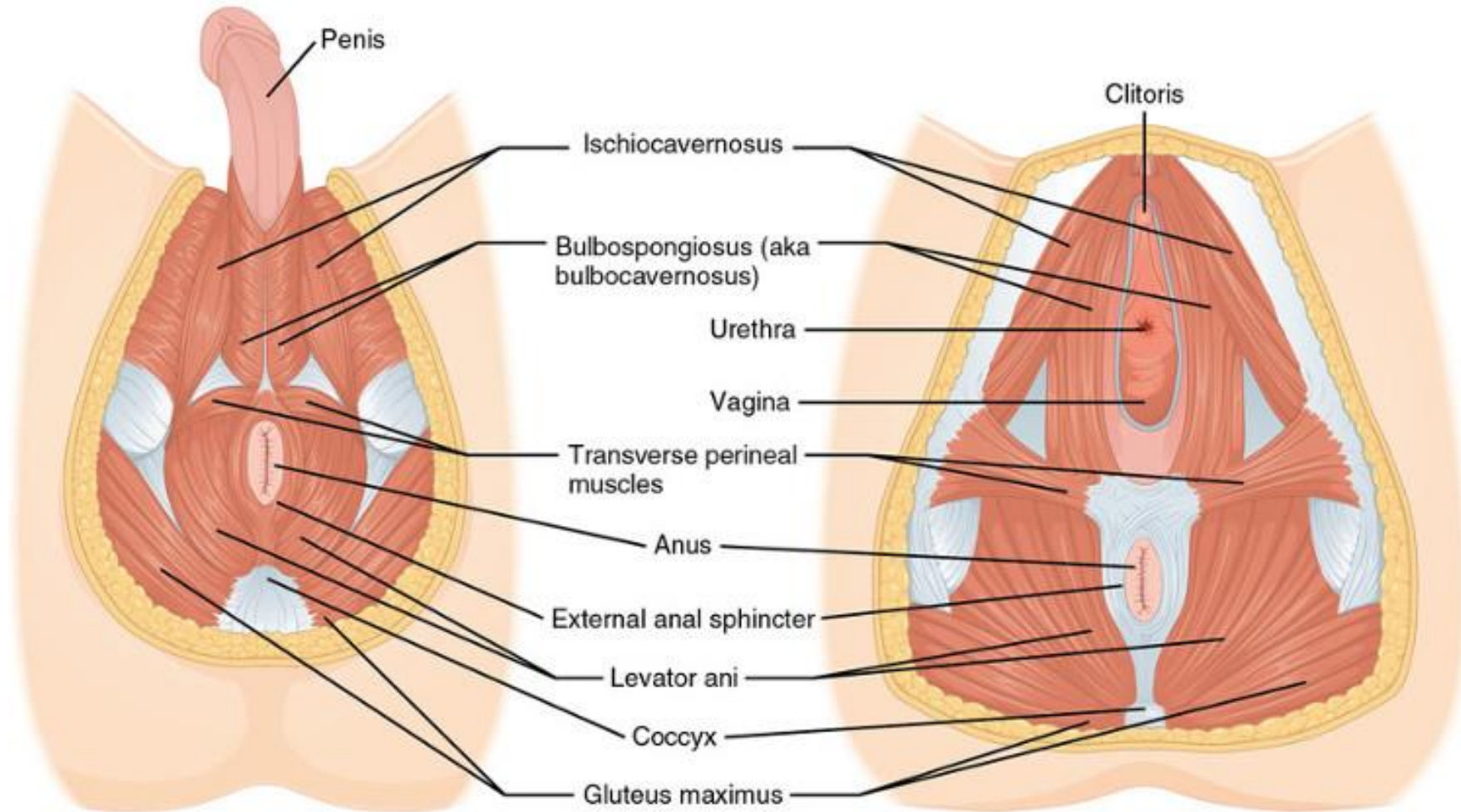


Figure 1: The pelvic floor at rest, during a Valsalva manoeuvre (bearing down) and during a contraction

Chiarelli, P. (2003). Postpartum stress incontinence: Prevention and rehabilitation. *International SportMed Journal*, 4(6), 1-10.



# The structure of pelvic floor muscles



Male perineal muscles: inferior view

Female perineal muscles: inferior view

# INTERNATIONAL CONTINENCE SOCIETY

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**David Castro-Diaz**

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# INTERNATIONAL CONTINENCE SOCIETY

Received: 4 November 2018 | Accepted: 7 November 2018  
DOI: 10.1002/nuu.23897

REVIEW ARTICLE



## The International Continence Society (ICS) report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction

Carlos D'Ancona<sup>1</sup> | Bernard Haylen<sup>2</sup> | Matthias Oelke<sup>3</sup> |  
Luis Abranches-Monteiro<sup>4</sup> | Edwin Arnold<sup>5</sup> | Howard Goldman<sup>6</sup> |  
Rizwan Hamid<sup>7</sup> | Yukio Homma<sup>8</sup> | Tom Marcelissen<sup>9</sup> | Kevin Rademakers<sup>9</sup> |  
Alexis Schizas<sup>10</sup> | Ajay Singla<sup>11</sup> | Irela Soto<sup>12</sup> | Vincent Tse<sup>13</sup> |  
Stefan de Wachter<sup>14</sup> | Sender Herschorn<sup>15</sup> |

On behalf of the Standardisation Steering Committee ICS and the ICS Working Group on Terminology for Male Lower Urinary Tract & Pelvic Floor Symptoms and Dysfunction

Neurourology and Urodynamics 29:4–20 (2010)

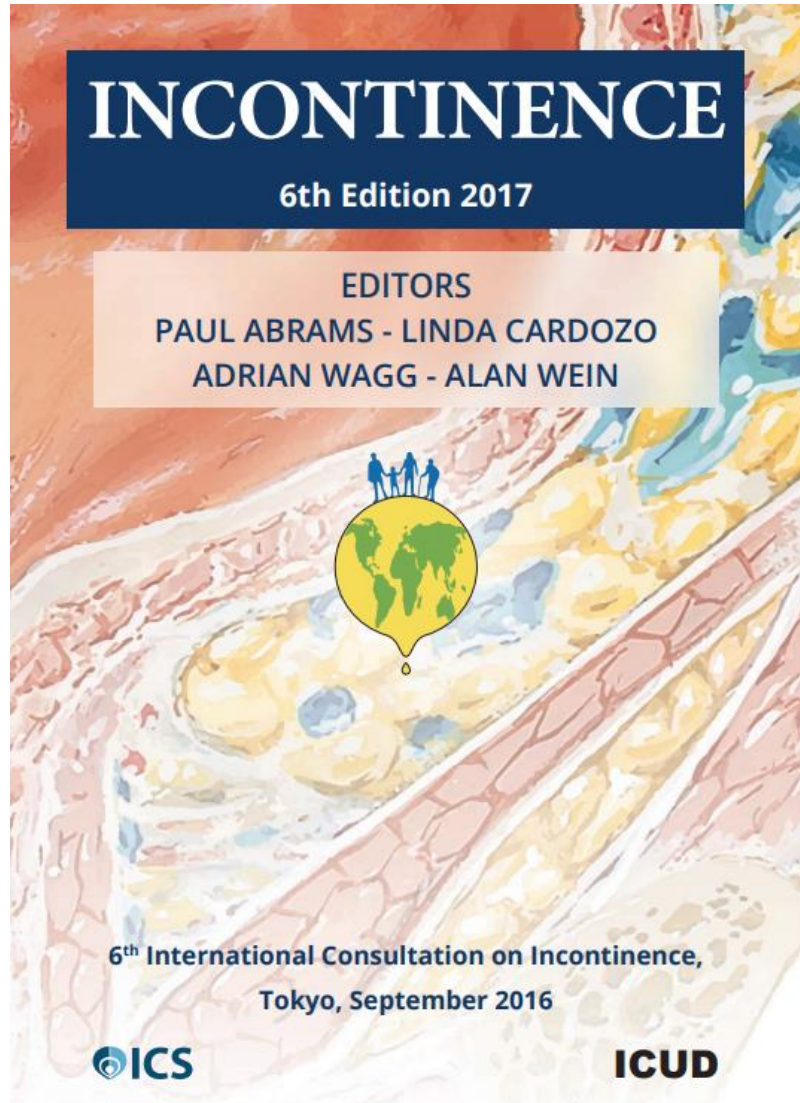


REVIEW ARTICLE

## An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Floor Dysfunction

Bernard T. Haylen,<sup>1\*,†,§</sup> Dirk de Ridder,<sup>2,†,§</sup> Robert M. Freeman,<sup>3†,‡,§</sup> Steven E. Swift,<sup>4†,§</sup> Bary Berghmans,<sup>5†,§</sup> Joseph Lee,<sup>6†</sup> Ash Monga,<sup>7†,§</sup> Eckhard Petri,<sup>8†</sup> Dina E. Rizk,<sup>9†</sup> Peter K. Sand,<sup>10†,‡,§</sup> and Gabriel N. Schaer<sup>11†</sup>  
<sup>1</sup>University of New South Wales, Sydney, New South Wales, Australia  
<sup>2</sup>University Hospital, UZ Leuven, Belgium  
<sup>3</sup>Derriford Hospital, Plymouth, Devon, UK  
<sup>4</sup>Medical University of South Carolina, Charleston, South Carolina  
<sup>5</sup>Maastricht University Hospital, Maastricht, the Netherlands  
<sup>6</sup>Mercy Hospital for Women, Melbourne, Victoria, Australia  
<sup>7</sup>Princess Anne Hospital, Southampton, UK  
<sup>8</sup>Klinikum Schwerin, Schwerin, Germany  
<sup>9</sup>Ain Shams University, Cairo, Egypt  
<sup>10</sup>Evanston Continence Centre, Evanston, Illinois  
<sup>11</sup>Kantonsspital, Aarau, Switzerland





Committee 21

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# SEXUAL FUNCTIONS ...

IMPORTANCE OF KEGEL EXERCISES FOR MALE  
AND FEMALE SEXUALITY AND PREVENTION OF  
VAGINISMUS



Hisham SHARIF

*Doctor Sexology Center of Sexual Study & Research, Tunis, Tunisia*

Vincenzo PUPPO<sup>1</sup>, Mansour EL FEKIH<sup>2</sup>

*<sup>1</sup>Centro Italiano di Sessuologia, Bologna, Italy; <sup>2</sup>Canadian Institute of sexual  
health & well-being, Montreal, Canada*

[Journal of Sexual Medicine](#). May2017 Supplement 4, Vol. 14, pe340-e340. 1p.

So called „Kegel exercises” are important in preventing vaginismus (involuntary contraction of the muscles located around the entrance to the vagina, preventing sexual intercourse).

In men, they can shorten the refractory period after ejaculation and prevent the physiological reduction of seminal fluid ejection.

## Does pelvic floor muscle training improve female sexual function? A systematic review

Cristine Homsí Jorge Ferreira<sup>1,2</sup> · Peter L. Dwyer<sup>3</sup> · Melissa Davidson<sup>4</sup> ·  
Alison De Souza<sup>5</sup>

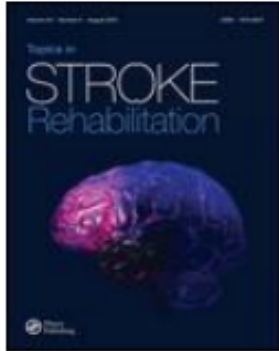
Received: 14 March 2015 / Accepted: 21 May 2015  
© The International Urogynecological Association 2015

Int Urogynecol J

**Table 4** Description of sexual function outcomes, baseline differences, postintervention results and withdrawal rates of the studies included in the systematic review

Study	Sexual function outcomes	Time points for data collection	Results of sexual function assessments after intervention	Study withdrawals
Wilson et al. [24]	GRISS (Rust et al. 1986) modified: Pain with sex Satisfactory sex Interest in sex Arousal Ability to orgasm Vaginal feelings Incontinence affects sex Adequacy of vaginal tone	No baseline measurement reported 12 months postnatal	Completers' results presented (CG 91, IG 54); no difference between groups on any question $p=0.15$ $p=0.24$ $p=0.79$ $p=0.45$ $p=0.11$ $p=0.93$ $p=0.43$	CG: 26/117; 22 % IG: 59/113; 52 %





## Topics in Stroke Rehabilitation

ISSN: 1074-9357 (Print) 1945-5119 (Online) Journal homepage: <http://www.tandfonline.com/loi/ytsr20>

### The effect of pelvic floor muscle training on sexual function in men with lower urinary tract symptoms after stroke

S. Tibaek, G. Gard, C. Dehlendorff, H. K. Iversen, J. Erdal, F. Biering-Sørensen, G. Dorey & R. Jensen

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To link to this article: <http://dx.doi.org/10.1179/1074935714Z.0000000019>

**Improvement of sexual function in men after stroke.**



# Restoring pelvic floor function in men: review of RCTs

Grace Dorey

## Abstract

The male pelvic floor muscles support the abdominal contents, are active during breathing, maintain urinary and faecal continence, increase local blood supply and are active during sexual intercourse. It was hypothesized that weak pelvic floor muscles would compromise these functions in men and lead to urinary and faecal incontinence and sexual dysfunction and that pelvic floor muscle strengthening would restore normal function. After a literature search of randomized controlled trials was undertaken, it was found that weak pelvic floor muscles compromised normal pelvic floor function and led to urinary incontinence and erectile dysfunction. Strengthening the pelvic floor muscles was shown to significantly improve post-prostatectomy urinary continence, post-micturition dribble and erectile function. It would be prudent for all men to exercise their pelvic floor muscles to maintain normal pelvic floor function.

**Key words:** Men's health ■ Male reproductive system and disorders ■ Rehabilitation

British Journal of Nursing, 2005, Vol 14, No 19

**Reduction of urinary incontinence and erectile dysfunction in men who have undergone prostatectomy (resection of the prostate) after pelvic floor muscle training.**

# How do we know the pelvic floor exercise is correct?

## Electromyography...



*"..is the study of muscle function through the inquiry of the electrical signal the muscles emanate."*

ISRCTN92265528 DOI 10.1186/ISRCTN92265528

Pelvic floor muscle training with surface electromyography

Fig. 2: Basmajian & DeLuca: Definition Muscles Alive (2 - p. 1)

Electromyography (EMG) is an experimental technique concerned with the development, recording and analysis of myoelectric signals. Myoelectric signals are formed by physiological variations in the state of muscle fiber membranes (Basmajian & De Luca, 1985).

EMG pelvic floor muscles evaluation with the NORAXON EMG & Sensors System, using vaginal or anal probes.



# Incontinence Impact Questionnaire – Short Form IIQ-7

Some people find that accidental urine loss may affect their activities, relationships, and feelings. The questions below refer to areas in your life that may have been influenced or changed by your problem. For each question, circle the response that best describes how much your activities, relationships, and feelings are being affected by urine leakage.

Has urine leakage affected your:

	Not at All	Slightly	Moderately	Greatly
1. Ability to do household chores (cooking, housecleaning, laundry)?	0	1	2	3
2. Physical recreation such as walking, swimming, or other exercise?	0	1	2	3
3. Entertainment activities (movies, concerts, etc.)?	0	1	2	3
4. Ability to travel by car or bus more than 30 minutes from home?	0	1	2	3
5. Participation in social activities outside your home?	0	1	2	3
6. Emotional health (nervousness, depression, etc.)?	0	1	2	3
7. Feeling frustrated?	0	1	2	3



## Incontinence Impact Questionnaire – Short Form IIQ-7

Items 1 and 2 = physical activity

Items 3 and 4 = travel

Item 5 = social/relationships

Items 6 and 7 = emotional health

**Scoring.** Item responses are assigned values of 0 for "not at all," 1 for "slightly," 2 for "moderately," and 3 for "greatly." The average score of items responded to is calculated. The average, which ranges from 0 to 3, is multiplied by 33 1/3 to put scores on a scale of 0 to 100.

**Reference.** Uebersax, J.S., Wyman, J. F., Shumaker, S. A., McClish, D. K., Fantl, J. A., & the Continence Program for Women Research Group. (1995). Short forms to assess life quality and symptom distress for urinary incontinence in women: The incontinence impact questionnaire and the urogenital distress inventory. *Neurourology and Urodynamics*, 14, 131-139.



# International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF)

Initial number

ICIQ-UI Short Form

**CONFIDENTIAL**

DAY MONTH YEAR

Today's date

Many people leak urine some of the time. We are trying to find out how many people leak urine, and how much this bothers them. We would be grateful if you could answer the following questions, thinking about how you have been, on average, over the PAST FOUR WEEKS.

1 Please write in your date of birth:

DAY MONTH YEAR

2 Are you (tick one):

Female  Male

3 How often do you leak urine? (Tick one box)

- never  0
- about once a week or less often  1
- two or three times a week  2
- about once a day  3
- several times a day  4
- all the time  5

4 We would like to know how much urine you think leaks.  
How much urine do you usually leak (whether you wear protection or not)?  
(Tick one box)

- none  0
- a small amount  2
- a moderate amount  4
- a large amount  6

5 Overall, how much does leaking urine interfere with your everyday life?  
Please ring a number between 0 (not at all) and 10 (a great deal)

0 1 2 3 4 5 6 7 8 9 10  
not at all a great deal

ICIQ score: sum scores 3+4+5

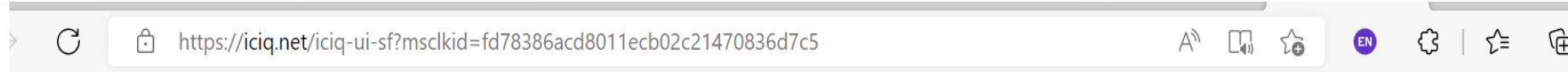
6 When does urine leak? (Please tick all that apply to you)

- never – urine does not leak
- leaks before you can get to the toilet
- leaks when you cough or sneeze
- leaks when you are asleep
- leaks when you are physically active/exercising
- leaks when you have finished urinating and are dressed
- leaks for no obvious reason
- leaks all the time

Thank you very much for answering these questions.

Copyright © "ICIQ Group"





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[Request modules](#)

**Level of validation according to ICI grades of recommendation:**

Grade A

Validity, reliability and responsiveness established with rigour in several data sets

**Suggested modules to use in conjunction:**

- ICIQ-MLUTS; ICIQ-FLUTS – Gender-specific symptom modules
- ICIQ-MLUTSsex; ICIQ-FLUTSsex – Gender-specific sexual matters modules

**Completion time:**

A few minutes

**Scoring scale:**

0-21

**Available languages:**

Afrikaans • Arabic • Australian English • Bengali (India) • Brazilian • Portuguese • Bulgarian • Canadian English • Cebuano (Philippines) • Chinese (Simplified) • Chinese (Traditional) • Chinese (Hong Kong) • Croatian • Czech • Danish • Dutch • Dutch (Belgium) • English (Philippines) • Estonian • Farsi • Finnish • French • French (Belgium) • French (Canada) • German • German (Austria) • German (Belgium) • Greek • Gujarati (India) • Hiligaynon (Philippines) • Hindi • Hungarian • Icelandic • Italian • Japanese • Kannada (India) • Korean • Latvian • Lithuanian • Malay • Marathi (India) • New Zealand English • Norwegian • Polish • Punjabi (India) • Romanian • Russian • Slovak • Slovenian • South African English • Spanish • Spanish (Argentina) • Spanish (Chile) • Spanish (Colombia) • Spanish (Guatemala) • Spanish (USA) • Swedish • Tagalog (Philippines) • Tamil • Telugu (India) • Thai • Turkish • UK English • Ukrainian • Urdu • US English



International Index of Erectile Function (IIEF) Questionnaire



PATIENT NAME: \_\_\_\_\_ DOB: \_\_\_\_\_ TODAY'S DATE: \_\_\_\_\_

The first five questions refer to erectile function.

	No sexual activity	Almost always or always	Most times (much more than half the time)	Sometimes (about half the time)	A few times (much less than half the time)	Almost never or never
1. Over the last month, how often were you able to get an erection during sexual activity?	0	5	4	3	2	1
2. Over the last month, when you had erections with sexual stimulation, how often were your erections hard enough for penetration?	0	5	4	3	2	1
3. Over the last month, when you attempted intercourse, how often were you able to penetrate your partner?	0	5	4	3	2	1
4. Over the last month, during sexual intercourse, how often were you able to maintain your erection after you had penetrated your partner?	0	5	4	3	2	1
	No sexual activity	Extremely difficult	Very difficult	Difficult	Slightly difficult	Not difficult
5. Over the last month, during sexual intercourse, how difficult was it to maintain your erection to completion of intercourse?	0	1	2	3	4	5



## The International Index of Erectile Function (IIEF-5) Questionnaire

Patient Name: \_\_\_\_\_

Date of Birth \_\_\_\_\_

Date Completed: \_\_\_\_\_

Over the past 6 months:					
1. How do you rate your <b>confidence</b> that you could get and keep an erection?	Very low 1	Low 2	Moderate 3	High 4	Very high 5
2. When you had erections with sexual stimulation, <b>how often</b> were your erections hard enough for penetration?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5
3. During sexual intercourse, <b>how often</b> were you able to maintain your erection after you had penetrated (entered) your partner?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5
4. During sexual intercourse, <b>how difficult</b> was it to maintain your erection to completion of intercourse?	Extremely difficult 1	Very difficult 2	Difficult 3	Slightly difficult 4	Not difficult 5
5. When you attempted sexual intercourse, <b>how often</b> was it satisfactory for you?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5

**IIEF-5 scoring:**

The IIEF-5 score is the sum of the ordinal responses to the 5 items.

22-25: No erectile dysfunction

17-21: Mild erectile dysfunction

12-16: Mild to moderate erectile dysfunction

8-11: Moderate erectile dysfunction

5-7: Severe erectile dysfunction

Total Score \_\_\_\_\_

1-5 scale to assess the feelings about the intravaginal probes:

1. „I feel completely comfortable, I can continue the test” (n=74; 75%);
2. „I feel the electrode, but I do not at all mind starting the test” (n=17; 17%);
3. „the electrode bothers me a little but I’ll start the test”;
4. „the electrode bothers me a lot but I’ll try starting the test”;
5. „I feel full discomfort, I cannot continue the test” (0).



Vaginal probes (Lifecare PR-02, Everyway Medical Instruments Co., Ltd., Tajwan).

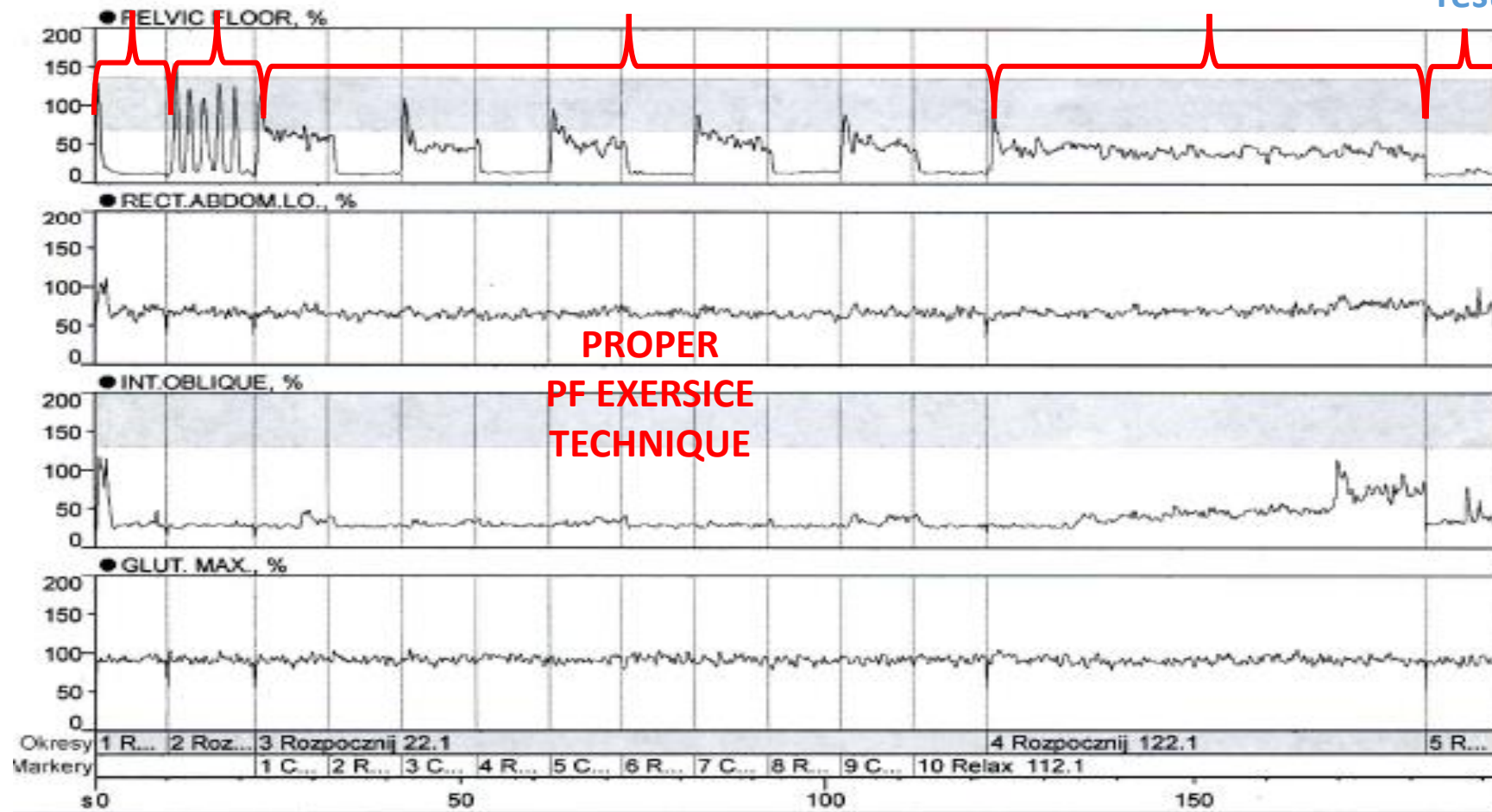


# Pelvic floor EMG evaluation

before training programme and after every 6 weeks of exercising



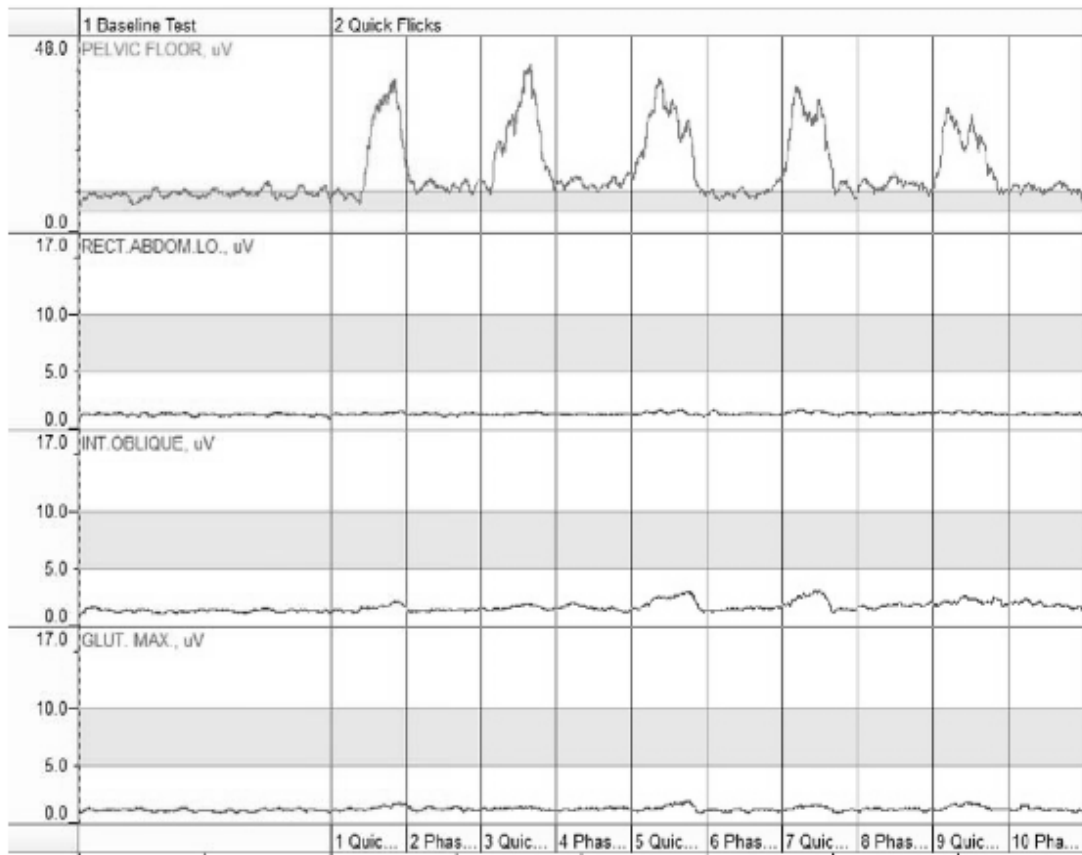
Pretest baseline    Quick flicks    10s-contractions    60 s static hold    Post-test rest



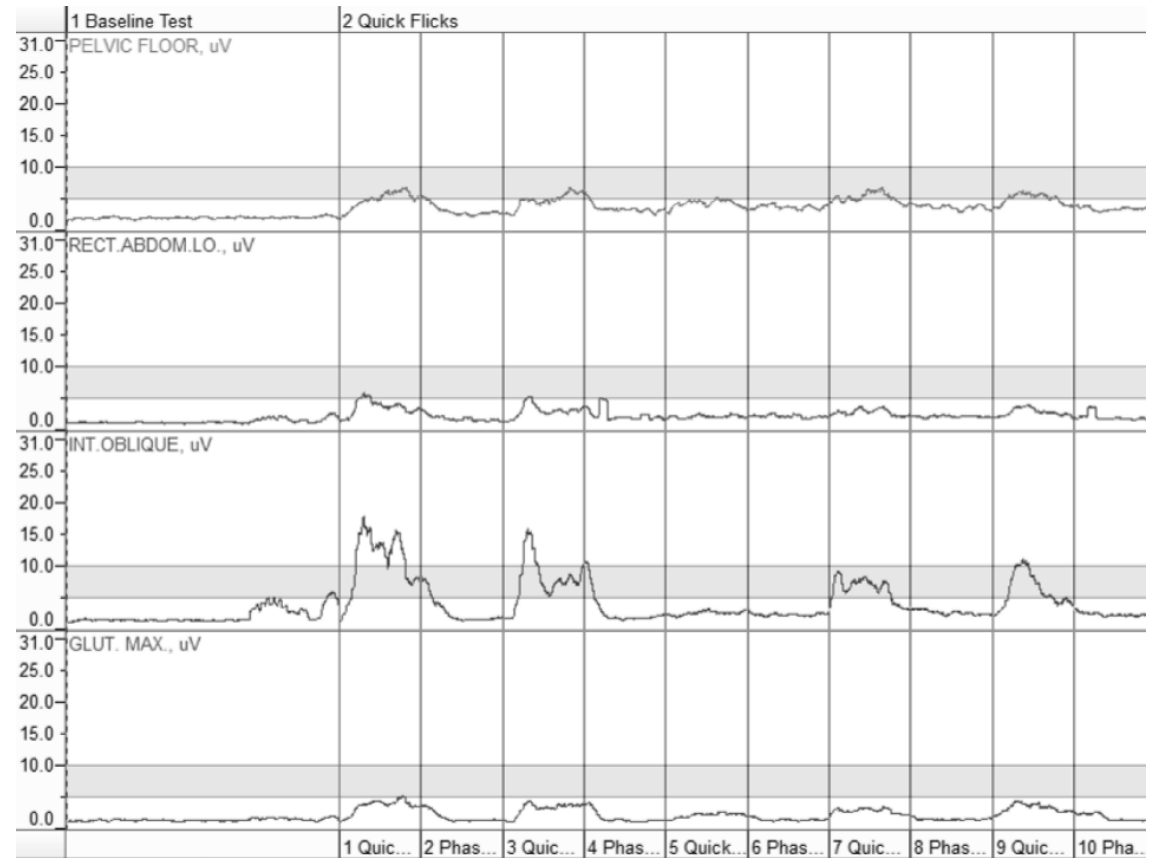
Only 45% of participants performed the exercise properly







Correct technique



Incorrect technique

We excluded 15% of the women by the start of the experiment





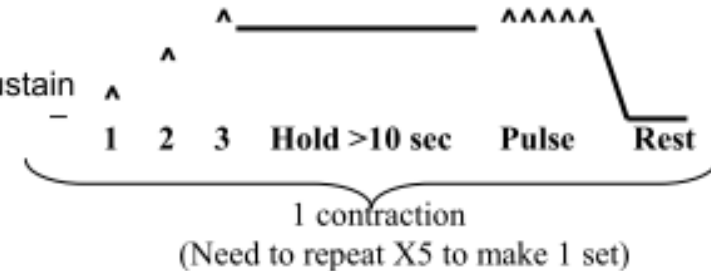
# Graduated Strength Training: A Pelvic Muscle Exercise Program

## Level 4: High-Intensity

**Goal:** Maximum, high-intensity contractions in order to increase muscle bulk and strength  
Sustain the contraction at high-intensity until fatigue  
Concentrate on maintaining the contraction without straining by pulsing to hold.

**Prescription:** 5 contractions/set; 3 sets/day  
Hold each contraction >10 seconds, pulse to sustain  
Allow 10 seconds rest between contractions  
Allow 30 seconds rest between sets

**Minimum Time:** ~10 minutes daily/5 days per week



Received: 2018.06.19  
Accepted: 2018.07.16  
Published: 2018.08.14

### Six-Week Pelvic Floor Muscle Activity (sEMG) Training in Pregnant Women as Prevention of Stress Urinary Incontinence

ORIGINAL RESEARCH  
Published: 30 January 2019  
doi: 10.23909/phys.2018.01.967



- 1 Marcin Dornowski
- 1 Piotr Sawicki
- 1 Dominika Wilczyńska
- 1 Inna Vereshchaka
- 2 Magdalena Piernicka
- Monika Błudnicka
- Aneta Worska
- Anna Szumilewicz

1 Department of Sport, Gdańsk University of Physical Education and Sport, Gdańsk, Poland  
2 Department of Universal Sport, Gdańsk University of Physical Education and Sport, Gdańsk, Poland

Correspondence: M. Dornowski, e-mail: mdornowski@awf.gda.pl  
Work was supported by scientific funding from Gdańsk University of Physical Education and Sports, Gdańsk, Poland

## High-Low Impact Exercise Program Including Pelvic Floor Muscle Exercises Improves Pelvic Floor Muscle Function in Healthy Pregnant Women – A Randomized Control Trial

Anna Szumilewicz<sup>a,\*</sup>, Marcin Dornowski<sup>b</sup>, Magdalena Piernicka<sup>1</sup>, Aneta Worska<sup>1</sup>, Agnieszka Kuchta<sup>a</sup>, Jakub Kortas<sup>a</sup>, Monika Błudnicka<sup>2</sup>, Łukasz Radzimiński<sup>b</sup> and Zbigniew Jastrzębski<sup>b</sup>

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## Prenatal high-low impact exercise program supported by pelvic floor muscle education and training decreases the life impact of postnatal urinary incontinence

A quasiexperimental trial

Anna Szumilewicz, PhD<sup>a,\*</sup>, Agnieszka Kuchta, PhD<sup>b</sup>, Monika Kranich, MSc<sup>a</sup>, Marcin Domowski, PhD<sup>c</sup>, Zbigniew Jastrzębski, PhD<sup>d</sup>

*Neurophysiology, Vol. 50, No. 3, June, 2018*

ACA ORIGINALNA

*Rocznik Naukowy, AWFIS w Gdańsku, 2015 r., t. XXV*

DOI 10.1007/s11062-021-09902-8  
*Neurophysiology, Vol. 52, No. 6, November, 2020*

## Effects of a One-Time Biofeedback EMG on Neuromuscular Activity of the Pelvic Floor Muscles in Pregnant Women

M. Błudnicka,<sup>1</sup> M. Piernicka,<sup>2</sup> J. Kortas,<sup>2</sup>  
B. Duda Biernacka,<sup>3</sup> and A. Szumilewicz<sup>2</sup>

## Training-Related Changes of EMG Activity of the Pelvic Floor Muscles in Women with Urinary Incontinence Problems

M. Dornowski,<sup>1</sup> P. Sawicki,<sup>1</sup> I. Vereshchaka,<sup>1</sup> M. Piernicka,<sup>1</sup>  
M. Błudnicka,<sup>1</sup> A. Worska,<sup>1</sup> and A. Szumilewicz<sup>1</sup>

## Nauczanie techniki ćwiczeń mięśni dna miednicy i studentek uczelni sportowej – randomizowane badanie eksperymentalne z grupą kontrolną

Teaching the technique of pelvic-floor muscle exercises among sport university female students – a randomized controlled trial

Clinical Trial/Experimental Study

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## High-impact aerobics programme supplemented by pelvic floor muscle training does not impair the function of pelvic floor muscles in active nulliparous women

A randomized control trial

Magdalena Piernicka, MSc<sup>a,\*</sup>, Monika Błudnicka, MSc<sup>b</sup>, Jakub Kortas, PhD<sup>c</sup>, Barbara Duda-Biernacka, Prof<sup>d</sup>, Anna Szumilewicz, Prof<sup>a</sup>

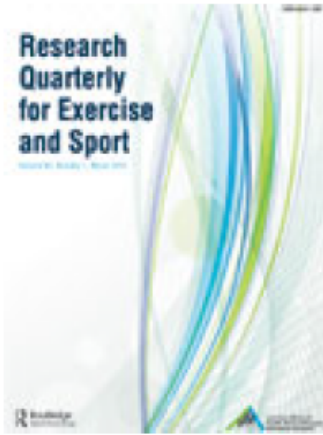
ACA ORIGINALNA

*Rocznik Naukowy, AWFIS w Gdańsku, 2015 r., t. XXV*

## Zmiany w aktywności nerwowo-mięśniowej mięśni dna miednicy u zdrowych nieródek po treningu realizowanym pod nadzorem instruktora lub samodzielnie – randomizowane badania z dwiema grupami eksperymentalnymi

Changes in the neuromuscular activity in pelvic-floor muscles in healthy nulliparas after supervised or unsupervised training – a randomized trial with two experimental groups





## Research Quarterly for Exercise and Sport

 Routledge  
Taylor & Francis Group



ISSN: 0270-1367 (Print) 2168-3824 (Online) Journal homepage: <https://www.tandfonline.com/loi/urqe20>

# Exercise Professionals Improve Their Poor Skills in Contracting Pelvic-Floor Muscles: A Randomized Controlled Trial

Anna Szumilewicz, Will G. Hopkins, Marcin Dornowski & Magdalena Piernicka

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To link to this article: <https://doi.org/10.1080/02701367.2019.1642993>









The technique scores for isolated pelvic floor muscle exercises (Szumilewicz et al. 2019)

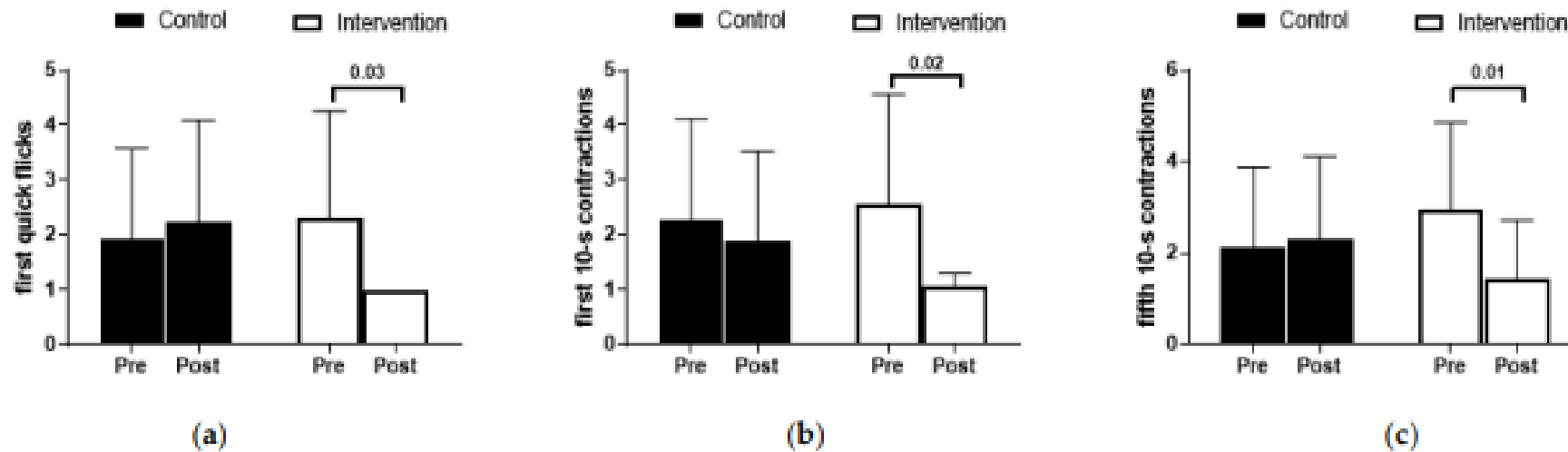
**Table 1. Technique scores for pelvic-floor contractions.**

Score	Score description	Pelvic-floor muscles	Synergistic muscles
4	Correct technique	activated	not activated
3	Incorrect technique	activated <i>first</i> in order	activated
2	Incorrect technique	activated <i>but not first</i> in order	activated <i>before</i> pelvic floor
1	Incorrect technique	not activated	activated

Article

# Improving the Technique of Pelvic Floor Muscle Contraction in Active Nulliparous Women Attending a Structured High–Low Impact Aerobics Program—A Randomized Control Trial

Magdalena Piernicka <sup>1,\*</sup>, Monika Błudnicka <sup>2</sup>, Damian Bojar <sup>3</sup>, Jakub Kortas <sup>4</sup> and Anna Szumilewicz <sup>1</sup>





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EDITED BY  
Tobias Siebert,  
University of Stuttgart, Germany

REVIEWED BY  
Marco Herbsleb,  
Friedrich Schiller University Jena,  
Germany  
Diana Escalona-Vargas,  
University of Arkansas for Medical  
Sciences, United States

\*CORRESPONDENCE  
Monika Błudnicka  
mbludnicka@interia.pl;  
monika.bludnicka@awf.gda.pl

SPECIALTY SECTION  
This article was submitted to  
Motor Neuroscience

# The influence of one-time biofeedback electromyography session on the firing order in the pelvic floor muscle contraction in pregnant woman—A randomized controlled trial

Monika Błudnicka<sup>1\*</sup>, Magdalena Piernicka<sup>2</sup>, Jakub Kortas<sup>3</sup>, Damian Bojar<sup>2</sup>, Barbara Duda-Biernacka<sup>3</sup> and Anna Szumilewicz<sup>2</sup>

Already a one-time EMG biofeedback session is effective to improve the technique of exercising the pelvic floor muscles.





# High-Low Impact Exercise Program Including Pelvic Floor Muscle Exercises Improves Pelvic Floor Muscle Function in Healthy Pregnant Women – A Randomized Control Trial

*Anna Szumilewicz<sup>1\*</sup>, Marcin Dornowski<sup>2</sup>, Magdalena Piernicka<sup>1</sup>, Aneta Worska<sup>1</sup>, Agnieszka Kuchta<sup>3</sup>, Jakub Kortas<sup>4</sup>, Monika Błudnicka<sup>5</sup>, Łukasz Radzimiński<sup>6</sup> and Zbigniew Jastrzębski<sup>6</sup>*

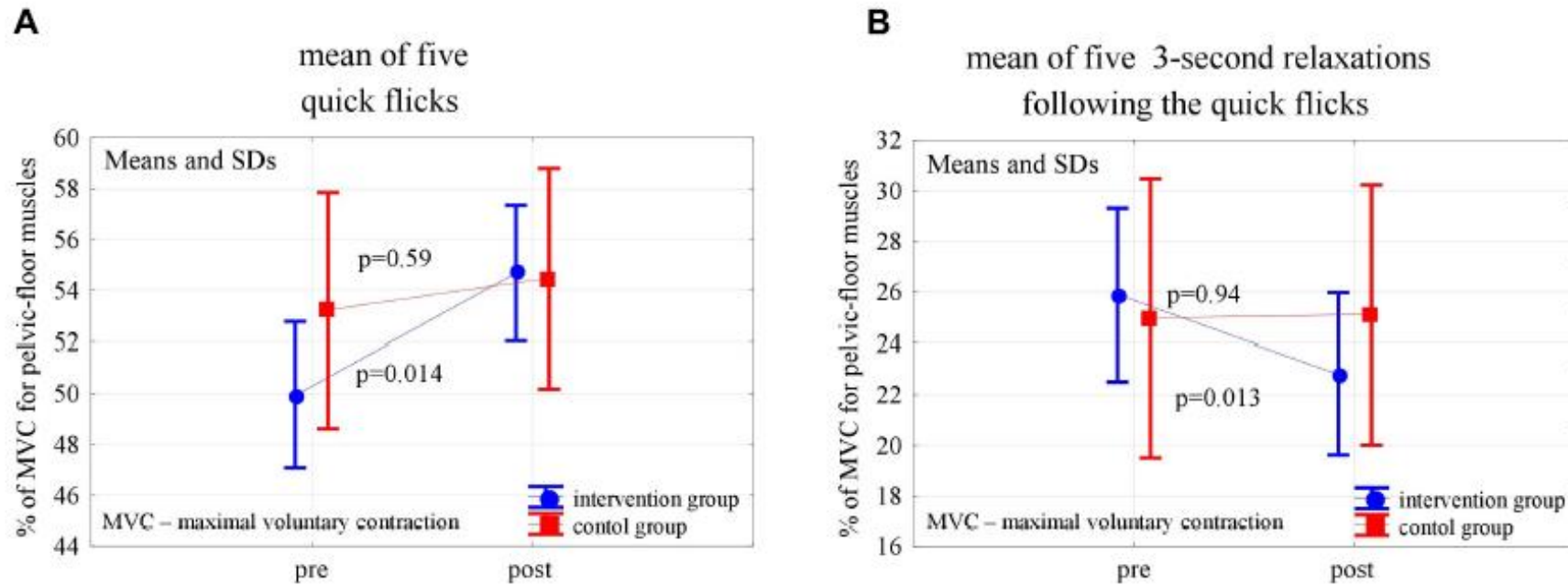
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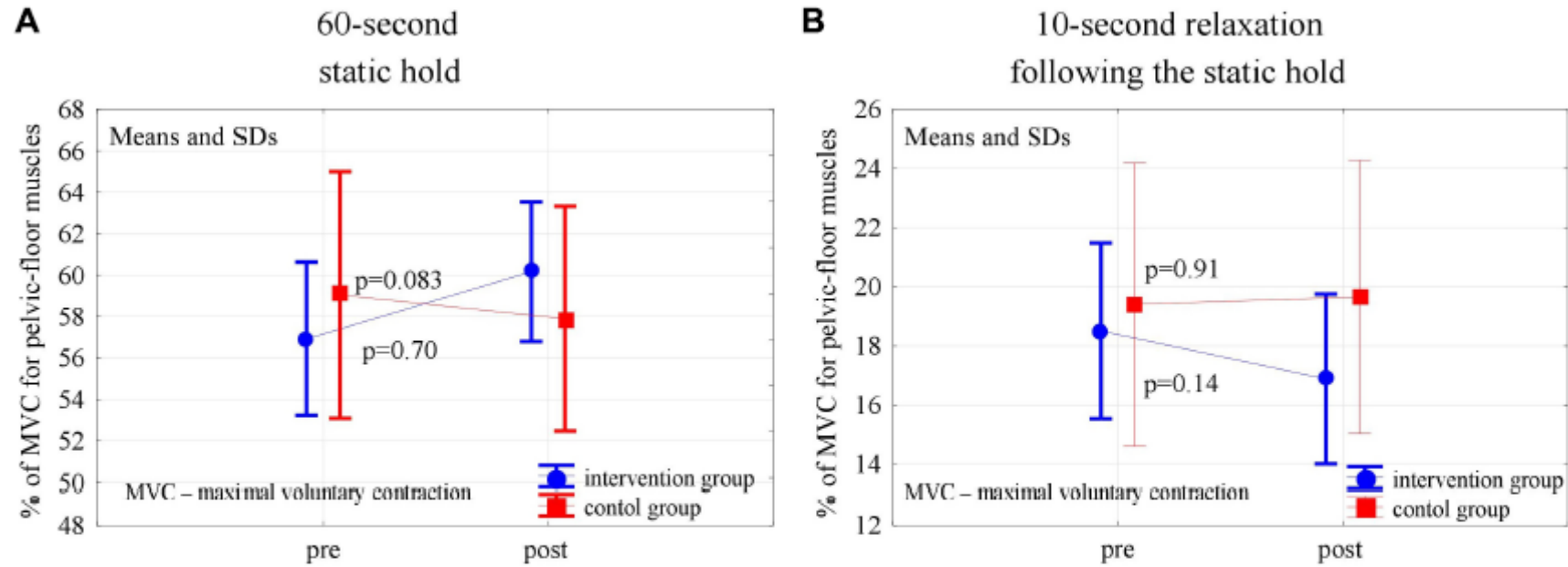
All study pregnant participants maintained good quality of life related to urinary incontinence!







**FIGURE 2** | Changes in the mean EMG amplitude of pelvic-floor muscle quick flicks **(A)** and following relaxations **(B)** in the control and experimental groups after 6 weeks of high-impact exercise program.



**FIGURE 4** | Changes in the mean EMG amplitude of the pelvic-floor muscle for the 60-s static hold **(A)** and following relaxation **(B)** in the control and experimental groups after 6 weeks of the high-impact exercise program.

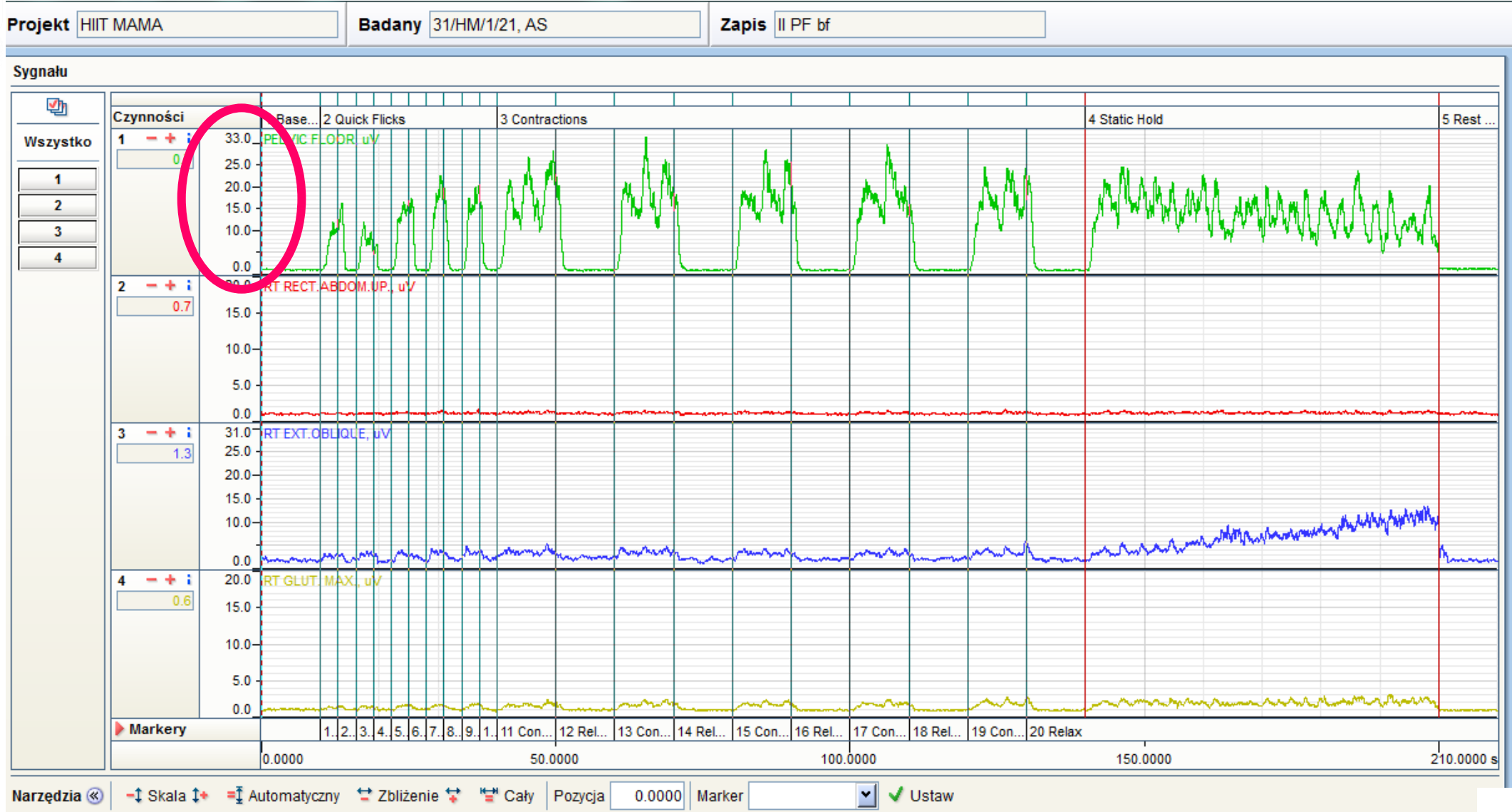
# **Prenatal high-low impact exercise program supported by pelvic floor muscle education and training decreases the life impact of postnatal urinary incontinence**

## **A quasiexperimental trial**

Anna Szumilewicz, PhD<sup>a,\*</sup>, Agnieszka Kuchta, PhD<sup>b</sup>, Monika Kranich, MSc<sup>a</sup>, Marcin Domowski, PhD<sup>c</sup>, Zbigniew Jastrzębski, PhD<sup>d</sup>

1. Firstly, we found that **significantly fewer training women** comparing to the control group reported the life impact of postnatal urinary incontinence both two months and one year postpartum (by 37% and 50%, respectively).
2. Secondly, in the training women the decrease of life impact of urinary incontinence between the second and twelfth months after delivery was almost twice as large as in the control group.
3. Thirdly, the symptomatic women in the training group reported lower impact of postnatal urinary incontinence in their daily life than the symptomatic controls.
4. **Performing high-low impact exercise in pregnancy did not adversely affect delivery parameters.**

# The EMG level of pelvic floor muscles in the supine position



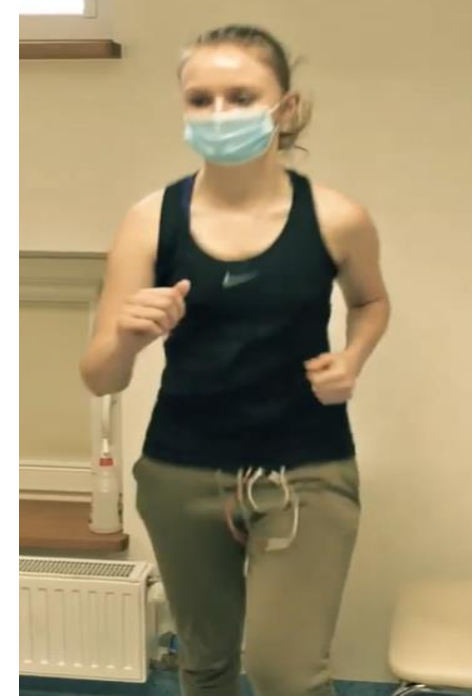


# The assessment of pelvic floor muscles in dynamic conditions

NIH U.S. National Library of Medicine

*ClinicalTrials.gov*

ClinicalTrials.gov Identifier: NCT05009433



Projekt HIIT MAMA

Badany 31/HM/1/21, AS

Zapis II marsz 2

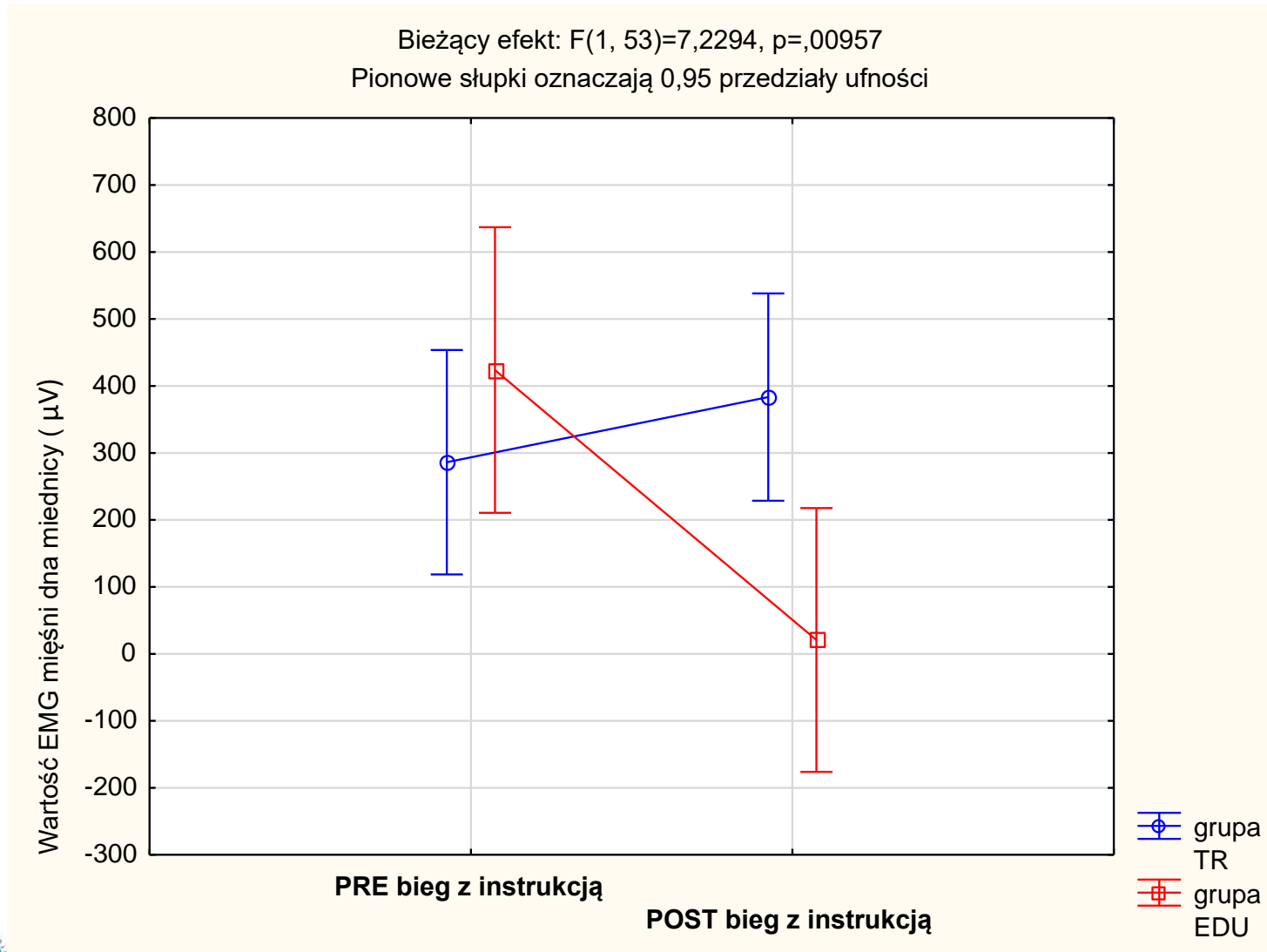
Sygnalu



Narzędzia ⏪ ⏩ Skala ⏴ ⏵ Automatyczny 🔍 Zbliżenie 🔍 🔄 Cały Pozycja 0.0000 Marker Ustaw



# The EMG level of PFM during running after HIIT Mama intervention



<https://a57.foxnews.com/media2.foxnews.com/2015/10/16/0/0/prega>

**The characteristics of childbirth parameters in the training and control groups.**

Variable at baseline	Training group n=133	Control group n=127	P-value
Maternal age, yr (M ± SD)	30 ± 4	28 ± 5	<.001*
Gestational age at birth, wk (M ± SD)	40 ± 2	40 ± 2	.71*
Newborn's birth weight, g (M ± SD)	3507 ± 480	3509 ± 495	.97*
The number of births delivered, n; %			
1	106; 80%	93; 73%	.55 <sup>†</sup>
2	21; 16%	29; 23%	
3	4; 3%	3; 2%	
4 and more	2; 2%	2; 2%	
Type of delivery, n; %			
Nonoperational vaginal delivery	87; 65%	86; 68%	.57 <sup>†</sup>
Operational vaginal delivery	2; 2%	4; 3%	
Cesarean section	44; 33%	37; 29%	
Labor induction, n; % <sup>‡</sup>			
Yes	42; 48%	39; 43%	.66 <sup>†</sup>
No	47; 53%	51; 57%	
Labor augmentation, n; % <sup>‡</sup>			
Yes	49; 55%	55; 61%	.49 <sup>†</sup>
No	40; 45%	35; 39%	
Perineal lacerations, n; % <sup>‡</sup>			
Yes	22; 25%	25; 28%	.64 <sup>†</sup>
No	67; 75%	65; 72%	
Any anesthetics, n; % <sup>§</sup>			
Yes	24; 28%	27; 31%	.58 <sup>†</sup>
No	63; 72%	59; 69%	
Possibility of choosing a delivery position during the first stage, n; % <sup>‡</sup>			
Yes	70; 79%	62; 69%	.14 <sup>†</sup>
No	19; 21%	28; 31%	
Possibility of choosing a delivery position during the 2nd stage, n; % <sup>§</sup>			
Yes	27; 31%	22; 26%	.43 <sup>†</sup>
No	60; 69%	64; 74%	

M = mean; n = number; SD = standard deviation; wk = weeks; yr = years.

\* Independent-samples *T* test.

<sup>†</sup> Chi-squared test;  $P \leq$  was considered as statistically significant.

<sup>‡</sup> Only for nonoperational and operational vaginal delivery.

<sup>§</sup> Only for nonoperational vaginal delivery.

## ORIGINAL ARTICLE

# Too tight to give birth? Assessment of pelvic floor muscle function in 277 nulliparous pregnant women


Kari Bø • Gunvor Hilde • Jette Stær Jensen •  
Franziska Siafarikas • Marie Ellstrøm Engh

Scientific data clearly contradicts the myths that performing pelvic floor tensing exercises until the day of birth can negatively affect the course of labor (Bø et al. 2013)!



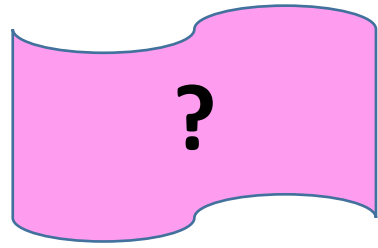


# Physical activity during pregnancy is associated with a lower number of perineal tears

Cristina Silva-Jose<sup>1</sup> | Ángeles Diaz-Blanco<sup>2</sup> | Rubén Barakat<sup>1</sup>  | Javier Coterón<sup>1</sup> | Ignacio Refoyo<sup>1</sup>

**Conclusions:** A significant association between the amount of physical activity performed by pregnant women and the number of tears resulting from the birth process was found.

**Perinatal perineal injuries are significantly related to the amount of physical activity undertaken during pregnancy!**



Is it painful to do MDM exercises after giving birth?





Contents lists available at ScienceDirect

## European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: [www.elsevier.com/locate/ejogrb](http://www.elsevier.com/locate/ejogrb)



Full length article

### Does pelvic floor muscle contraction early after delivery cause perineal pain in postpartum women?



Hedwig Neels<sup>a,b,\*</sup>, Stefan De Wachter<sup>b,c</sup>, Jean-Jacques Wyndaele<sup>c</sup>, Michel Wyndaele<sup>c</sup>,  
Alexandra Vermandel<sup>a,b</sup>

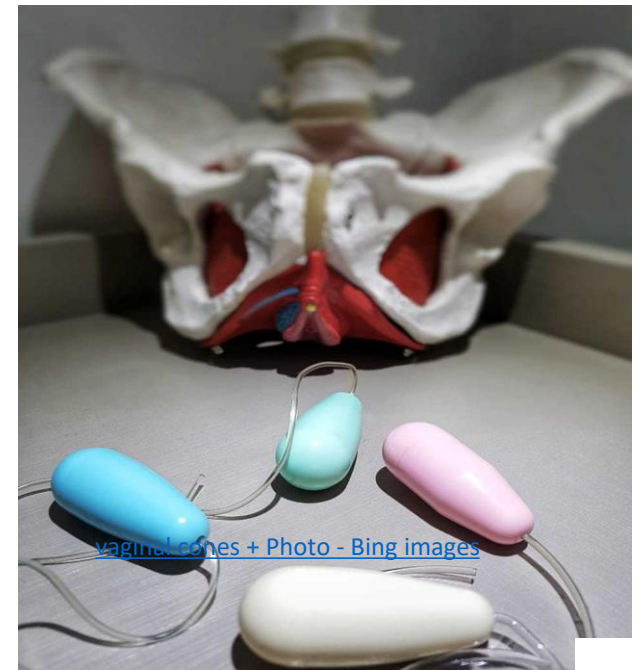
<sup>a</sup> Department Rehabilitation Sciences and Physiotherapy, University of Antwerp, Wilrijk, Belgium

<sup>b</sup> Department of Urology, Antwerp University Hospital, Edegem, Belgium

<sup>c</sup> Department of Urology, University of Antwerp, Wilrijk, Belgium

1. Perineal pain often occurs shortly after delivery during daily activities, micturition or defecation, but not during pelvic floor muscle exercises (it occurred in only 8% of respondents).
2. When perineal pain appeared during exercise, it was of low intensity (2 on the 1-10 VAS scale).
3. Fear of perineal pain should not discourage a woman from exercising pelvic floor muscles shortly after giving birth.

It is a myth that the use of vaginal weights (so-called Geisha balls) is harmful.





CLIMACTERIC 2012;15:45–51



# Vaginal cone for postmenopausal women with stress urinary incontinence: randomized, controlled trial

*V. S. Pereira, M. V. de Melo, G. N. Correia and P. Driusso*

Department of Physical Therapy, Federal University of São Carlos, São Carlos, SP, Brazil

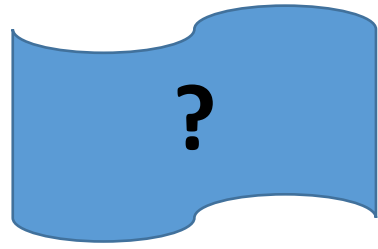
Key words: PELVIC FLOOR MUSCLE, POSTMENOPAUSAL WOMEN, URINARY INCONTINENCE, VAGINAL CONES

---

Similar results in terms of reducing the symptoms of urinary incontinence were obtained in the group of individuals training with vaginal cones compared to the group performing the exercises without additional load.







# Are mobile applications necessary for the effectiveness of pelvic floor muscle training?










[3 Great Pelvic Floor Exercise Apps - Supported Mums](#)





**REVIEW ARTICLE**

## **Use of mobile apps for controlling of the urinary incontinence: A systematic review**

Anita Bellotto Leme Nagib<sup>1,2</sup>  | Cássio Riccetto<sup>2</sup>  |  
Natalia Miguel Martinho<sup>2,3</sup>  | Pedro Rogério Camargos Pennisi<sup>4</sup>  |  
Cauane Blumenberg<sup>5</sup>  | Luiz Renato Paranhos<sup>4</sup>  | Simone Botelho<sup>2,6</sup> 

All studies have demonstrated the effectiveness of the use of mobile applications in reducing urinary incontinence.  
The effectiveness of training requires regularity !!!

# The urine flow must never be stopped during micturition!



oddawanie moczu obrzy - Bing Images



Searching: **Hospitality & Tourism Complete**, [Show all](#) | [Choose Databases](#)

pelvic floor muscle training or pelvic floor muscle e:

Select a Field (optional) ▾

**Search**

AND ▾

micturition

Select a Field (optional) ▾

[Clear](#) ?

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[Basic Search](#) [Advanced Search](#) [Search History](#) ▶

**Refine Results**

Search Results: 1 - 50 of 89



The only available work on one-time intervention in the course of voiding ...

INTERNATIONAL JOURNAL OF  
**UROLOGY**

International Journal of Urology (2019) 26, 1059–1063

doi: 10.1111/iju.14092

**Original Article: Clinical Investigation**

## **Influence of the urine stream interruption exercise on micturition**

Camille Chesnel, Audrey Charlanes, Eliane Tan, Nicolas Turmel, Frédérique Le Breton, Samer Sheikh Ismael, Claire Hentzen and Gérard Amarenco

GRC 001, GREEN Groupe de Recherche Clinique en Neuro-Urologie, AP-HP, Hôpital Tenon, Sorbonne Université, Paris, France

To date, there are no reliable data on the long-term effects of regular urinary interruptions ...







# Gdzie szukać wiarygodnych informacji o treningu mięśni dna miednicy?



Cochrane Database of Systematic Reviews

## Pelvic floor muscle training for preventing and treating urinary and faecal incontinence in antenatal and postnatal women (Review)

Woodley SJ, Lawrenson P, Boyle R, Cody JD, Mørkved S, Kernohan A, Hay-Smith EJC

Pelvic floor muscle training for preventing and treating urinary and faecal incontinence in antenatal and postnatal women (Review)

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Ko 2011	?	?	-	-	+	+	+
Kocaoz 2013	-	-	-	-	-	-	+
Kou 2013	?	?	-	-	?	+	?
Liu 2011	?	?	-	-	?	+	?
Meyer 2001	?	?	-	-	+	+	+
Miquelutti 2013	+	+	-	-	-	+	?
Mørkved 2003	+	+	-	-	+	+	+
Oakley 2016	+	+	-	-	+	+	?
Peirce 2013	+	+	-	-	+	+	+
Pelaez 2014	+	?	-	-	+	+	?
Reilly 2002	+	+	-	-	?	+	+
Sacomori 2019	?	+	-	-	-	+	+
Sampselle 1998	+	+	-	-	-	+	?
Sangsawang 2016	+	+	-	-	+	+	+
Skelly 2004	?	?	-	-	?	?	?
Sleep 1987	?	?	-	-	?	+	?
Stafne 2012	+	+	-	-	?	+	+
Stothers 2002	?	?	-	-	+	?	?
Sut 2016	?	?	-	-	+	+	+
Szumilewicz 2019	+	?	-	-	-	+	?
Torsdatter Markussen 2017	+	+	-	-	-	+	+
Wen 2010	?	?	-	-	?	+	?
Wilson 1998	+	?	-	-	-	+	+
Woldringh 2007	+	?	-	-	-	+	+
Yang 2017	+	?	-	-	-	+	+



## Prenatal high-low impact exercise program supported by pelvic floor muscle education and training decreases the life impact of postnatal urinary incontinence

A quasiexperimental trial

Anna Szumilewicz, PhD<sup>a,\*</sup>, Agnieszka Kuchta, PhD<sup>b</sup>, Monika Kranich, MSc<sup>a</sup>, Marcin Domowski, PhD<sup>c</sup>, Zbigniew Jastrzębski, PhD<sup>d</sup>

Table 2. The characteristics of physical activity patterns in pregnancy and within one year postpartum in the experimental and control groups

Variable at baseline	All pregnant women n=260	Experimental group n=133	Control group n=127	P-value
<b>Meeting recommended level of physical activity from the second trimester of pregnancy (n; %):</b>				
Yes		133; 100%	17; 14%	-
No		0	110; 87%	-
<b>Exercising pelvic floor muscles regularly from the second trimester of pregnancy; at least three times a week (n; %):</b>				
Yes		133; 100%	31; 24%	-
No		0	96; 76%	-
<b>Starting any body workout<sup>1</sup> after delivery</b>				
Within the 24 hours after birth		11; 8%	1; 1%	P<0.0001*
Within the 2 <sup>nd</sup> and 7 <sup>th</sup> day postpartum		46; 35%	15; 12%	
Within the 2 <sup>nd</sup> and 8 <sup>th</sup> week postpartum		56; 42%	50; 39%	
Later than 8 weeks postpartum		18; 13%	38; 30%	
I have not started the exercises yet		2; 2%	23; 18%	
<b>Starting regular pelvic floor muscle exercises<sup>2</sup> after delivery</b>				
Within the 24 hours after birth		35; 27%	8; 6%	P<0.0001*
Within the 2 <sup>nd</sup> and 7 <sup>th</sup> day postpartum		48; 36%	17; 14%	
Within the 2 <sup>nd</sup> and 8 <sup>th</sup> week postpartum		27; 20%	22; 17%	
Later than 8 weeks postpartum		3; 2%	19; 15%	
I have not started the exercises yet		2; 15%	61; 48%	

\*Chi<sup>2</sup>

P=< was considered as statistically significant

<sup>1</sup> any exercise engaging major muscle groups

<sup>2</sup> any conscious contraction and relaxations of pelvic floor muscles

## Antepartum, Intrapartum, and Neonatal Significance of Exercise on Healthy Low-Risk Pregnant Working Women

April 2002 · Obstetrics and Gynecology 99(3):466-72

DOI: [10.1016/S0029-7844\(01\)01754-9](https://doi.org/10.1016/S0029-7844(01)01754-9)

Source · [PubMed](#)

● Everett F Magann · ● Sharon F Evans · ● Beth Weitz · ● John Newnhan

Women participating in the fitness pro-military program for the Navy until the end of pregnancy, more often required oxytocin augmentation.

**Table 3.** Influence of Exercise on Labor

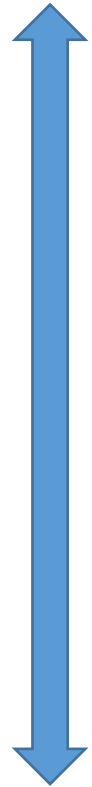
	Group 1 n = 217 (29)	Group 2 n = 222 (29)	Group 3 n = 73 (10)	Group 4 n = 238 (32)	P
Preterm labor	16 (7.4)	22 (9.9)	8 (11)	19 (8)	.683
Gestational age at onset of PTL (wk)	29.9 ± 5.1	30.1 ± 3.8	29.1 ± 3.5	32.2 ± 3.1	.231
Preterm birth	18 (8.3)	26 (11.7)	9 (12.3)	22 (9.2)	.414
PPROM	3 (1.4)	5 (2.3)	3 (4.1)	3 (1.3)	.250
Onset of labor					.175
Elective cesarean delivery	11 (5)	10 (4.5)	3 (4.1)	15 (6.3)	
Spontaneous labor	188 (87.1)	183 (82.4)	61 (83.6)	190 (79.8)	
Induction of labor	17 (7.9)	29 (13.1)	9 (12.3)	33 (13.9)	
Oxytocin use					.015
Induction	15 (6.9)	31 (14)	9 (12.3)	30 (12.6)	
Augmentation	47 (21.7)	46 (20.7)	18 (24.6)	74 (31)	
Length of 1st stage of labor (h)	8.3 ± 4.9	9.7 ± 6.2	9.2 ± 5.8	9.8 ± 5.7	.832
Length of 2nd stage of labor (min)	48.1 ± 41.4	53.9 ± 45.4	65.7 ± 61.9	52.6 ± 45.9	.076
Length of 3rd stage of labor (min)	7.3 ± 6.4	8 ± 6.8	6.9 ± 4	7.7 ± 8	.661
Did abnormal FHR influence delivery?					.714
Yes	23 (10.6)	30 (13.5)	10 (13.7)	30 (12.6)	
Partially	31 (14.3)	31 (14)	8 (11)	36 (15.1)	
No	1 (0.5)	5 (2.3)	1 (1.4)	6 (2.5)	
Cord abnormalities	18 (8.3)	15 (6.8)	7 (9.6)	9 (3.8)	.051

PTL = preterm labor; PPRM = preterm premature rupture of membranes; FHR = fetal heart rate.

Data presented as ± standard error or n (%) as appropriate.

# During training, we take care of the hormonal balance

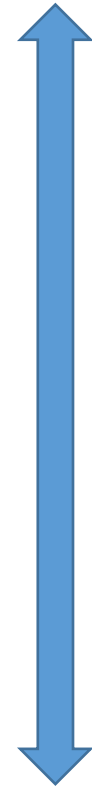
Stress hormones



Labour hormones



Labour hormones



Stress hormones

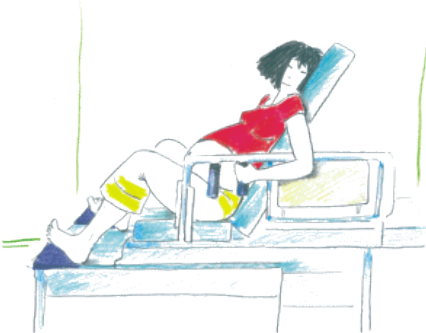
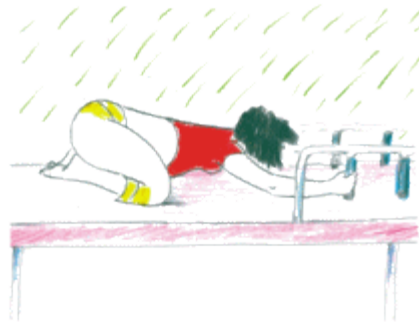




# We implement birthing positions ...



# Birth positions



Źródło zdjęć: <http://www.rodzicpoludzku.pl/Porod/Wertykalne-pozycje-porodowe-przyklady.html>





## So called, vertical positions



- Berk B. Motherwell maternity fitness plan. Human Kinetics, Champaign, IL 2005.
- Ciobanu DI, Relaxation and breathing techniques – positive factors in the deployment of pregnant women's labor and delivery. European Journal of Physical and Health Education. 2010; 3 (2): 39-48.
- Zwelling E. Overcoming the challenges: maternal movement and positioning to facilitate labor progress. MCN Am J Matern Child Nurs. 2010; 35 (2): 72-78.
- De Jonge A, Lagro-Janssen ALM. Birthing positions. A qualitative study into the views of women about various birthing positions. J Psychosom Obstet Gynecol. 2004; 25 (1): 47-55.
- Smith MDH. Preparation for labor and delivery. In: Mostofsky DL, Zaichkowsky LD. Medical and psychological aspects of sport and exercise. Fitness Information Technology, Morgantown, WV, 2002. p. 83-90.

Randomized Controlled Trial > BMC Pregnancy Childbirth. 2013 Sep 5;13:171.

doi: 10.1186/1471-2393-13-171.

# Antenatal education and the birthing experience of Brazilian women: a qualitative study

Maria Amelia Miquelutti <sup>1</sup>, José Guilherme Cecatti, Maria Yolanda Makuch

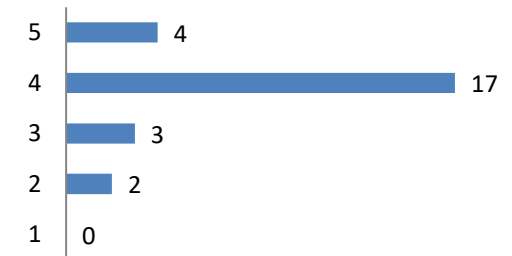
Affiliations + expand

PMID: 24007540 PMCID: PMC3766656 DOI: 10.1186/1471-2393-13-171

[Free PMC article](#)



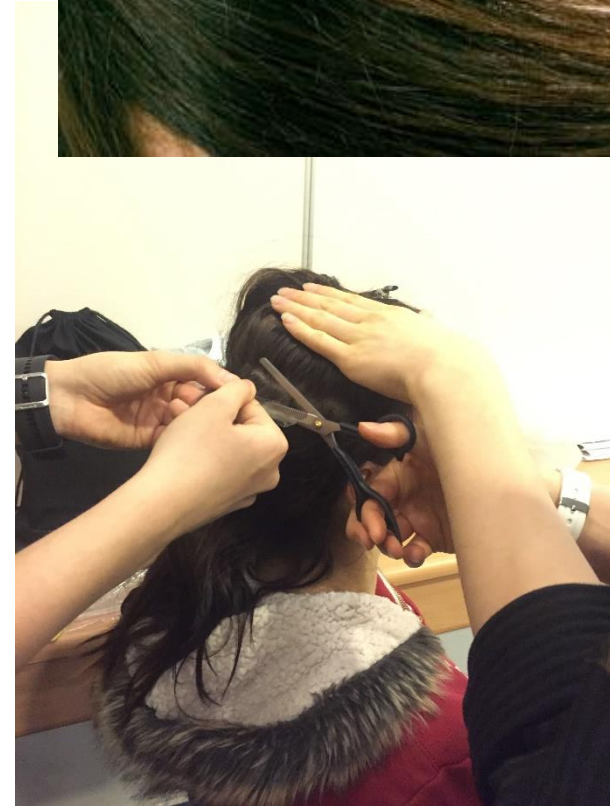
# Vertical birth position



1 – very difficult, 2 – difficult, 3 – average difficulty, 4 – easy, 5 – very easy








# The assessment of cortisol levels in women's hair.



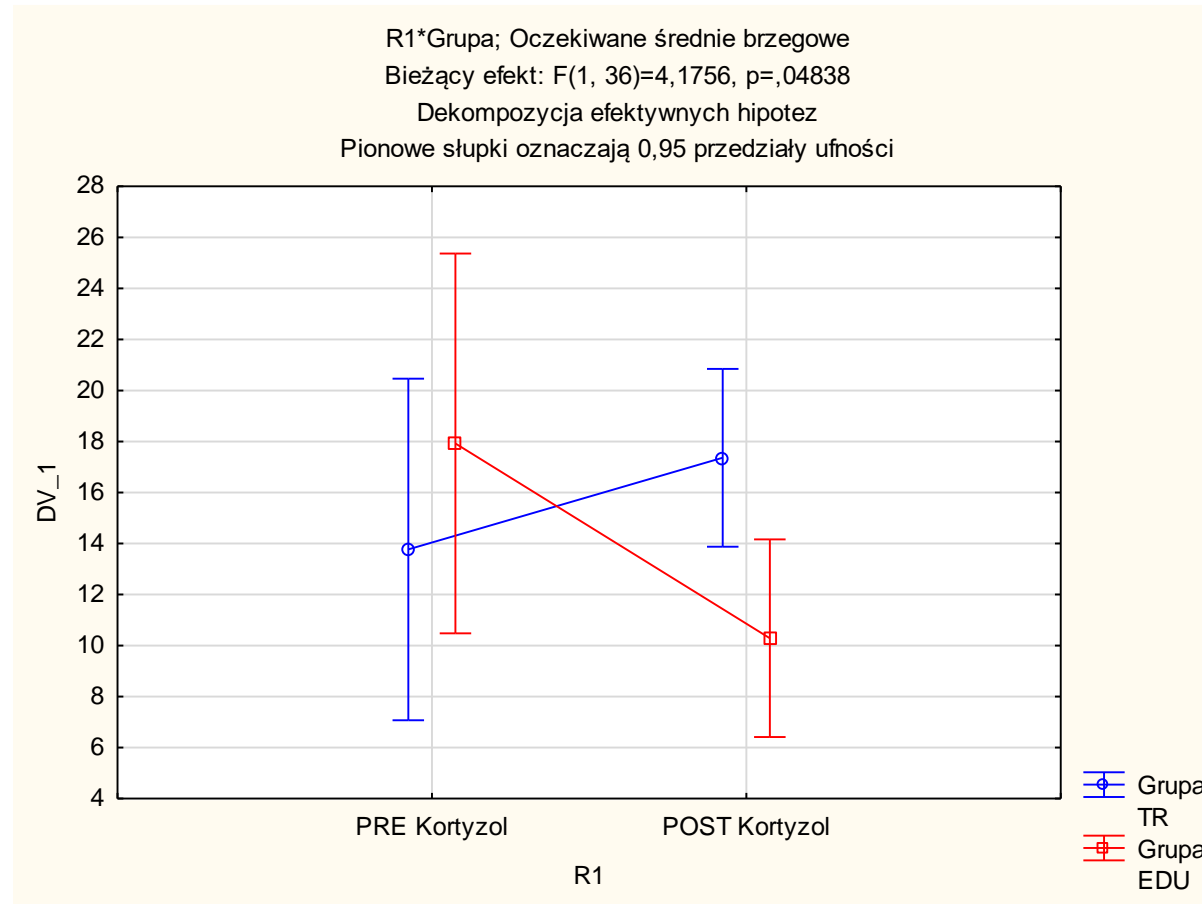


*Article*

# Do Physical Activity and Personality Matter for Hair Cortisol Concentration and Self-Reported Stress in Pregnancy? A Pilot Cross-Sectional Study

Dagmara Budnik-Przybylska <sup>1</sup>, Radosław Laskowski <sup>2</sup>, Paulina Pawlicka <sup>3</sup>,  
Paulina Anikiej-Wiczenbach <sup>4</sup>, Ariadna Łada-Maśko <sup>5</sup>, Anna Szumilewicz <sup>6</sup>,  
Franciszek Makurat <sup>1</sup>, Jacek Przybylski <sup>1</sup>, Hideaki Soya <sup>7</sup> and Maria Kaźmierczak <sup>8,\*</sup>

# Changes in the hair cortisol levels after the 8-week program



Exercise during pregnancy  
reduce the risk by 67% perinatal  
depression.

## Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: a systematic review and meta-analysis

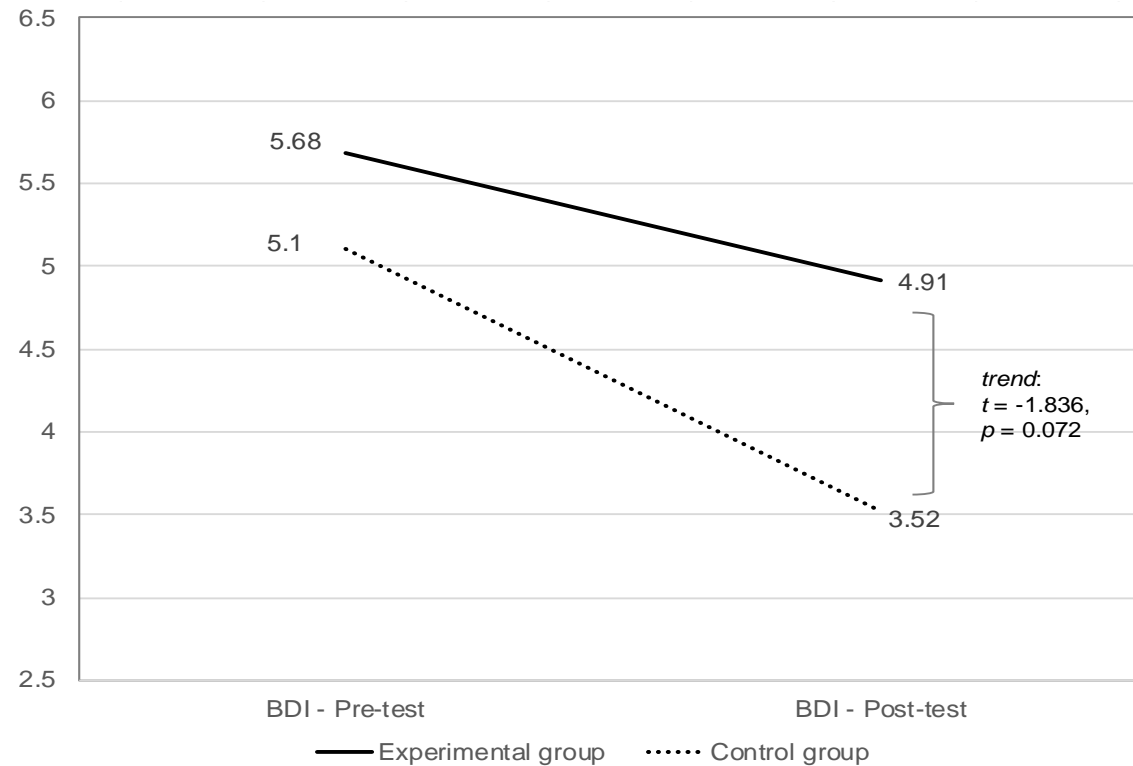
Margie H Davenport,<sup>1</sup> Ashley P McCurdy,<sup>1</sup> Michelle F Mottola,<sup>2</sup> Rachel J Skow,<sup>1</sup> Victoria L Meah,<sup>3</sup> Veronica J Poitras,<sup>4</sup> Alejandra Jaramillo Garcia,<sup>4</sup> Casey E Gray,<sup>5</sup> Nick Barrowman,<sup>6</sup> Laurel Riske,<sup>1</sup> Frances Sobierajski,<sup>1</sup> Marina James,<sup>1</sup> Taniya Nagpal,<sup>2</sup> Andree-Anne Marchand,<sup>7</sup> Megan Nuspl,<sup>8</sup> Linda G Slater,<sup>9</sup> Ruben Barakat,<sup>10</sup> Kristi B Adamo,<sup>11</sup> Gregory A Davies,<sup>12</sup> Stephanie-May Ruchat<sup>13</sup>



<https://www.sensity.pl/wp-content/uploads/2017/06/depresja-w-ciazy.jpg>

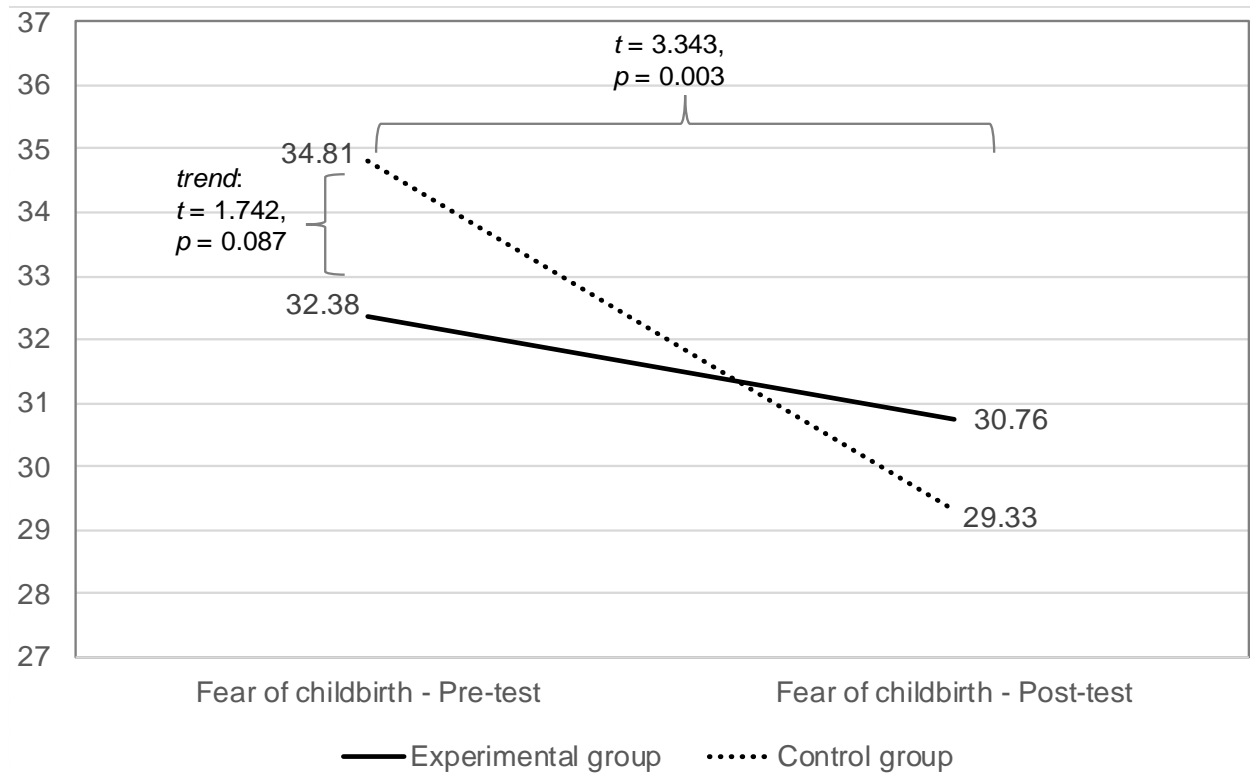


The differences in the severity of depressive symptoms (measured with the BDI) between HIIT and control group before and after the intervention.

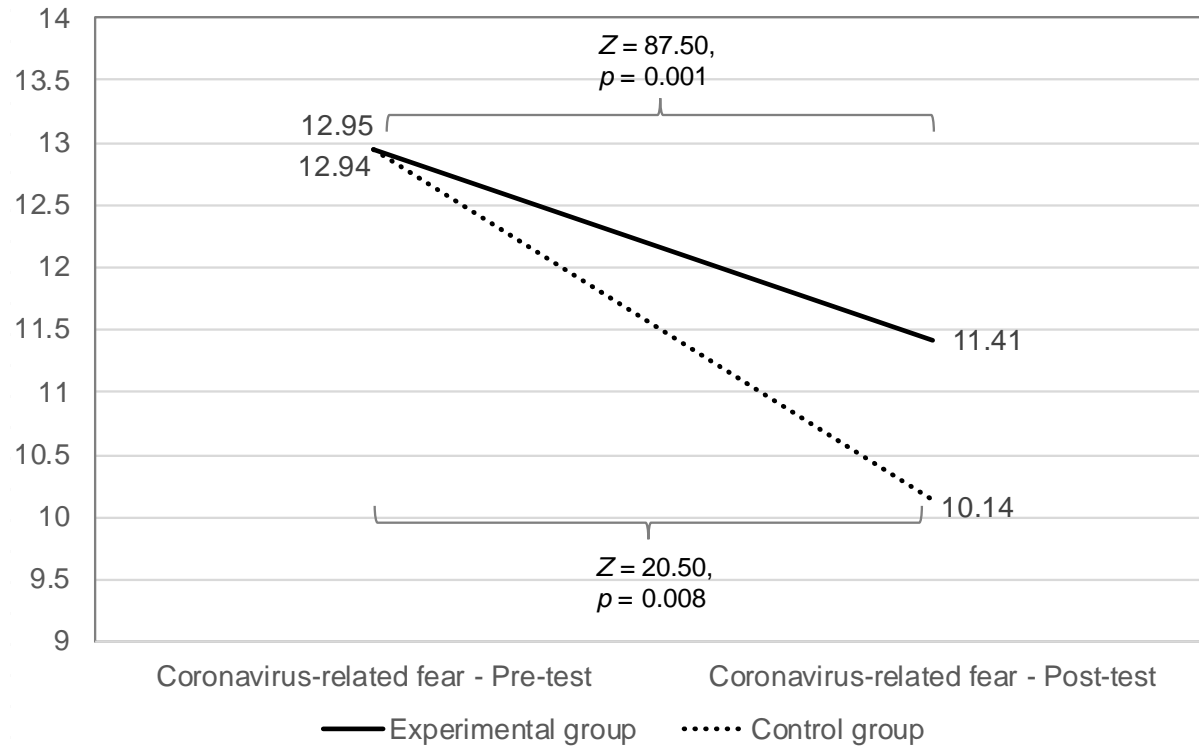




*The differences in the severity of fear of childbirth between HIIT and control group before and after the intervention.*



*The differences in the severity of the coronavirus-related fear between experimental and control group before and after the intervention.*





# HIIT babies☺





# Our research team





**Thank you for your attention 😊**

**Any questions?**

