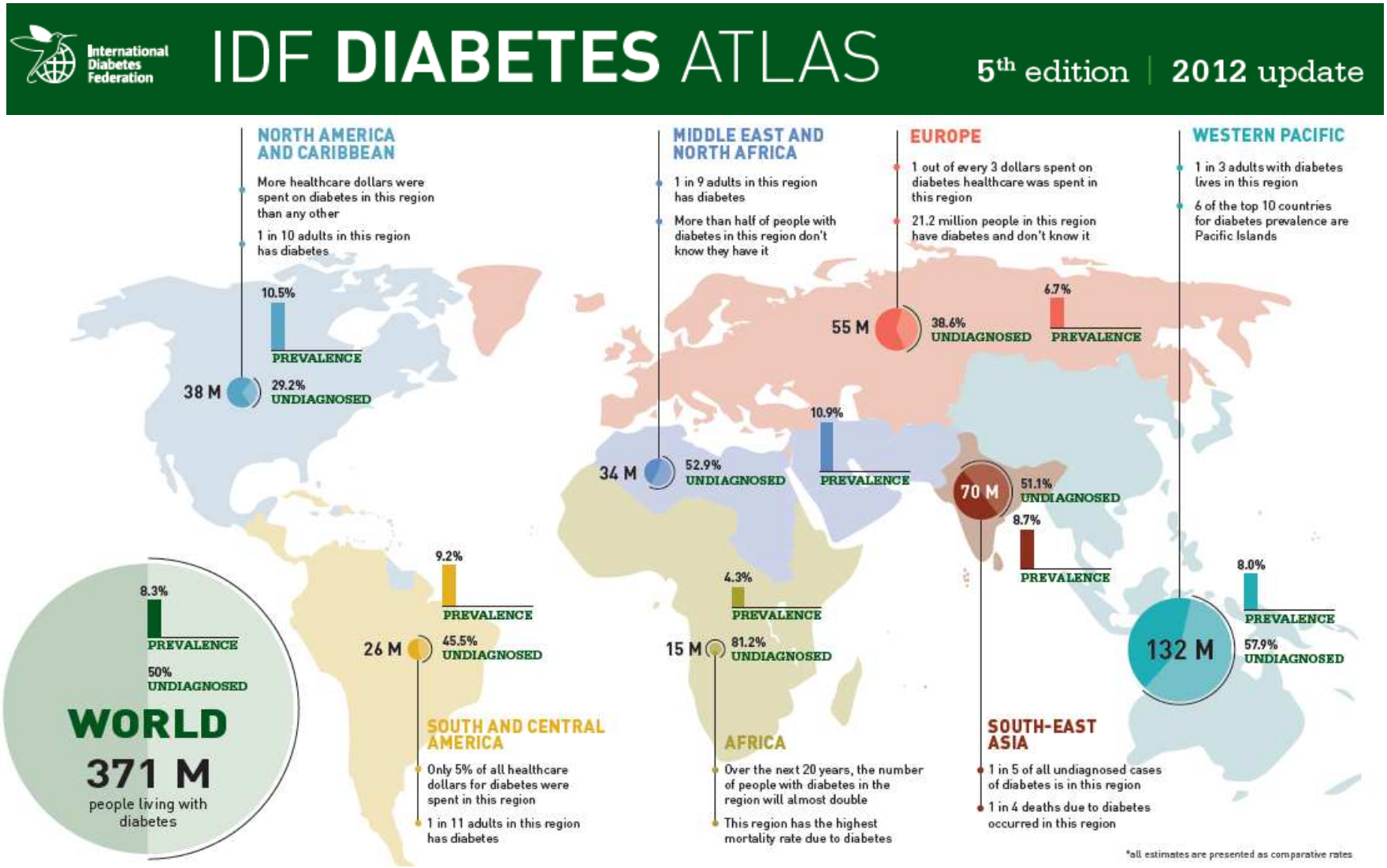
Sport en diabetes

Prof. dr. Dominique Hansen

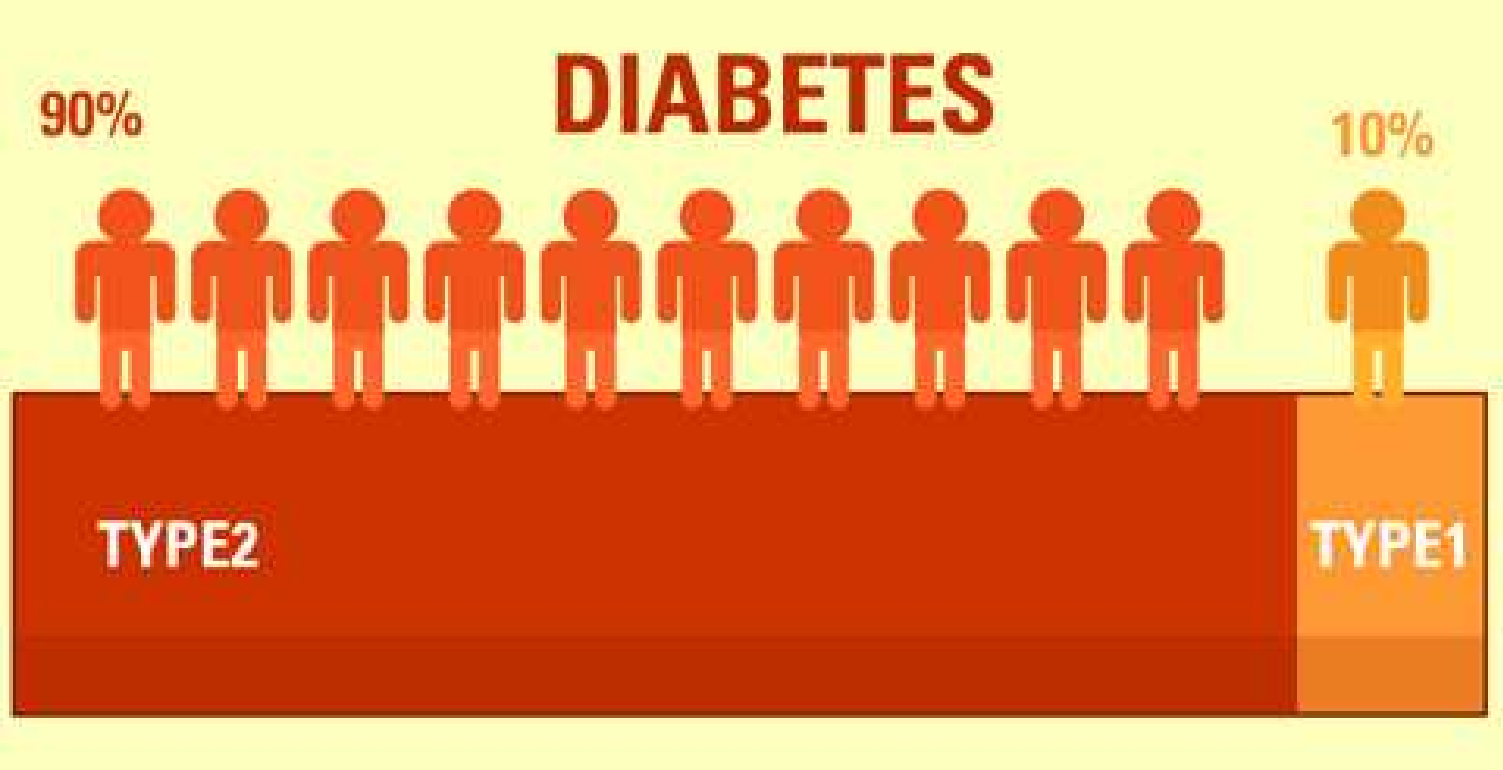
universiteit hasselt
KNOWLEDGE IN ACTION

Diabetes epidemie



universiteit hasselt
KNOWLEDGE IN ACTION

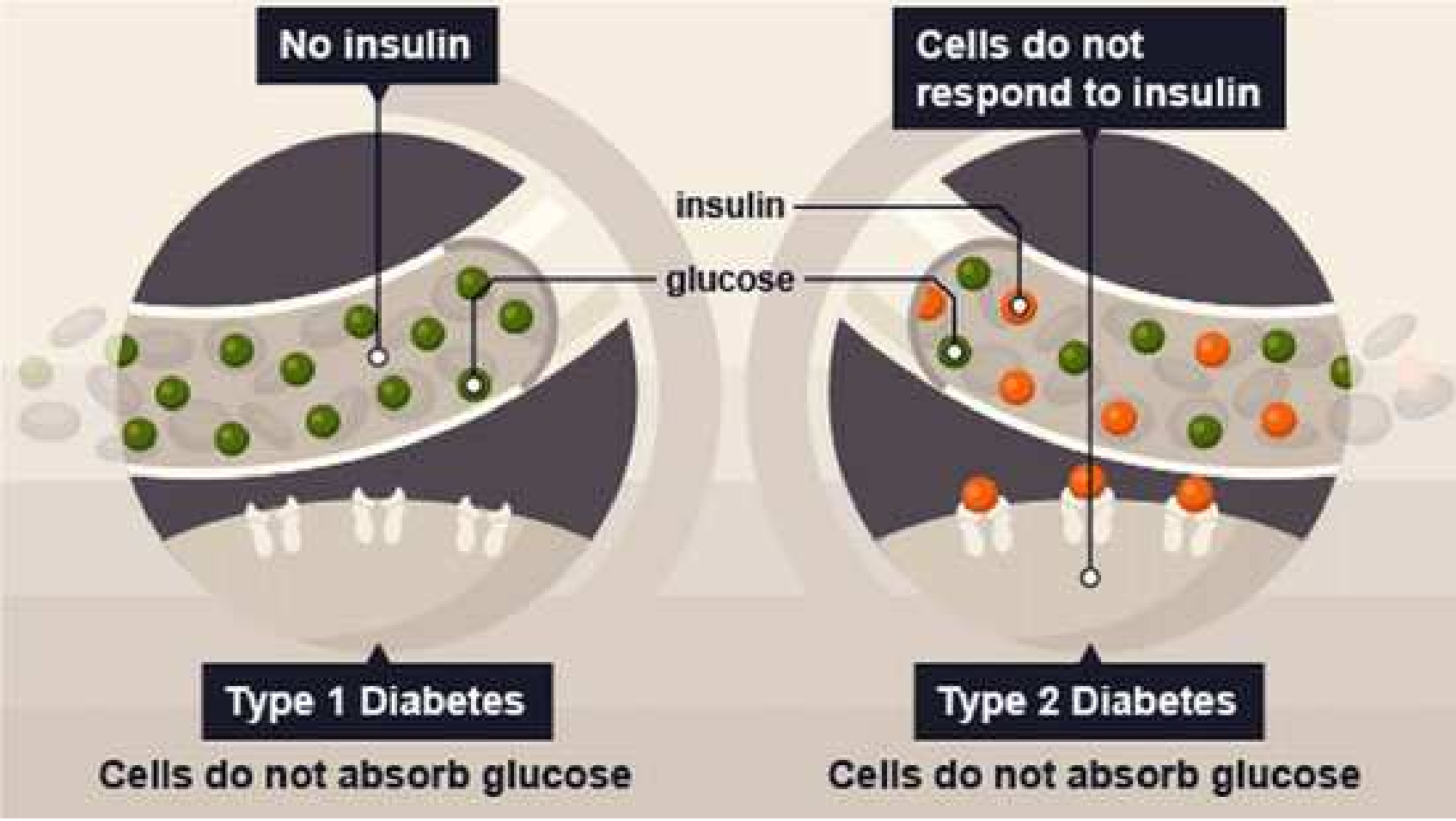
Diabetes epidemie



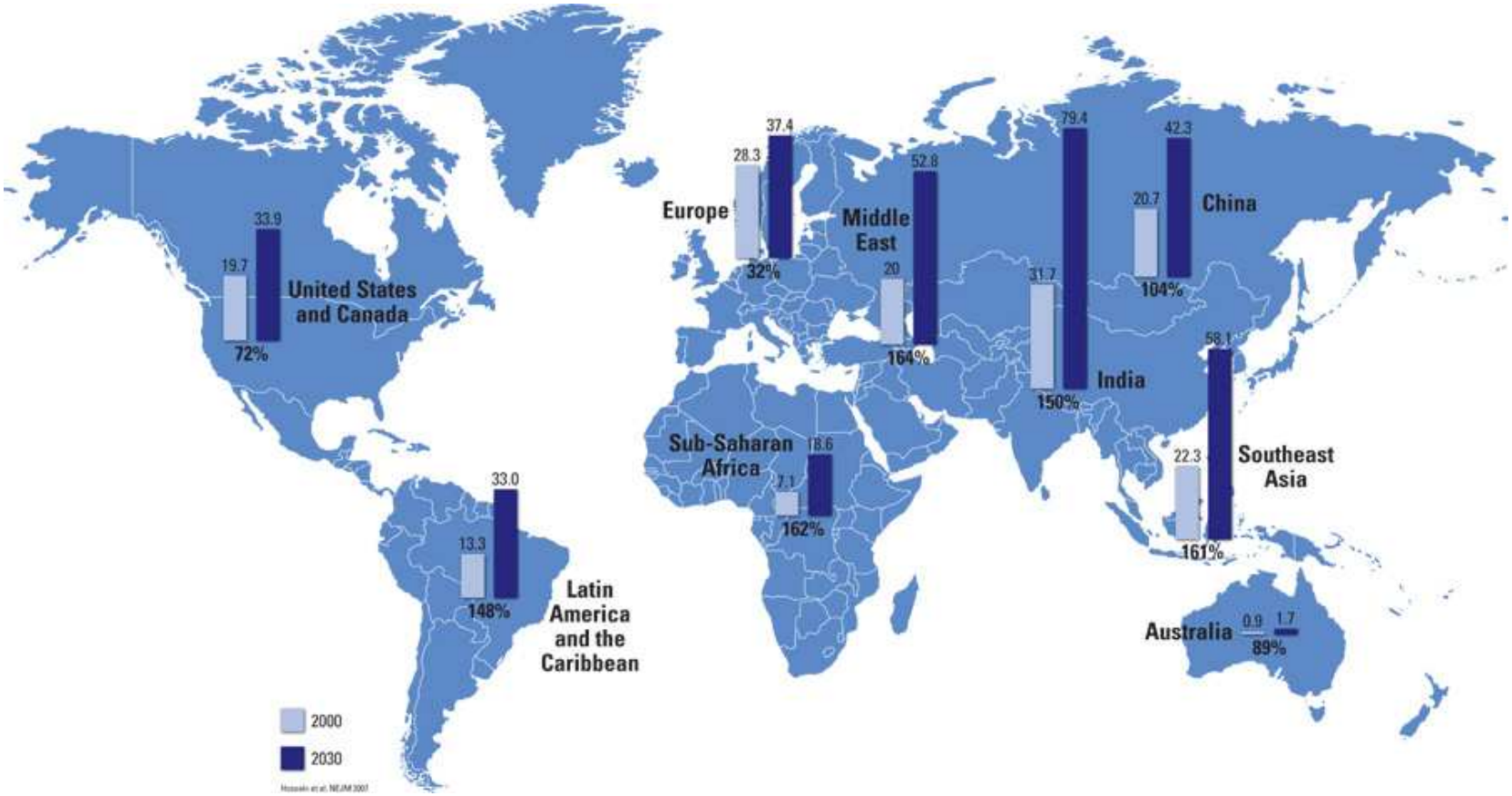
Type 1 vs. type 2 diabetes

Type 1 Diabetes	Type 2 Diabetes
1. Young onset (less than 35 years)	Older onset
2. Rapid onset of symptoms (eg. ketoacidosis)	No obvious symtoms in the early stage
3. Non-obese	Obese
4. Body cannot produce insulin	Insulin secretion can be normal or adnormal, Body cells are resistant to insulin
5. Managed by insulin injections, with diet and exercise control	Managed by oral medications or insulin injections, with diet and exercise control

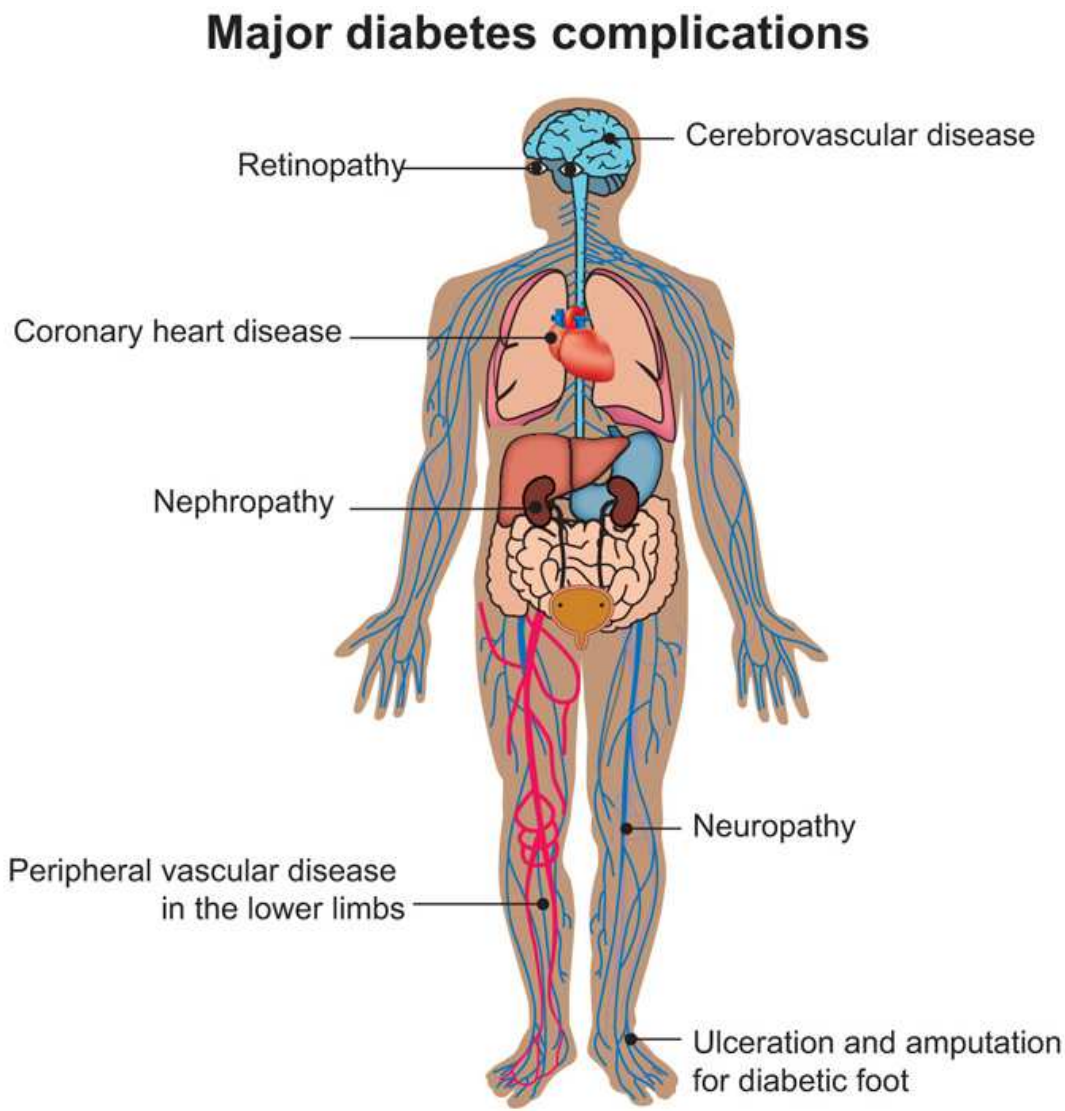
Type 1 vs. type 2 diabetes



Diabetes epidemie



Diabetes epidemie



Diabetes epidemie

QD1 How often do you exercise or play sport?

	Regularly	With some regularity	Seldom	Never	Don't know
EU28	8%	33%	17%	42%	0%
Gender					
Man	9%	36%	18%	37%	0%
Woman	7%	30%	16%	47%	0%
Age					
15-24	11%	53%	17%	19%	0%
25-39	8%	38%	21%	33%	0%
40-54	8%	31%	20%	41%	0%
55 +	8%	22%	12%	58%	0%

European Opinion Research Group: Eurobarometer Report 2014

Sport: waarom?

Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study

Chi Pang Wen, Jackson Pui Man Wai*, Min Kuang Tsai, Yi Chen Yang, Ting Yuan David Cheng, Meng-Chih Lee, Hui Ting Chan, Chwen Keng Tsao, Shan Pou Tsai, Xifeng Wu*

416 175 individuals **average follow-up of 8·05 years**

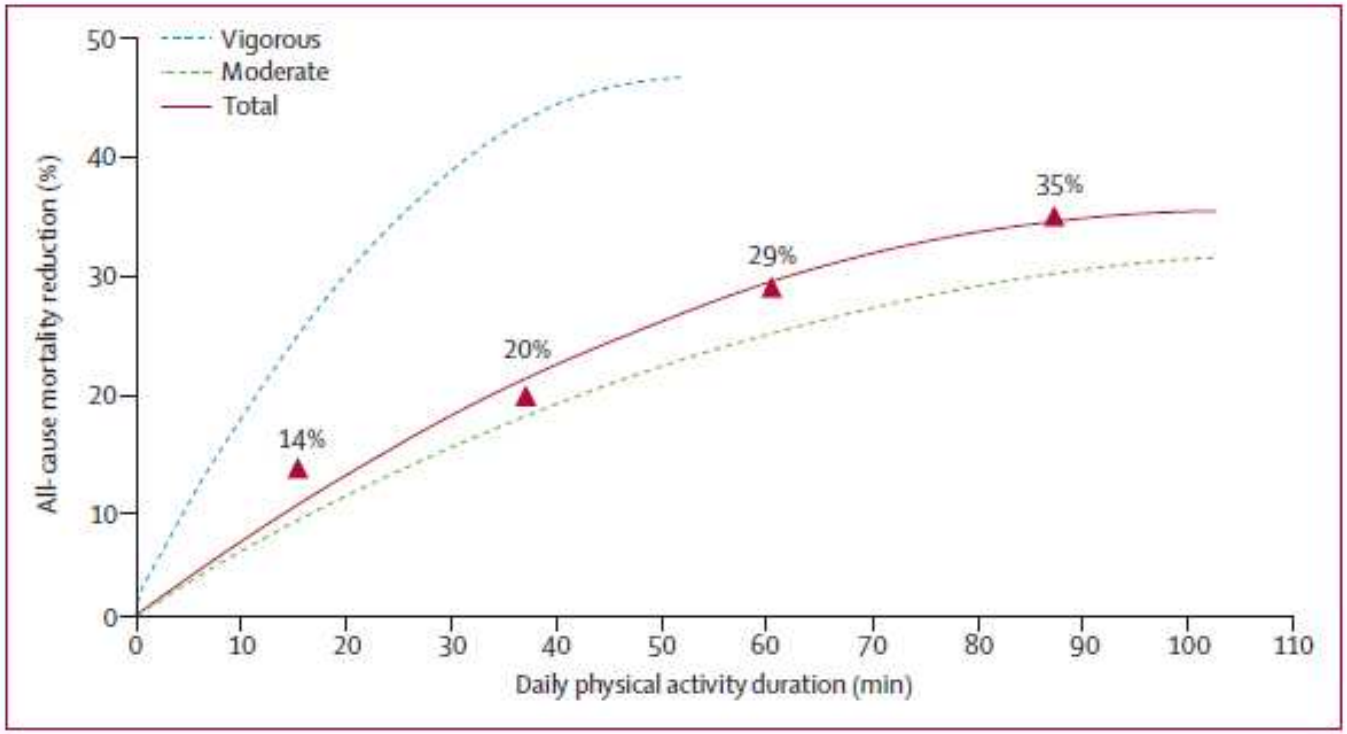


Figure 2: **Daily physical activity duration and all-cause mortality reduction**

Lancet 2011; 378: 1244-53

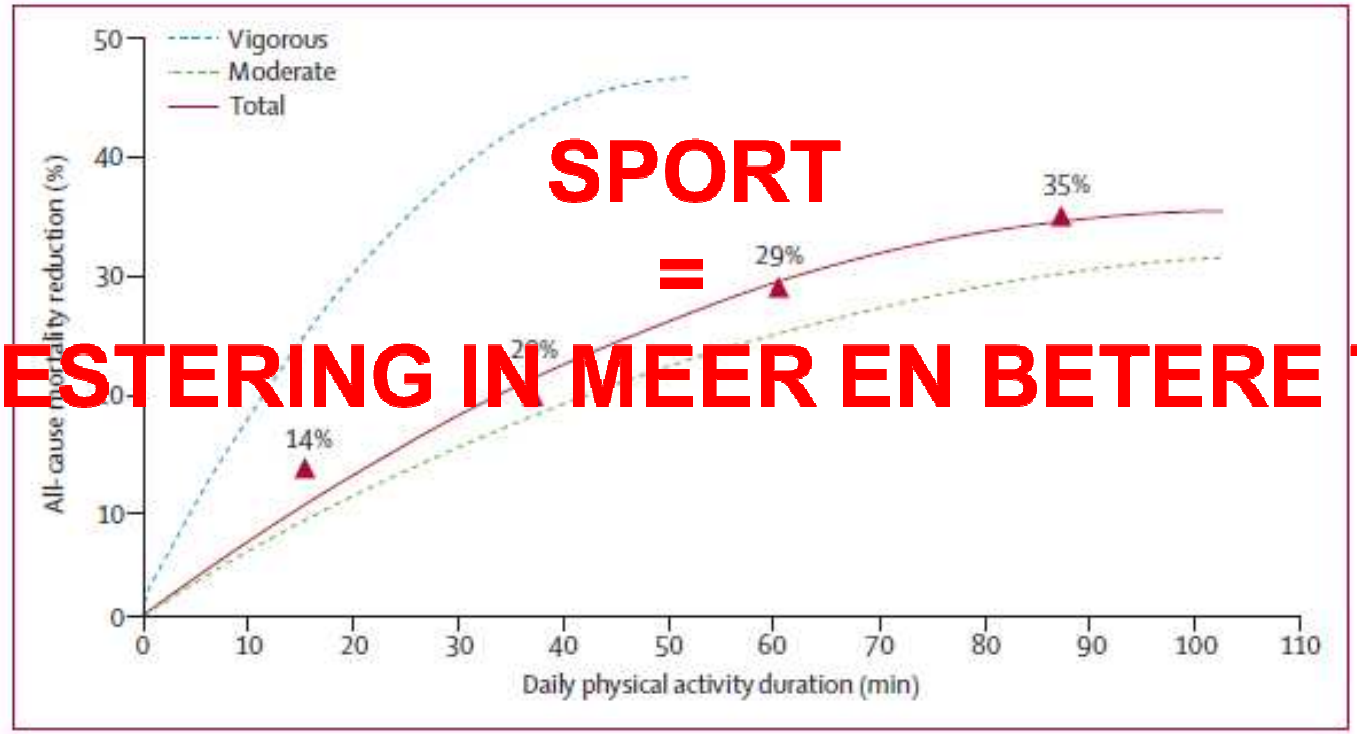
universiteit hasselt
KNOWLEDGE IN ACTION

Sport: waarom?

Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study

Chi Pang Wen, Jackson Pui Man Wai*, Min Kuang Tsai, Yi Chen Yang, Ting Yuan David Cheng, Meng-Chih Lee, Hui Ting Chan, Chwen Keng Tsao, Shan Pou Tsai, Xifeng Wu*

416 175 individuals **average follow-up of 8·05 years**



SPORT
=
INVESTERING IN MEER EN BETERE TIJD

Figure 2: Daily physical activity duration and all-cause mortality reduction

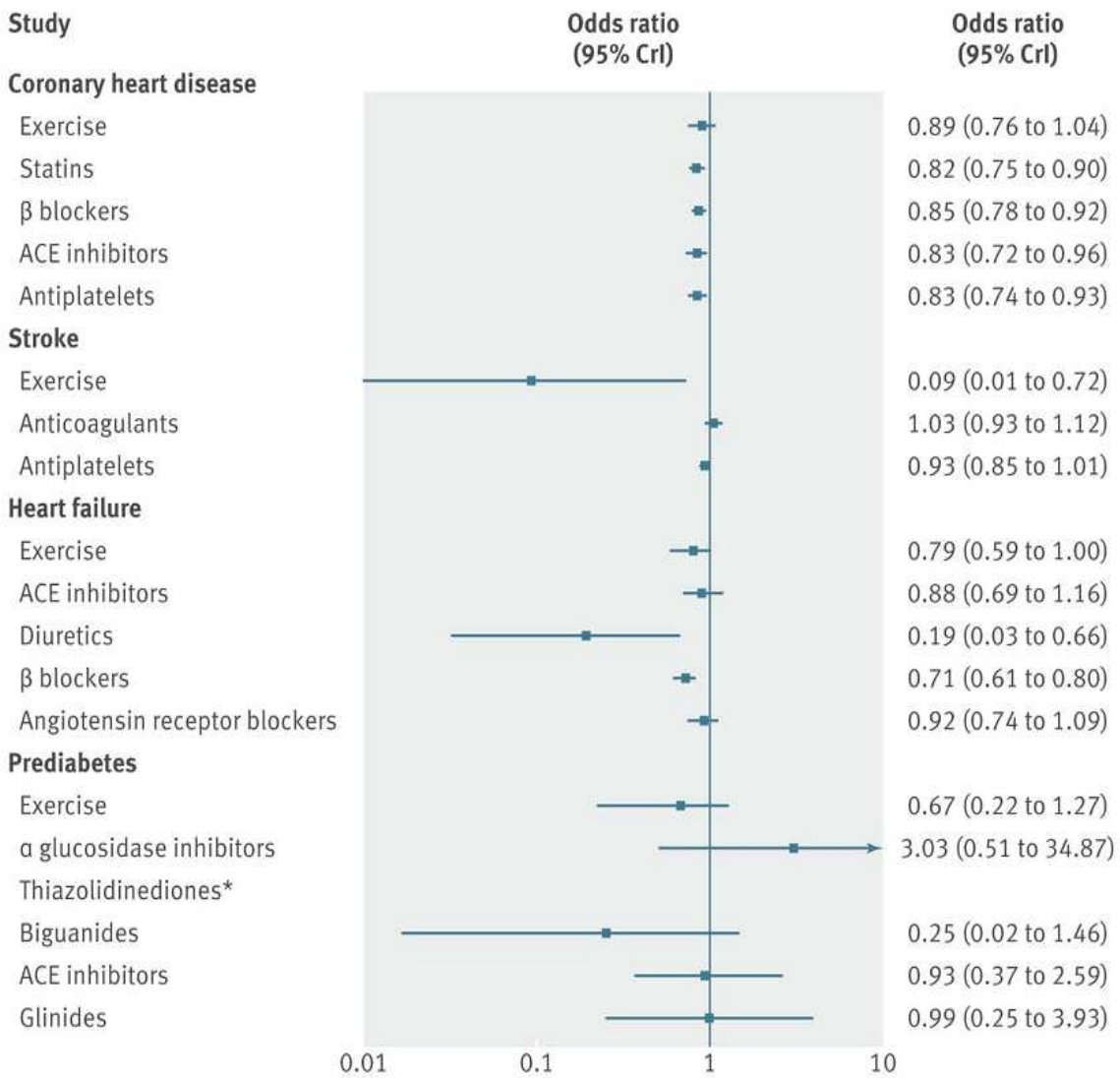
Lancet 2011; 378: 1244-53

universiteit hasselt
KNOWLEDGE IN ACTION

Sport: waarom?

Comparative effectiveness of exercise interventions on mortality outcomes: metaepidemiological study

Huseyin Naci,[1,2] John P A Ioannidis[3]



Br J Sports Med 2015;**49**:1414–1422.

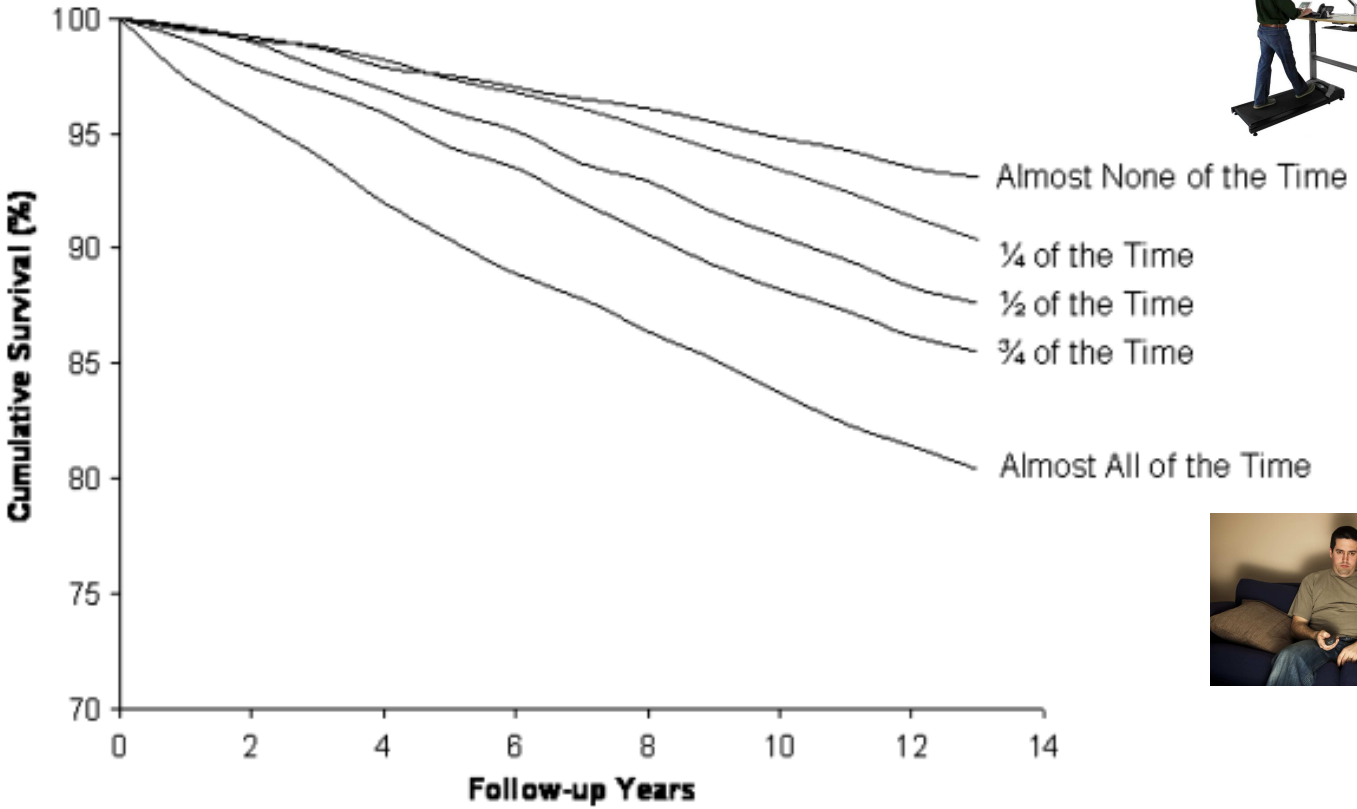
universiteit hasselt
KNOWLEDGE IN ACTION

Sport: waarom?

Leisure Time Spent Sitting in Relation to Total Mortality in a Prospective Cohort of US Adults

Alpa V. Patel*, Leslie Bernstein, Anusila Deka, Heather Spencer Feigelson, Peter T. Campbell, Susan M. Gapstur, Graham A. Colditz, and Michael J. Thun

184,190 participants



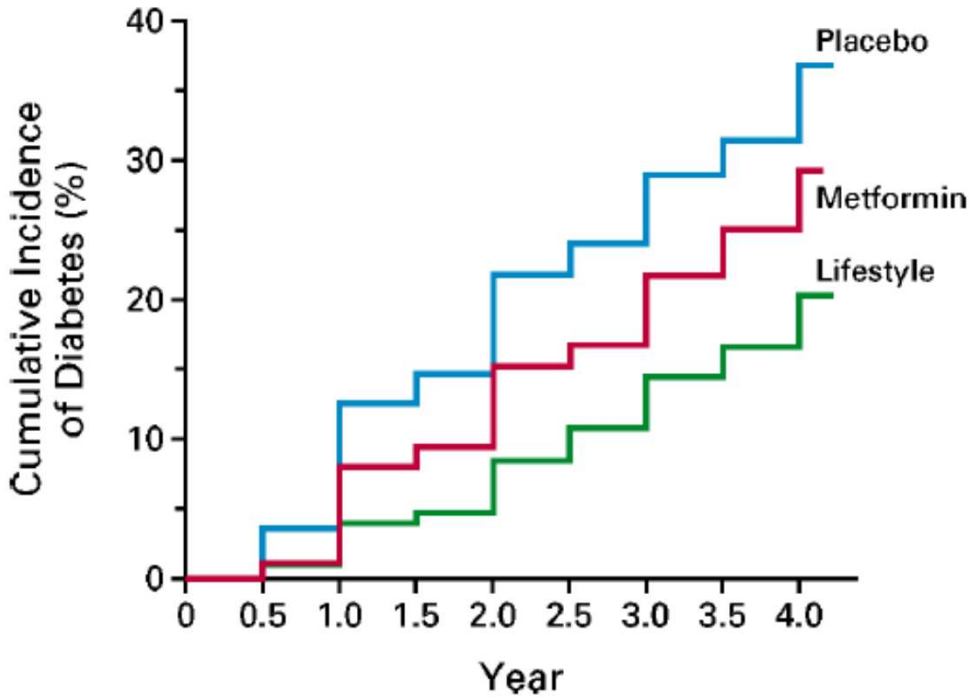
Am J Epidemiol 2010;172:419–429

universiteit hasselt
KNOWLEDGE IN ACTION

Sport in type 2 diabetes: waarom?

Prevention of type 2 diabetes

– 3234 glucose-intolerant subjects

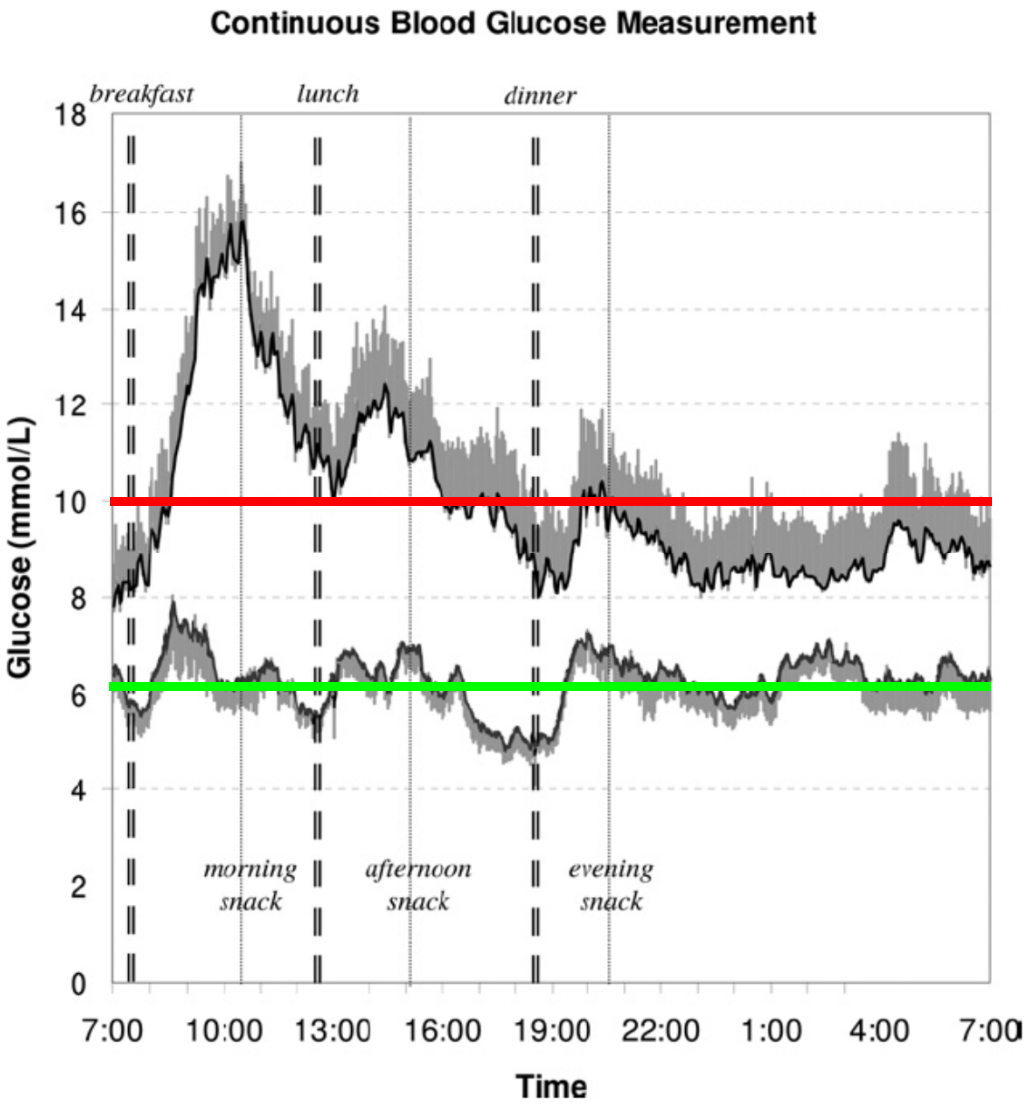


Dagelijkse metformine inname = -33% T2DM risico

Verandering in levensstijl = -58% T2DM risico

Knowler et al. N Engl J Med 2002; 346: 393

Sport in type 2 diabetes: waarom?



13.30h hyperglycemisch

0.4h hyperglycemisch

Praet et al. Clin Sci 2006; 111: 119

universiteit hasselt
KNOWLEDGE IN ACTION

Sport in type 2 diabetes: waarom?

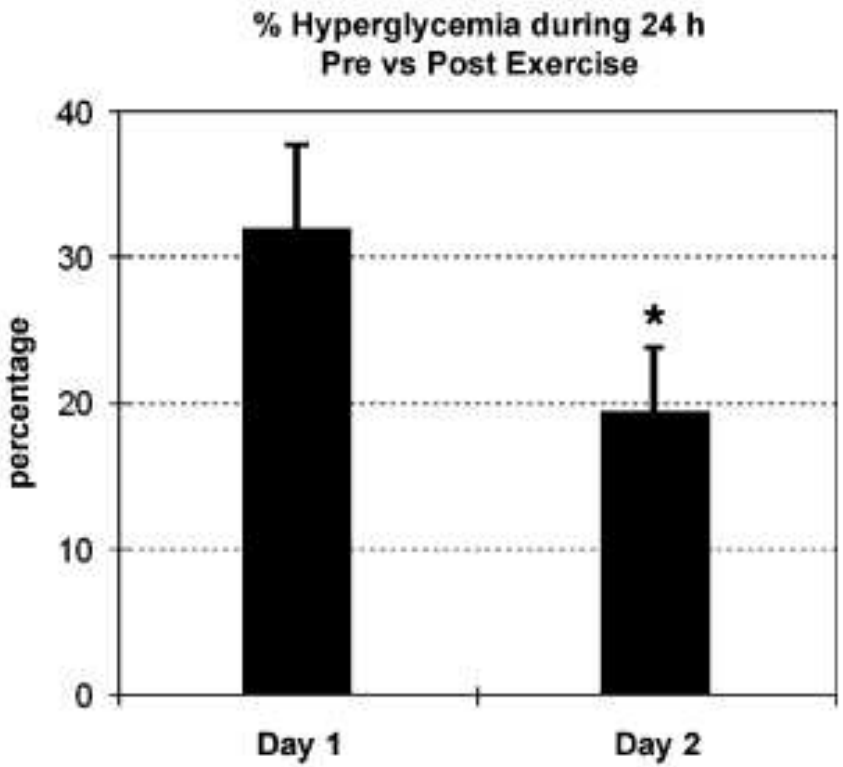


FIGURE 3—The duration of hyperglycemia, (i.e., percentage of time [glucose] above 10.0 mmol·L^{-1}), 24 h before and after 45 min of circuit training. Values are expressed as means ± SEM. * Significantly different from values observed on day 1 (preexercise) ($P < 0.05$).

Praet et al. Med Sci Sports Exerc 2006; 38: 2037

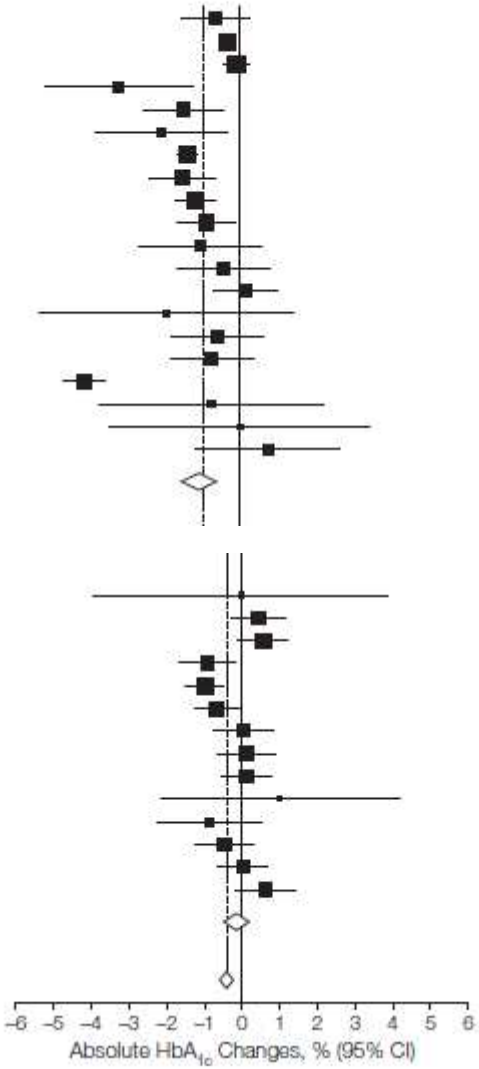
universiteit hasselt
KNOWLEDGE IN ACTION

Umpierre D, et al. JAMA 2011; 305: 1790-99

Sport in type 2 diabetes: waarom?

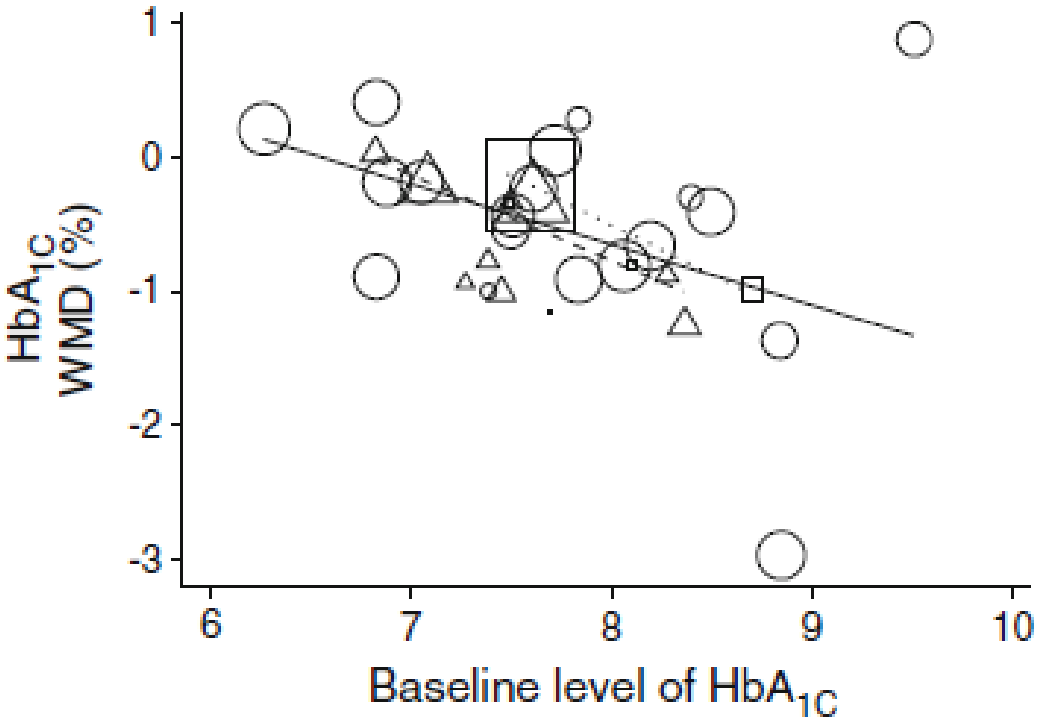
Figure 1. Absolute Changes in HbA_{1c} of Individual Studies of Structured Exercise Training vs No Intervention

Source	No. of Patients: Intervention	No. of Patients: Control	HbA_{1c} Weighted Mean Difference, % (95% CI)	Weight, %
Aerobic training				
Bjørgaas et al,[20] 2005	11	11	−0.44 (−1.03 to 0.15)	3.46
Church et al,[8] 2010	72	41	−0.23 (−0.30 to −0.16)	5.77
Cuff et al,[21] 2003	9	9	−0.07 (−0.28 to 0.14)	5.37
Dela et al,[22] 2004	14	10	−2.14 (−3.43 to −0.86)	1.38
Giannopoulou et al,[23] 2005	11	11	−1.00 (−1.70 to −0.30)	2.96
Goldhaber-Fiebert et al,[24] 2003	33	28	−1.40 (−2.56 to −0.24)	1.61
Kadoglou et al,[25] 2007	29	27	−0.93 (−1.08 to −0.78)	5.57
Kadoglou et al,[26] 2007	28	26	−1.02 (−1.59 to −0.45)	3.55
Kadoglou et al,[27] 2010[a]	22	21	−0.80 (−1.15 to −0.45)	4.68
Kadoglou et al,[27] 2010[b]	23	23	−0.59 (−1.11 to −0.07)	3.81
Lambers et al,[28] 2008	18	11	−0.70 (−1.78 to 0.38)	1.78
Ligtenberg al,[29] 1997	25	26	−0.30 (−1.11 to 0.51)	2.57
Middlebrooke et al,[30] 2006	22	30	0.10 (−0.45 to −0.65)	3.64
Raz et al,[31] 1994	19	19	−0.30 (−3.53 to 0.93)	0.54
Ribeiro et al,[32] 2008	11	10	−0.40 (−1.19 to 0.39)	2.61
Sigal et al,[7] 2007	60	63	−0.50 (−1.22 to 0.22)	2.88
Sridhar et al,[33] 2010	55	50	−2.76 (−3.13 to −2.39)	4.60
Vancea et al,[34] 2009[c]	14	17	−0.50 (−2.47 to 1.47)	0.68
Vancea et al,[34] 2009[d]	9	17	0.00 (−2.30 to 2.30)	0.51
Verity and Ismail,[35] 1989	5	5	0.50 (−0.75 to 1.75)	1.43
All aerobic training I^2 = 92.8%; *P* for heterogeneity <.001			−0.73 (−1.06 to −0.40)	59.41
Physical activity advice alone				
Brun et al,[53] 2008	13	12	−0.04 (−3.93 to 3.85)	0.16
Cheung et al,[54] 2009	20	17	0.40 (−0.29 to −1.09)	3.49
Diedrich et al,[55] 2010	27	26	0.54 (−0.11 to 1.19)	3.82
Kim and Kang,[56] 2006[a]	22	23	−0.94 (−1.68 to −0.20)	3.19
Kim and Kang,[56] 2006[b]	28	23	−1.02 (−1.51 to −0.53)	5.28
Kirk et al,[57] 2003	26	31	−0.68 (−1.26 to −0.10)	4.40
Kirk et al,[58] 2009[c]	47	35	0.00 (−0.79 to 0.79)	2.88
Kirk et al,[58] 2009[d]	51	35	0.10 (−0.65 to 0.85)	3.13
Krousel-Wood et al,[59] 2008	37	39	0.10 (−0.56 to 0.76)	3.71
Leehey et al,[60] 2009	7	4	1.00 (−2.16 to 4.16)	0.24
Rönnemaa et al,[61] 1986	13	12	−0.90 (−2.25 to 0.45)	1.20
Samaras et al,[62] 1997	13	13	−0.49 (−1.24 to 0.26)	3.10
Tudor-Locke et al,[63] 2004	24	23	0.00 (−0.66 to 0.66)	3.72
van Rooijen et al,[64] 2004	75	74	0.62 (−0.14 to 1.38)	3.09
All advice alone I^2 = 61.2%; *P* for heterogeneity = .001			−0.16 (−0.50 to 0.18)	41.40
Overall I^2 = 62.9%; *P* for heterogeneity <.001			−0.43 (−0.59 to −0.28)	100.00



universiteit hasselt
KNOWLEDGE IN ACTION

Sport in type 2 diabetes: waarom?



Umpierre D, et al. Diabetologia 2013; 56: 242-51

Sport in type 2 diabetes: waarom?

- Er zijn velerlei andere positieve effecten:
  - Kwaliteit van leven
  - Fysieke fitheid
  - Risico voor kanker
  - Risico voor dementie
  - Risico voor hart –en vaatziekten
    - Betere risicofactoren

Sport in type 1 diabetes: waarom?

Sport in type 1 diabetes: waarom?

A systematic review and meta-analysis of exercise interventions in adults with type 1 diabetes

Jane E. Yardley[a,b], *Jacqueline Hay*[a], *Ahmed M. Abou-Setta*[c,d], *Seth D. Marks*[e], *Jonathan McGavock*[a,*]

Study or Subgroup	Excerise group Mean	SD	Total	Control group Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Landt 1985	12	3	9	12	2.45	6	1.7%	0.00 [-2.77, 2.77]	1985
Wallberg-Henriksson 1986	10.83	1.42	6	10.58	1.53	7	5.2%	0.25 [-1.35, 1.85]	1986
Laaksonen 2000	8	1	20	8.5	1.6	22	21.0%	-0.50 [-1.30, 0.30]	2000
Salem 2010	7.95	1.06	148	8.9	1.4	48	72.1%	-0.95 [-1.38, -0.52]	2010
Total (95% CI)			**183**			**83**	**100.0%**	**-0.78 [-1.14, -0.41]**	

Heterogeneity: Tau² = 0.00; Chi² = 2.95, df = 3 (P = 0.40); I² = 0%
Test for overall effect: Z = 4.16 (P < 0.0001)

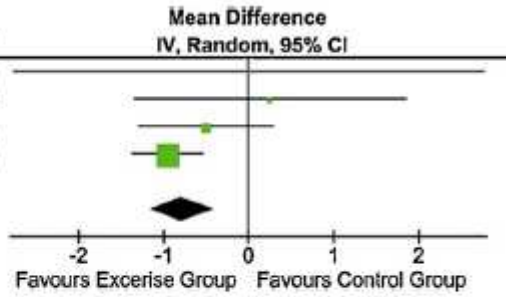


Fig. 2 – Post-treatment glycated hemoglobin (HbA_{1C})*.

Table 3 – Secondary study outcomes.

Outcome Measure	Trials	Intervention	Control	Effect estimate (95% CI)	I^2 (uCI)
Maximal oxygen uptake [12,22,23]	3	35	35	MD 3.45 (0.59, 6.31)	0% (0%, 88%)
Weight (kg) [21,24]	2	24	19	MD 1.10 (0.11, 2.10)	0%
Body mass index [22,24,26]	3	183	82	MD −0.02 (−0.40, 0.37)	57% (0%, 88%)
Insulin dose (U/kg) [22,26]	2	168	70	MD −0.21 (−0.58, 0.16)	94%
High density lipoprotein [12,21,22,26]	4	183	84	SMD 0.34 (−0.56, 1.23)	85% (63%, 94%)
Low density lipoprotein [12,21,22,26]	4	183	84	SMD −0.02 (−0.29, 0.25)	0% (0%, 70%)
Very low density lipoprotein [12]	1	6	7	MD 0.00 (−0.14, 0.14)	NE
Total cholesterol [12,21,26]	3	163	62	SMD −0.72 (−1.70, 0.27)	77% (24%, 93%)
Total triglycerides [12,21,26]	3	163	62	SMD −0.57 (−1.19, 0.06)	48% (0%, 85%)
Apolipoprotein (a) [12]	1	9	7	MD 0.13 (−0.05, 0.31)	NE
Apolipoprotein (b) [22]	1	20	22	MD −0.07 (−0.19, 0.05)	NE

CI = confidence intervals; I^2 = I-squared; MD = mean difference; SMD = standardized mean difference; uCI = uncertainty intervals around the I-squared statistic.

Sport in type 2 diabetes: hoe?

Your Prescription for Health

ExeRcise is Medicine™

www.ExerciseIsMedicine.org

Trainingsintensiteit

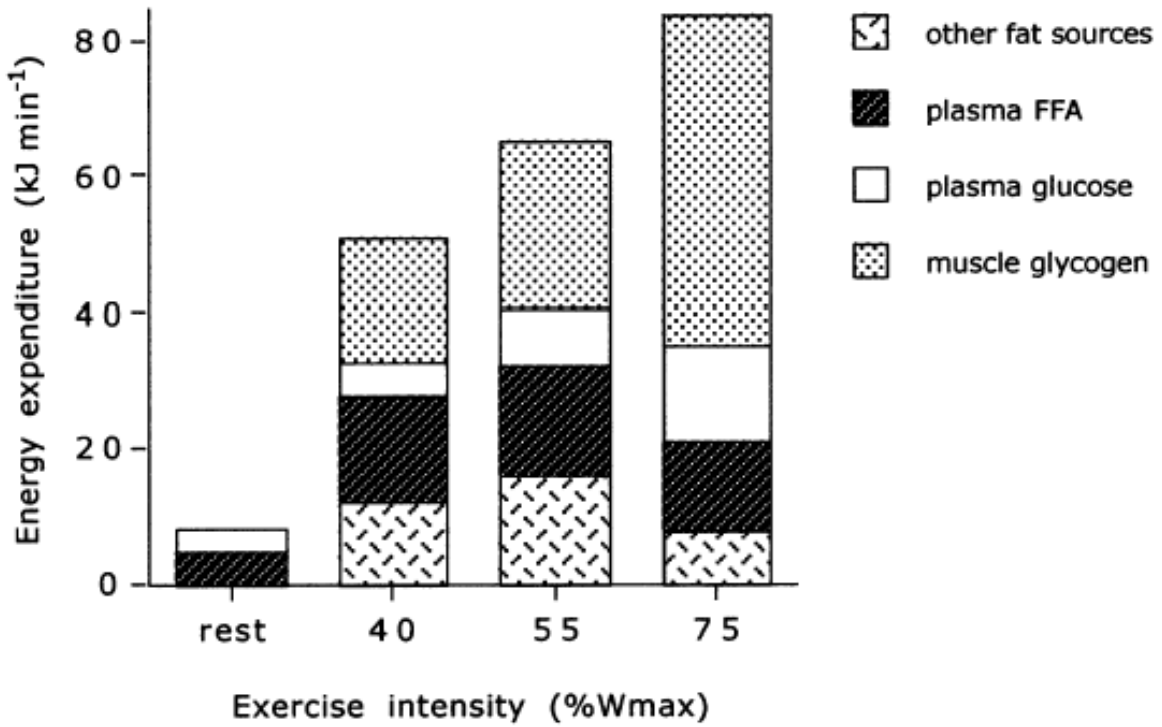
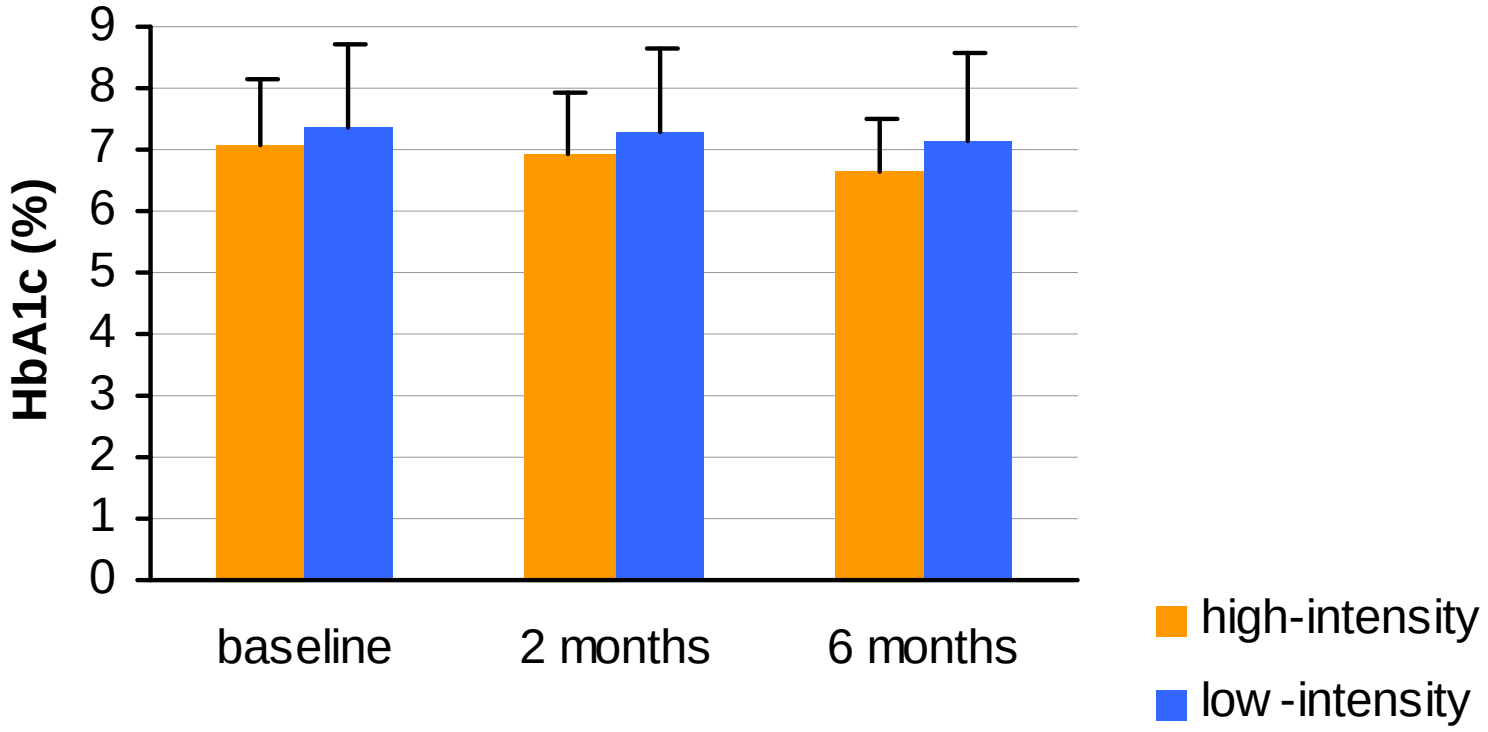


Figure 4. Energy expenditure and fuel selection
Values are means. FFA, free fatty acid.

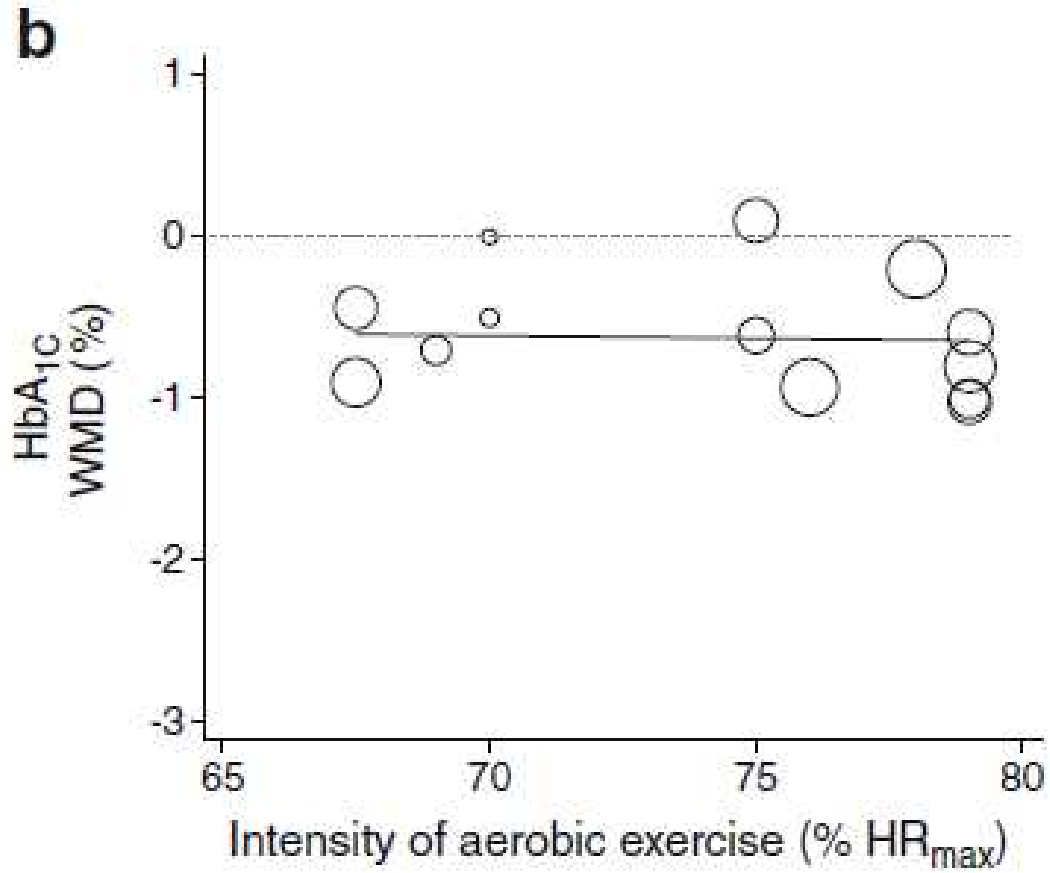
Van Loon LJ, et al. J Physiol 2001; 536: 295

Trainingsintensiteit



Hansen D, et al. Diabetologia 2008: 52: 1789-97

Trainingsintensiteit



Umpierre D, et al. Diabetologia 2013; 56: 242-51

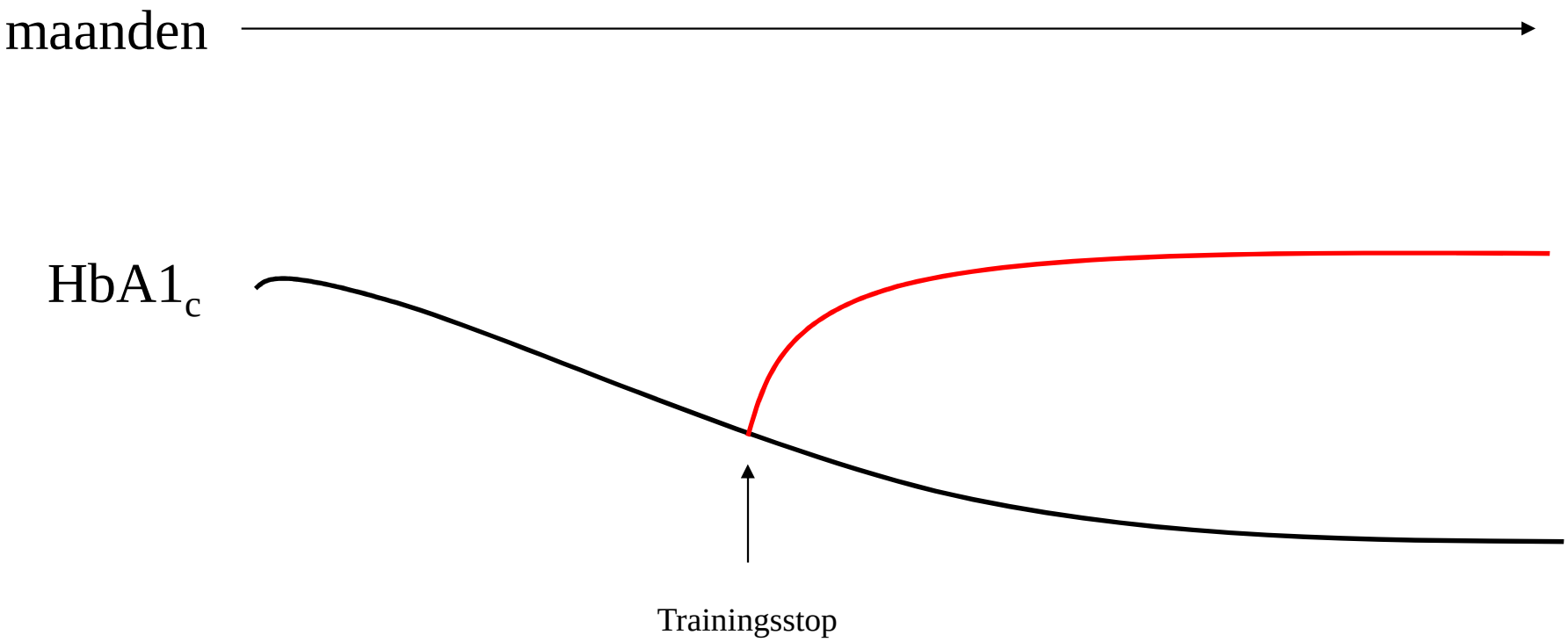
universiteit hasselt
KNOWLEDGE IN ACTION

Sessieduur/volume

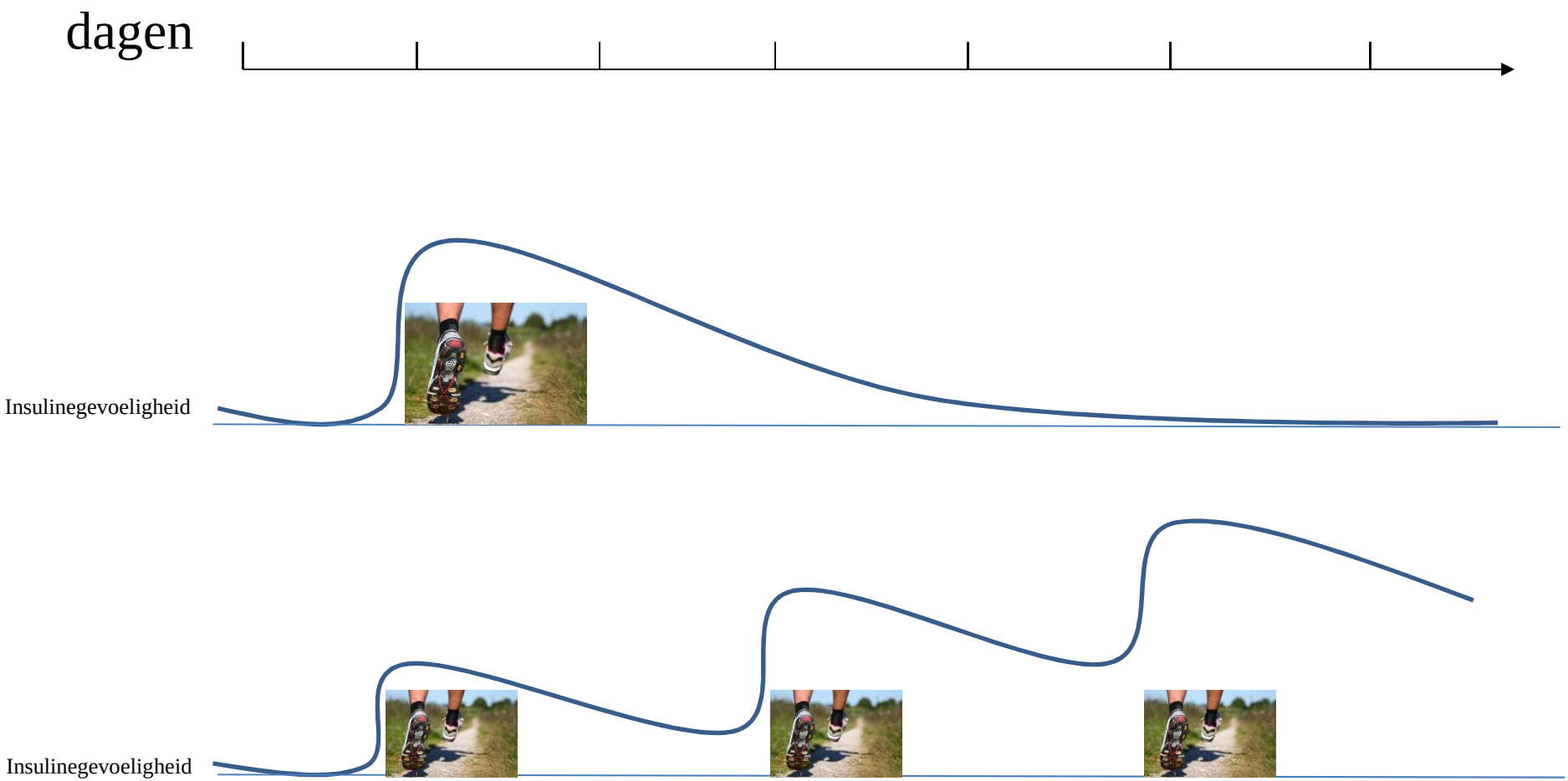
- Veronderstelling
  - Groter sportvolume = groter effect
    - Bloedsuikerspiegel daalt sterker

Sriwijitkamol A, et al. Diabetes 2007; 56: 836-48

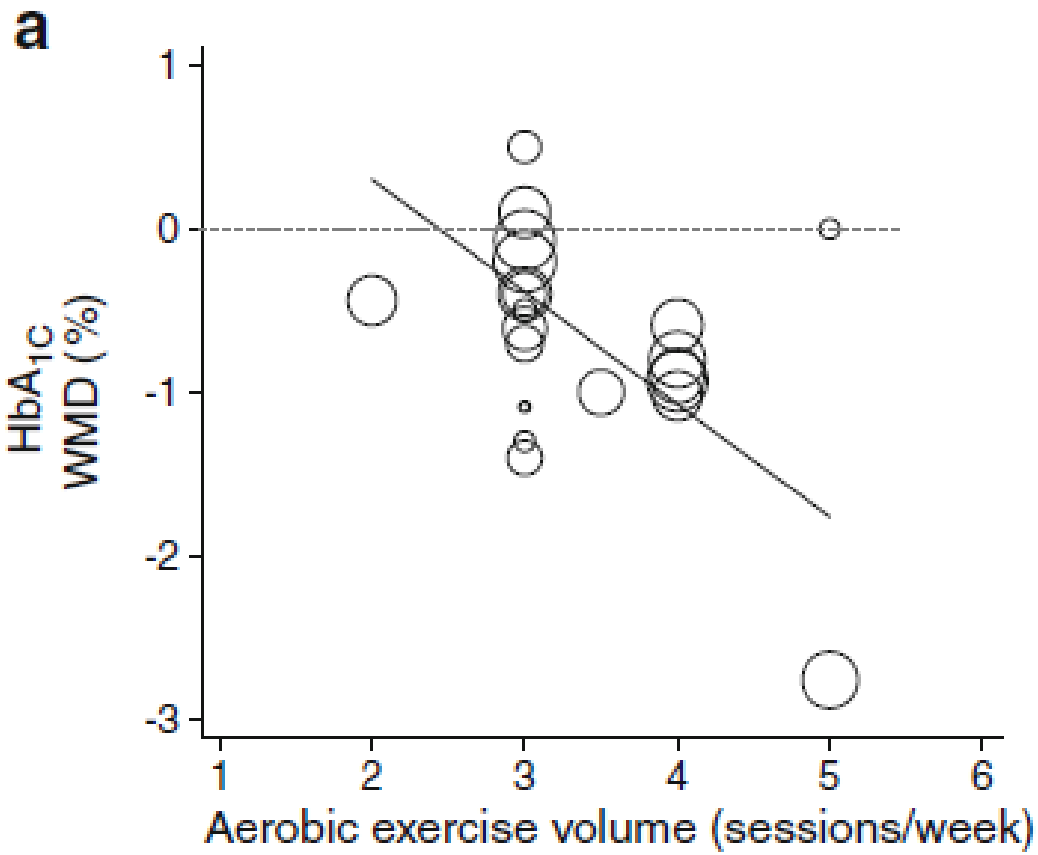
Programmaduur



Oefenfrequentie

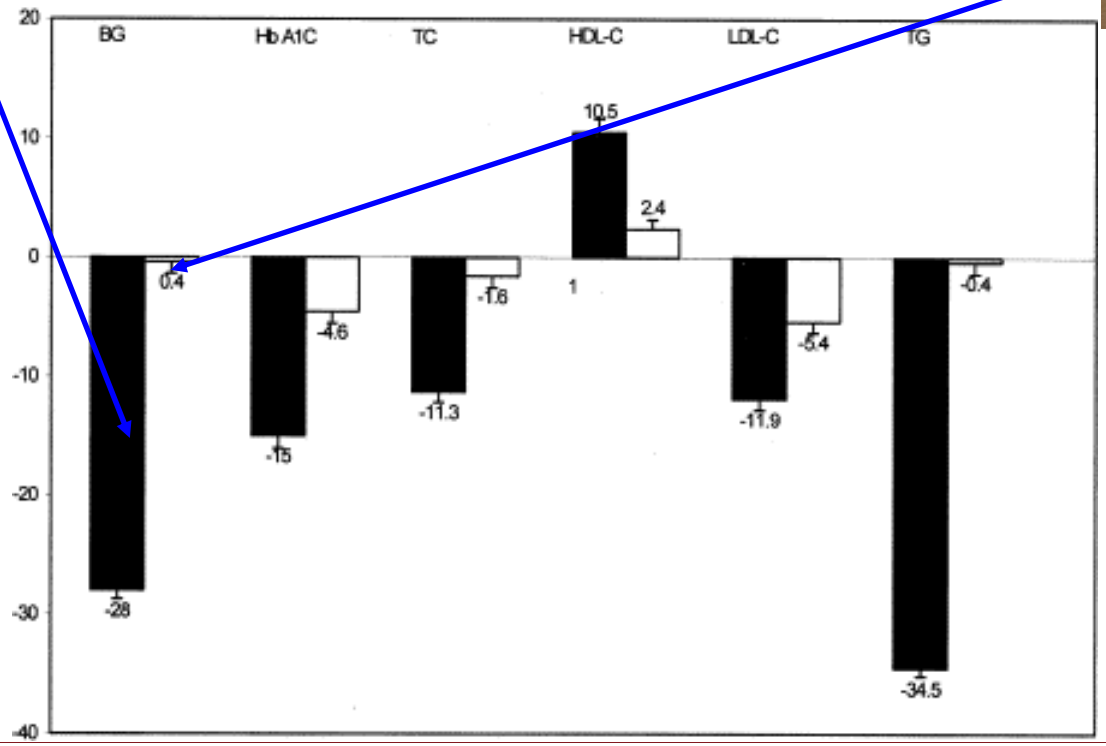


Oefenfrequentie



Umpierre D, et al. Diabetologia 2013; 56: 242-51

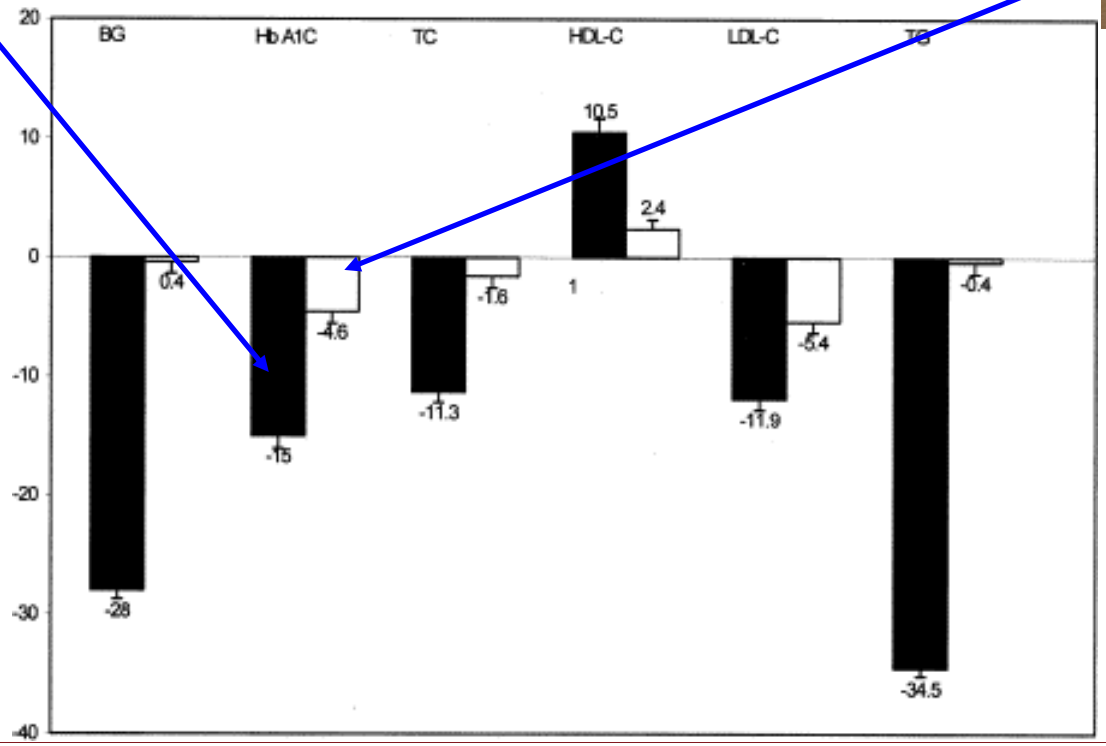
Krachttraining?



Cauza et al. Arch Phys Med Rehabil 2005; 86: 1527

universiteit hasselt
KNOWLEDGE IN ACTION

Krachttraining?

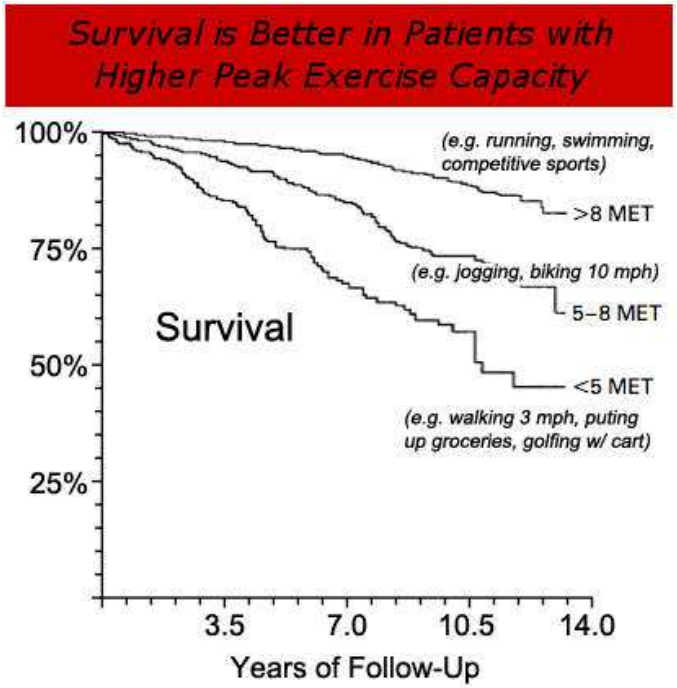


Cauza et al. Arch Phys Med Rehabil 2005; 86: 1527

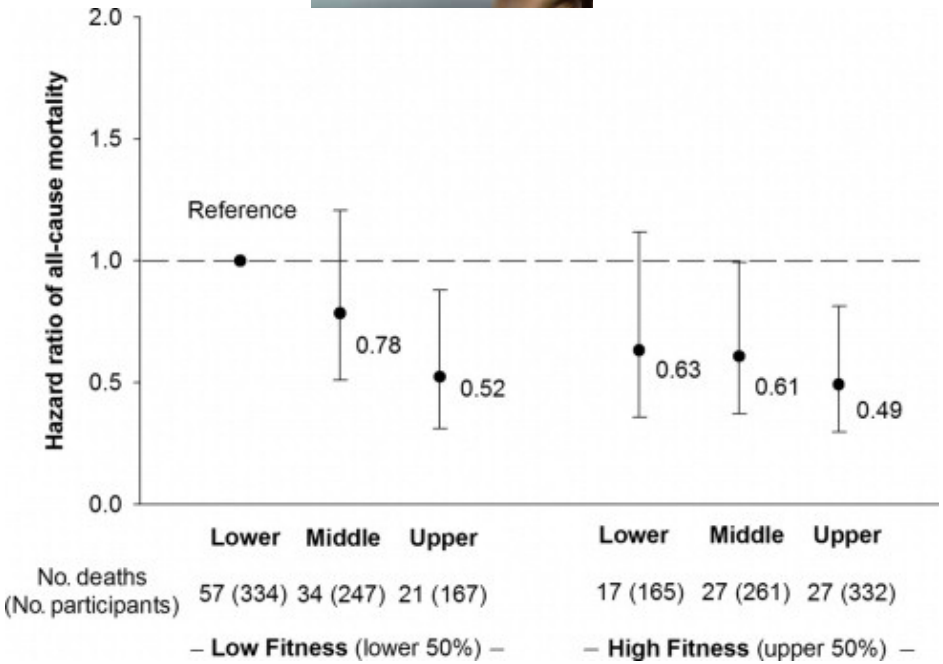
universiteit hasselt
KNOWLEDGE IN ACTION

Krachttraining?

Vs.



Myers J. et al. N Engl J Med 2002; 346:793-801.



Artero EG, et al. J Am Coll Cardiol. 2011; 57:1831-1837

Sport in type 1 diabetes: hoe?

Effects of Different Types of Acute and Chronic (Training) Exercise on Glycaemic Control in Type 1 Diabetes Mellitus

A Meta-Analysis

Cajsa Tonoli,[1,2] *Elsa Heyman,*[2] *Bart Roelands,*[1,3] *Luk Buyse,*[1] *Stephen S. Cheung,*[4] *Serge Berthoin*[5] and *Romain Meeusen*[1]

Sports Med 2012; 42 (12): 1059-1080

Table VIII. Meta-analytic results for specific thresholds (volume, duration, intensity; additional recommendations; baseline glycaemic control) to gain significant improvement in glycated haemoglobin

Training protocol	Cohen's d	95% CI LL	95% CI UL	No. of studies	No. of subjects
Overall					
<3 mo of training	−0.49	−0.96	0.00	3	35
=3 mo of training	0.06	−0.26	0.39	6	73
>3 mo of training	−0.75	−1.03	−0.47	8	108
<3 ×/wk training	−0.34	−0.65	−0.02	5	79
≥3 ×/wk training	−0.06	−0.33	0.21	10	106
Poor baseline glycaemic control (>8% HbA_{1c})	−0.25	−0.48	−0.02	11	151
Adequate baseline glycaemic control (<8% HbA_{1c})	−0.02	−0.64	0.6	1	20
Increased $\dot{V}O_{2max}$ due to training programme	−0.43	−1.31	0.46	1	10
No changes in $\dot{V}O_{2max}$ due to training programme	−0.63	−1.39	0.13	1	14
Aerobic training					
<3 mo of training	−0.27	−0.9	0.35	1	20
=3 mo of training	0.13	−0.21	0.47	5	67
>3 mo of training	−0.43	−0.83	−0.16	5	71
Poor baseline glycaemic control (>8% HbA_{1c})	−0.25	−0.48	−0.02	11	151
Adequate baseline glycaemic control (<8% HbA_{1c})	−0.02	−0.64	0.6	1	20
<3 ×/wk training	−0.63	−0.97	−0.29	5	69
≥3 ×/wk training	0.00	−0.3	0.31	7	82
Increased $\dot{V}O_{2max}$ due to training programme	−0.43	−1.31	0.46	1	10
No changes in $\dot{V}O_{2max}$ due to training programme	−0.63	−1.39	0.13	1	14
Dietary advice	0.65	−0.43	1.72	1	7
No dietary advice	−0.66	−1.45	0.13	1	13
Resistance training					
<3 mo of training	−0.93	−1.96	0.09	1	8
=3 mo of training	−0.26	−1.39	0.88	1	6
Mixed training					
Insulin and dietary advice	−0.6	−1.14	−0.82	1	8
No insulin and dietary advice	−0.23	−1.16	0.69	1	9
<3 d/wk	0.82	−0.09	1.73	1	10
=3 d/wk	−0.2	−0.87	0.48	2	17

HbA_{1c} = glycated haemoglobin **LL** = lower limit; **UL** = upper limit; **$\dot{V}O_{2max}$** = maximal oxygen consumption.

Sport in type 1 diabetes: hoe?

Grotere vrijzetting van groeihormoon en adrenaline

Verhoogde vrijzetting van glucose door lever

Medische veiligheid van inspanning

- Perifere neuropathie en vertraagde wondgenezing
  - Wees alert voor voetwonden

- Autonome neuropathie
  - Stoornissen bloeddruk
- Hart –en vaatziekten
  - Stoornissen hartfunctie
- Retinopathie
  - Geen hoog-intense inspanning
- Nefropathie
  - Geen hoge bloeddrukken toelaten

ACSM & ADA. Med Sci Sports Exerc 2010; 42: 2282-303

Medische veiligheid van inspanning

Suikercontrole tijdens training

- Start trainingssessie
  - Glucose <75 mg/dl: suiker innemen
  - Glucose <100 mg/dl: wees alert voor hypoglycemie
  - Glucose >300 mg/dl: niet ok

- Risico's voor hypoglycemie tijdens inspanning
  - Hoog calorieverbruik
  - Training in nuchtere toestand?
  - Medicatie: sulfonylorea, meglitinide, insuline

ACSM & ADA. Med Sci Sports Exerc 2010; 42: 2282-303

Medische veiligheid van inspanning

Adjustments of Exogenous Insulin Therapy Dose Ahead of Exercise Training[69]

Duration and Type of Exercise	Glycemia Pre-exercise	Insulin Adjustment Pre-exercise	Extra Glucose Intake During Exercise
<30 min low-intensity exercise	<5 mmol/L, <90 mg/dL	Half dose	10–15 g
	>5 mmol/L, >90 mg/dL	Normal dose	None
30–60 min moderate-intensity exercise	<5 mmol/L, <90 mg/dL	Skip	30–45 g
	5–10 mmol/L, 90–180 mg/dL	Half dose	15 g
	>10 mmol/L, >180 mg/dL	Normal dose	None
>60 min moderate-intensity exercise	<5 mmol/L, <90 mg/dL	Skip	45 g/h
	5–10 mmol/L, 90–180 mg/dL	Half dose	30–45 g/h
	>10 mmol/L, >180 mg/dL	Half dose	15 g/h

Hansen D, et al. Phys Ther 2013; 93: 597-610

KineCoach project

Physical Therapy
Journal of the American Physical Therapy Association

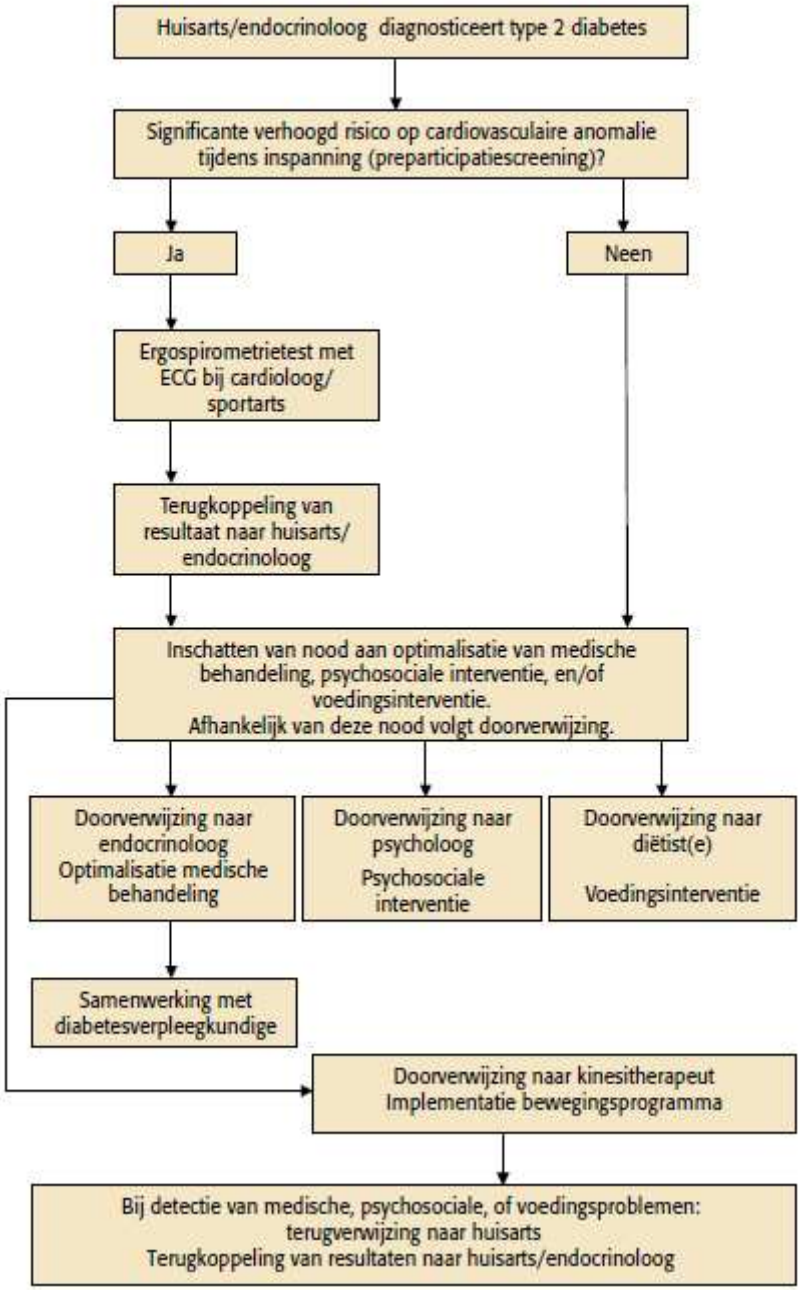
Exercise Assessment and Prescription in Patients With Type 2 Diabetes in the Private and Home Care Setting: Clinical Recommendations From AXXON (Belgian Physical Therapy Association)

Dominique Hansen, Stefaan Peeters, Bruno Zwaenepoel, Dirk Verleyen, Carla Wittebrood, Nicole Timmerman, Michel Schotte

Hansen D, et al. Phys Ther 2013; 93: 597-610

KineCoach pr

Figuur 1: Stappenplan bij het opzetten van bewegingsprogramma's voor personen met type 2 diabetes.



Hansen D, et al. Vlaams Tijdschr Diabetol 2013; 1: 10-12

universiteit hasselt
KNOWLEDGE IN ACTION

Contact: Dominique.hansen@uhasselt.be

universiteit hasselt
KNOWLEDGE IN ACTION