



THE EFFECT OF KETOGENIC DIET AND EXERCISE ON WEIGHT LOSS OF PERSONS WITH OBESITY

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Simon Potokar, B.S.
Kinesiology

HYPOTHESIS

- ▶ **Our questions:**
 - ▶ **Is ketogenic diet an appropriate mechanism for weight reduction?**
 - ▶ **Which form of physical activity is the most efficient in reducing body mass?**

FEW FACTS ABOUT OBESITY

- ▶ Doubled since 1980
- ▶ 1.9 billion adults were overweight
- ▶ 600 million were obese
- ▶ Overweight and obesity kills more people than underweight
- ▶ 41 million children under the age of 5 were overweight or obese in 2014
- ▶ 15,9 % europeans are obese
- ▶ The incidence of obesity raises concern
- ▶ Educational campaigns seem to have no effect

KETOGENIC DIET

- ▶ Dieting once focused on calorie intake reduction mostly on account of fat
- ▶ Ketogenic diet shifts the paradigm to prefer high fat and protein intake
- ▶ Replaces glucose as a primary energy carrier with ketogenic bodies
- ▶ High concentration of ketogenic bodies triggers ketosis
- ▶ As ketogenic bodies are formed from fat, the high intake of fats is not detrimental to the process of weight loss

PHYSICAL ACTIVITY

- ▶ WHO (2012) recommends at least 150 minutes of aerobic physical activity or 75 minutes of high intensive training per week
- ▶ Jakčič (2001) recommends at least 200 minutes of aerobic exercise per week for people with obesity
- ▶ Aerobic exercise remains the main intervention for obesity
- ▶ New research suggests resistance training and combination of resistance training and aerobic exercise may be a more effective tool for weight loss

METHODS USED

Database :

- ▶ PubMed & BioMed Central

Keywords:

- ▶ »ketogenic diet and exercise and obesity«
- ▶ »resistance training and aerobic training and obesity«

Selection criteria:

- ▶ In english
- ▶ People oriented research
- ▶ Independent
- ▶ Age 18-65

THE EFFECT OF KETOGENIC DIET ON WEIGHT LOSS IN PERSONS WITH OBESITY

Table 1: Summary of the effect of the ketogenic diet on body mass based on research papers fitting the search criteria

Research	Researchers	Sample (M/F)	ITM	Duration of research	Intervention		
					Diet	Measurements	Results
Johnstone idr., 2008	People with obesity, 20–65 years	20	≥30 kg/m ²	65 days	HPKD proteins 30 %/kcal, OH 4 %/kcal	W, FM, FFM	W, BMI in FM so se izboljšali pri obeh skupinah; s HPKD je prišlo tudi do povečanja FFM (p = 0,054); sprememb v CG pri FFM ni.
					HPCD proteins 30 %/kcal, OH 35 %/kcal		
Goday idr., 2016	People with obesity, 30–65 years	89	30 in 35 kg/m ²	4 months	VLCK (600–800 kcal/dan) < 50 g OH, 10 g fats, 0,8–1,2 g/kg	W, BMI, WC	Pri VLCK je prišlo do sprememb pri W (p = 0,0001); v CG sprememb ni. BMI se je spremenil pri obeh skupinah (p = 0,0001); WC se je spremenil pri obeh skupinah, a je bila sprememba večja pri VLCK (p = 0,0001; p = 0,048).
					BKITM CG (500–1000 kcal) < 30 % fats, 10–20 % protein, 45–60 % OH		
Pérez-Guisado idr., 2008	People with obesity, ≥ 18 in ≤ 65 years	40	36,46 ± 2,22 kg/m ²	3 months	30 g fats per day	W, BMI, SBP, DBP, TC, LDL-C, HDL-C	Prišlo je do sprememb pri W (p = 0,0001), BMI (p = 0,0001), SBP (p = 0,0001), DBP (p = 0,0001), TC (p = 0,0001), LDL-C (p = 0,0167) in povečanja HDL-C (p = 0,0001)

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Yancy Jr. idr., 2005	People with obesity and type 2 diabetes, 56,0 ± 7,9 years	28	42,2 ± 5,8 kg/m ²	16 weeks	≤ 20 g OH per day, unlimited intake of meat, ≤ 115 g cheese per day	W, BMI, WC, TC, LDL-C, HDL-C	Pri W, BMI in WC je prišlo do statistično enakih sprememb (p = 0,001), TC se je zmanjšal, vendar sprememba ni statistično značilna (p = 0,7), HDL-C in LDL-C sta se prav tako spremenila, vendar sprememba ni statistično značilna (p = 0,08; p = 0,1),
Westman idr., 2008	People with obesity and type 2 diabetes, 18–65 years	49	≥ 30 kg/m ²	24 weeks	VLCK < 20 g OH CG 55 % OH	W, BMI, TC, LDL-C, HDL-C	pri W in BMI prišlo do statistično značilnih sprememb v obeh skupinah. Pri TC in LDL-C prišlo do sprememb v obeh skupinah, a niso bile statistično značilne. HDL-C se je povečal (p < 0,05) pri VLCK in CG ni sprememb HDL-C.
Volek idr., 2004	Osebe z debelostjo, starost M 33,2 ± 2,9 leta, Ž 34,0 ± 2,4 leta	28 (15/13)	M → 34,1 ± 1,1 kg/m ² Ž → 29,6 ± 1,1 kg/m ²	M → 50 dni, Ž → 30 dni	VLCK protein 30 %/kcal, 10 %/kcal OH fats 60 %/kcal; CG 20 %/kcal, 55 %/kcal OH, fats 25 %/kcal	W, BMI, FM, WC, REE	V obeh skupinah je prišlo do sprememb pri W, BMI, FM, WC, REE (p < 0,05), a so bile spremembe večje pri VLCK v primerjavi s CG.
Dashfi idr., 2004	Osebe z debelostjo	83	≥ 35 kg/m ²	24 tednov	20–30 g OH, 80–100 g protein, fats	W, BMI, TC, LDL-C, HDL-C	Prišlo je do velikih sprememb pri W (91,10 ± 2,76 kg → 86,67 ± 3,70 kg), BMI (37,77 ± 0,79 kg/m ² → 32,06 ± 1,13 kg/m ²), pri TC, LDL-C in HDL-C so bile spremembe statistično značilne.

RESULTS – EFFECT OF KETOGENIC DIET ON WEIGHT LOSS

- ▶ Johnstone, Horgan, Murison, Bremner in Lobley (2008):
KD: 108,02 kg → 101,69 kg ($p = 0,006$)
CG: 108,18 kg → 103,83 kg
- ▶ Goday etc. (2016):
KD: 91,5 kg ($\pm 11,4$) → 76,8 kg ($\pm 9,1$)
CG: 90,0 kg ($\pm 11,3$) → 84,95 kg ($\pm 13,6$)
- ▶ Pérez-Guisado etc. (2008) :
108,62 kg ($\pm 3,18$) → 94,48 kg ($\pm 2,83$)
- ▶ Yancy Jr., Foy, Chalecki, Vernon in Westman (2005):
131,4 kg ($\pm 18,3$) → 122,7 kg ($\pm 18,9$)
- ▶ Westman, Yancy Jr., Mavropoulos, Marquart in McDuffie (2008):
KD: 108,4 kg ($\pm 20,5$) → 97,3 kg ($\pm 17,6$)
CG: 105,2 ($\pm 19,8$) kg na 98,3 ($\pm 20,3$) kg
- ▶ Volek etc. (2004):
- 15,4 kg
- ▶ Dashti etc. (2004):
101,03 kg ($\pm 2,33$) → 86,67 kg ($\pm 3,70$)

▶ KD = ketogenic diet
CG = control group

THE EFFECT OF AEROBIC EXERCISE ON WEIGHT LOSS OF PERSONS WITH OBESITY

Table 2: Summary of the effect of aerobic exercise on weight loss of persons with obesity

Research	Researchers	Sample (M/F)	ITM	Duration of research	Intervention		
					Diet	Meassurments	Results
Johnson idr., 2009	People with obesity and hipertensia	23	$\geq 30 \text{ kg/m}^2$	4 weeks	EG 1. week– 50 % VO_2max 2. week – 60 % VO_2max 3. and 4. weeks – 70 % VO_2max CG (mobility exercise)	W, BMI, VM	Pri W in BMI ni prišlo do sprememb v nobeni skupini. VM se je zmanjšal ($p = 0,001$); v CG ni sprememb pri VM.
Leehey idr., 2009	People with obesity and cronic kidney disease	13	$\geq 30 \text{ kg/m}^2$	24 weeks	TK 1.–3. weeks – 25–44 % VO_2max (6 min), 45–59 % VO_2max (18 min), 60–84 % VO_2max (6 min) 4.–6. weeks – 25–44 % VO_2max (6 min), 45–59 % VO_2max (22 min), 60–84 % VO_2max (12 min) 7.–24. weeks, recreation at home CG, no activity	W, FM	Pri W, BMI in FM ni prišlo do sprememb v nobeni skupini.
Ho idr., 2012	People with obesity	15	$32,7 \pm 1,3 \text{ kg/m}^2$	12 weeks	AG 30 min/60 % max. Heart frequency, 3–5x per week CG no activity	W, BMI, FM, WC TC, LDL-C, HDL-C	Pri W, BMI, FM ni prišlo do sprememb v nobeni skupini. Pri WC, TC, LDL-C, HDL-C prišlo do statistično značilnih sprememb pri AG ($p = 0,027$); v CG sprememb ni.

RESULTS – EFFECT OF AEROBIC EXERCISE ON WEIGHT LOSS

- ▶ Johnson etc. (2009):
AE: $94,4 \pm 3,8$ kg \rightarrow $94,1 \pm 4,0$ kg
CG: $98,8 \pm 6,0$ kg \rightarrow $98,6 \pm 6,3$ kg
- ▶ Leehey etc. (2009):
AE: 116 ± 27 kg \rightarrow 115 ± 23 kg
CG: 140 ± 15 kg \rightarrow 136 ± 20 kg
- ▶ Ho etc. (2012):
 $91,9 \pm 4,1$ kg \rightarrow $91,0 \pm 4,0$ kg

- ▶ AE = aerobic exercise
CG = control group

THE EFFECT OF RESISTANCE TRAINING ON WEIGHT LOSS OF PERSONS WITH OBESITY

Table 3: Summary of the effect of resistance training on weight loss of persons with obesity

Research	Researchers	Sample (M/F)	ITM	Duration of research	Intervention		
					Diet	Meassurments	Results
Franklin idr., 2015	People with obesity	18	30 kg/m ² to 40 kg/m ²	8 weeks	2x per week, 2–3x 10 excercises, 80–90 % 10 RM CG, no activity	W, BMI, WC, FM	Ni prišlo do statistično značilnih sprememb pri W, BMI, WC in FM v primerjavi s CG.
Willis idr., 2012	People with obesity and „sitting“ lifestyle	44	25 kg/m ² to 35 kg/m ²	10 weeks	3x per week 3 series per day 8–12 repetition	W, BMI, FM, FFM	W, BMI in FM so se zmanjšali (p = 0,022, p < 0,0001). FFM se je povečala (p = 0,001).
Hamasaki idr., 2015	People with obesity And type 2 diabetes	26	33,4 ± 5,4 kg/m ²	12 weeks	4x per week ≥ 3 series 8–12 repetition	W, BMI, WC, FM	Prišlo je do zmanjšanja pri W, BMI in FM (p = 0,002, p = 0,021); pri WC ni sprememb (p = 0,184).

RESULTS – EFFECT OF RESISTANCE TRAINING ON WEIGHT LOSS

- ▶ Franklin etc. (2015):
89,6 (\pm 15,4) kg \rightarrow 88,8 (\pm 15,7) kg
- ▶ Willis etc. (2012):
-0,83 \pm 2,32 kg
- ▶ Hamasaki etc. (2015):
87,6 kg \rightarrow 85,4 kg

EFFECT OF COMBINATION TRAINING ON WEIGHT LOSS

Table 4: Summary of the effect of combination training on weight loss of persons with obesity

Research	Researchers	Sample (M/F)	ITM	Duration of research	Intervention		
					Diet	Meassurments	Results
Ho idr., 2012	People with obisety	17	33 kg/m ² ± 1,3 kg/m ²	12 weeks	TS 15 min/60 % max. Heart frequency; 15 min 8–12 repetitions, 10 RM CG no activity	W, BMI, FM, WC TC, LDL-C, HDL-C	Pri W, BMI, FM, WC, TC, LDL-C in HDL-C je prišlo do statistično značilnih sprememb. V CG sprememb ni.
Willis idr. 2012	People with obesity and „sitting“ lifestyle	37	25 kg/m ² – 35 kg/m ²	10 weeks	19,3 kilometres/teden pri 65–80 % VO ₂ max; 3x per week 3 series per day 8–12 repetition	W, BMI, FM, FFM, WC	Prišlo je do sprememb pri W (p = 0,004), BMI, FM (p < 0,0001) in FFM (p = 0,001).
Sigal idr., 2007	People with obesity And type 2 diabetes	251	35,0 ± 9,6 kg/m ²	26 weeks	TS/EG 15–20 min 60 % HRmax 45 min 75 % HRmax; 7 excercises 2–3 series per excercise, 7–9 repetitions	W, BMI, FM, WC	Prišlo je do statistično značilnih sprememb vseh parametrov.

RESULTS – EFFECT OF COMBINATION TRAINING ON WEIGHT LOSS

- ▶ Ho etc. (2012):
CT: $90,0 \pm 4,0$ kg \rightarrow $88,4 \pm 3,6$ kg
CG: $85,1 \pm 4,2$ kg \rightarrow $85,1 \pm 4,3$ kg
- ▶ Willis etc. (2012):
 $-1,63 \pm 3,17$ kg
- ▶ Sigal etc. (2007):
 $101,9 \pm 30,4$ kg na $99,3 \pm 30,4$ kg

CT = combination training
CG = control group

CONCLUSION

- ▶ Ketogenic diet proved effective for weight loss
- ▶ Aerobic exercise seems inconsequential to weight loss
- ▶ Resistance training is effective for weightloss
- ▶ Combination of resistance and aerobic exercise proves to be most effective for weight loss
- ▶ Appropriate physical activity and diet can help improve weight loss attempts