SINut
Società Italiana di Nutraceutica

Ketogenic Diet Academy

Dieta Chetogenica: La posizione delle istituzioni scientifiche internazionali

EDIZIONE 2020
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HOTEL RELAIS BELLARIA
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centro italiano per la cura e il benessere del paziente obeso

Ketogenic diet: situational analysis of current nutrition guidelines

Sanjay Kalra,[1] Rajiv Singla,[2] Rahul Rosha,[3] Munish Dhawan[4]

Abstract

Ketogenic diet is gaining popularity as a nonpharmacological intervention for weight loss and glycaemic control. There is abundant literature on this topic, which serves to confuse the reader. No scientific recommendations have been formulated to guide evidence-based or rational use of ketogenic diet in obesity and diabetes management. This article is a situational analysis of leading professional guidelines on diabetes care, with regards to their coverage of ketogenic diet. It underscores the need for leading experts to pay attention to this upcoming field of metabolic medicine.

Lack Of Guidance

Nutrition is an integral part of metabolic management, and is recognized as such. The need for patient centred choices in diabetes care is also well known. One nutritional management choice, which may be of help to many persons with diabetes and/or obesity, is the ketogenic diet4. However, no professional organization in endocrinology or diabetology has focused on the rational use of ketogenic diet in these conditions. This may be due to many factors. These include lack of interprofessional communication with ketogenic diet experts, a misplaced fear of the pathological effects of ketosis, and poor awareness regarding the difference between nutritional (physiological) ketosis and insulin deficiency induced (pathological) ketosis.

Kalra S et al. J Pak Med Assoc 2019

Attualità in DIETETICA e NUTRIZIONE CLINICA 37

ADI 2014;6:38-43

FONDAZIONE ADI: POSITION PAPER

La dieta chetogenica

INDICAZIONI:

- Obesità grave o complicata (ipertensione, diabete tipo 2, dislipidemia, OSAS, sindrome metabolica, osteopatie o artropatie severe.
- Obesità severa con indicazione alla chirurgia bariatrica (nel periodo pre-operatorio).
- Pazienti con indicazioni a rapido dimagrimento per severe comorbilità.
- Non-alcoholic fatty liver disease (NAFLD).
- **Epilessia farmaco-resistente**

CONTROINDICAZIONI:

- Gravidanza e allattamento.
- Anamnesi positiva per disturbi psichici e comportamentali, abuso di alcol e altre sostanze.
- Insufficienza epatica e/o renale
- Diabete tipo 1.
- Angina instabile, IMA recente.<<<<

Molte delle criticità emerse sono dovute a: errori prescrittivi, gestionali, e alla carenza di follow-up!
Difficoltà legate alla compliance, scarsità di studi a lungo termine

VIEWPOINT

The Ketogenic Diet for Obesity and Diabetes—Enthusiasm Outpaces Evidence

Joshi S - JAMA Internal Medicine Published online July 15, 2019

The ketogenic diet has recently received much attention for its promise of treating obesity and type 2 diabetes. However, the enthusiasm for its potential benefits exceeds the current evidence supporting its use for these conditions. Although the temptation is great to recommend a potentially novel approach for otherwise difficult-to-treat diseases, it is important to remain grounded in our appraisal of the risks, benefits, and applicability of the diet to avoid unnecessary harm and costs to patients.

The risks posed by the ketogenic diet may explain why the majority of, if not all, populations consume enough carbohydrates to avoid chronic ketosis.

Although the ketogenic diet has garnered much attention for the dietary treatment of chronic diseases such as obesity and type 2 diabetes, the evidence supporting its use is currently limited and the diet's potential risks are real. Physicians and patients should continue to judiciously appraise the benefits and risks of the ketogenic diet in accordance with the evidence, not the hype.

CONSENSUS STATEMENT

Very-low-calorie ketogenic diet (VLCKD) in the management of metabolic diseases: systematic review and consensus statement from the Italian Society of Endocrinology (SIE)

M. Caprio[1,2] · M. Infante[3] · E. Moriconi[1,4] · A. Armani[1] · A. Fabbri[3] · G. Mantovani[5] · S. Mariani[4] · C. Lubrano[4] · E. Poggiogalle[4] · S. Migliaccio[6] · L. M. Donini[4] · S. Basciani[4] · A. Cignarelli[7] · E. Conte[7] · G. Ceccarini[8] · F. Bogazzi[9] · L. Cimino[10] · R. A. Condorelli[10] · S. La Vignera[10] · A. E. Calogero[10] · A. Gambineri[11] · L. Vignozzi[12] · F. Prodam[13] · G. Aimaretti[13] · G. Linsalata[14] · S. Buralli[14] · F. Monzani[14] · A. Aversa[15] · R. Vettor[16] · F. Santini[8] · P. Vitti[9] · L. Gnessi[4] · U. Pagotto[11] · F. Giorgino[7] · A. Colao[17] · A. Lenzi[4] on behalf of the Cardiovascular Endocrinology Club of the Italian Society of Endocrinology

Journal of Endocrinological Investigation 2019

Sono state formulate raccomandazioni basate sull'evidenza riguardo l'uso della VLCKD in diversi contesti clinici.
Segnalando la forza delle raccomandazioni e la qualità delle prove secondo il sistema (GRADE).

Journal of Endocrinological Investigation
https://doi.org/10.1007/s40618-019-01061-2

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Table 2 Indications for the use of VLCKD in metabolic diseases

Strong recommendations	Strength of recommendations and quality of evidence according to GRADE system
Severe obesity	(1 ØØØO)
Management of severe obesity before bariatric surgery	(1 ØØØO)
Sarcopenic obesity	(1 ØØØO)
Obesity associated with type 2 diabetes (preserved beta cell function)	(1 ØØØO)
Obesity associated with hypertriglyceridemia	(1 ØØØO)
Obesity associated with hypertension	(1 ØØØO)
Pediatric obesity associated with epilepsy and/or with a high level of insulin resistance and/or comorbidities, not responsive to standardized diet	(1 ØØØO)

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Weak recommendations

Obesity associated with dysbiosis of the gut microbiota	(2 ØØØO)
Obesity associated with high levels of LDL-cholesterol and/or low levels of HDL-cholesterol	(2 ØØØO)
Obesity associated with non-alcoholic fatty liver disease (NAFLD)	(2 ØØØO)
Obesity associated with heart failure (NYHA I–II)	(2 ØOOO)
Obesity associated with atherosclerosis	(2 ØOOO)
Male obesity secondary hypogonadism	(2 ØØØO)
Obesity associated with polycystic ovary syndrome (PCOS)	(2 ØOOO)
Menopausal transition-related obesity	(2 ØOOO)
Neurodegenerative disorders associated with sarcopenic obesity	(2 ØOOO)

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Table 3 Absolute contraindications to the use of VLCKD

Absolute contraindications
Type 1 diabetes mellitus, latent autoimmune diabetes in adults, β-cell failure in type 2 diabetes mellitus, use of sodium/glucose cotransporter 2 (SGLT2) inhibitors (risk for euglycemic diabetic ketoacidosis)
Pregnancy and breastfeeding
Kidney failure and moderate-to-severe chronic kidney disease, liver failure, hearth failure (NYHA III-IV), respiratory failure
Unstable angina, recent stroke or myocardial infarction (< 12 months), cardiac arrhythmias
Eating disorders and other severe mental illnesses, alcohol and substance abuse
Active/severe infections
Frail elderly patients
48 h prior to elective surgery or invasive procedures and perioperative period
Rare disorders: porphyria, carnitine deficiency, carnitine palmitoyltransferase deficiency, carnitine-acylcarnitine translocase deficiency, mitochondrial fatty acid β-oxidation disorders, pyruvate carboxylase deficiency

Muscogiuri *et al. J Transl Med* (2019) 17:356
https://doi.org/10.1186/s12967-019-2104-z

Journal of Translational Medicine

REVIEW Open Access

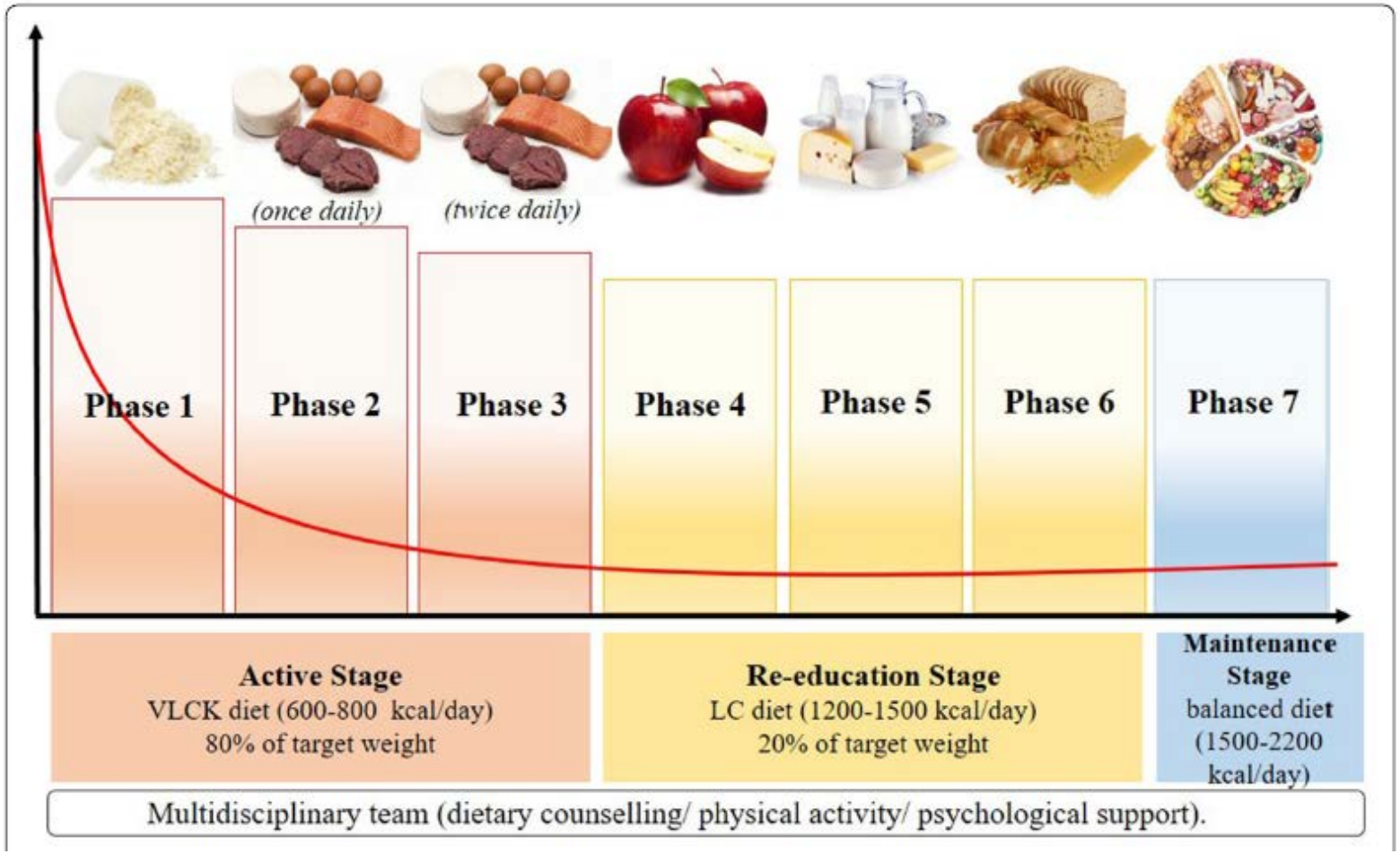
The management of very low-calorie ketogenic diet in obesity outpatient clinic: a practical guide

Giovanna Muscogiuri[†], Luigi Barrea[*†], Daniela Laudisio, Gabriella Pugliese, Ciro Salzano, Silvia Savastano and Annamaria Colao

VLCKD is a nutritional protocol that resembles fasting through a marked restriction of daily carbohydrate intake, usually lower than 30 g/day (≃ 13% of total energy intake) along with a relative increase in the proportions of fat (≃ 44%) and protein (≃ 43%) and a total daily energy intake < 800 kcal. The VLCKD protocol is a weight loss nutritional program based on a high-biological-value protein (coming from milk, peas, whey and soy) preparations diet and natural foods.

VLCKD PROTOCOL

Muscogiuri et al JTM 2019



Cosa valutare prima e durante VLCKD ?

Muscogiuri et al JTM 2019

Table 2 Anthropometric measurements and laboratory assessment to be monitored during the VLCKD

	Parameters	Baseline	During active stages	At the end of VLCKD
Anthropometric assessment	Weight, height, BMI	✓	✓	✓
	Body composition and hydration status (by bioelectrical impedance analysis)	✓	✓	✓
Laboratory assessment	Complete blood count with platelets	✓	✓	✓
	Sodium, potassium, magnesium, and inorganic phosphate	✓	✓	✓
	Serum liver and kidney tests (including albumin, AST, ALT, blood urea nitrogen, creatinine, γ-GT, total and direct bilirubin)	✓	✓	✓
	Fasting lipid profile	✓		✓
	25(OH)D, calcium	✓		✓
	Glucose, Insulin	✓		✓
	β-Hydroxybutyrate (capillary blood or urine)		✓	
	TSH, FT4	✓		
	Complete urinalysis and microalbuminuria (urine)	✓	✓	✓

BMI body mass index, *AST* aspartate aminotransferase, *ALT* alanine transaminase, *γGT* γ-glutamyltransferase, *25(OH)D* 25-hydroxy vitamin D, *TSH* thyroid-stimulating hormone, *FT4* free thyroxine

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CONSENSUS STATEMENT

Check for updates

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VLCKD in severe obesity

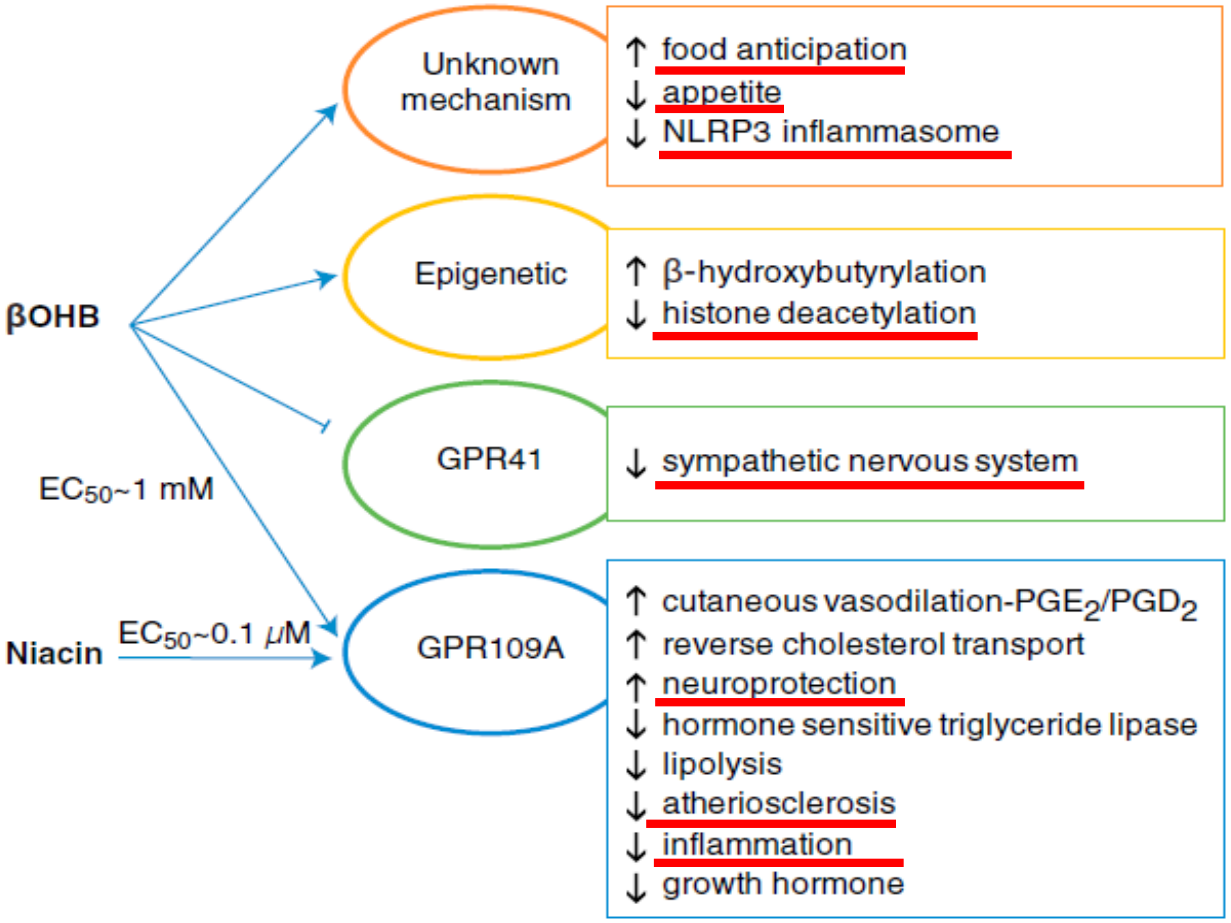
- We recommend a maximum 12-week weight-loss program with VLCKD as part of a multidisciplinary weight management strategy to adult severely (class 2 or higher) obese patients not responsive to standardized diet as a second line option (1 ØØØO).

- We recommend a maximum 12-week VLCKD treatment as part of a multidisciplinary weight management strategy for obese patients who have a clinically assessed need to lose weight rapidly (1 ØØØO).

- We suggest the use of a weight-loss program with VLCKD in intermittently combination with low-calorie dietary approaches for severely obese patients (2 ØOOO).

- We recommend a long-term weight-loss maintenance follow-up after VLCKD in severely obese patients (1 ØØØO). Weight maintenance or additional weight-loss strategies, if weight-loss target is not achieved, are recommended.

Azioni biologiche dei corpi chetonici



- Riduzione dell'infiammazione (GPR109A è abbondantemente espresso da monociti e macrofagi)
- Riduzione dell stress ossidativo
- Aumento delle proteine antiossidanti
- Riduzione dell'appetito/aumento della sazietà
- Miglioramento delle proteine mitocondriali

Metodo che può essere applicato in diversi contesti clinici!

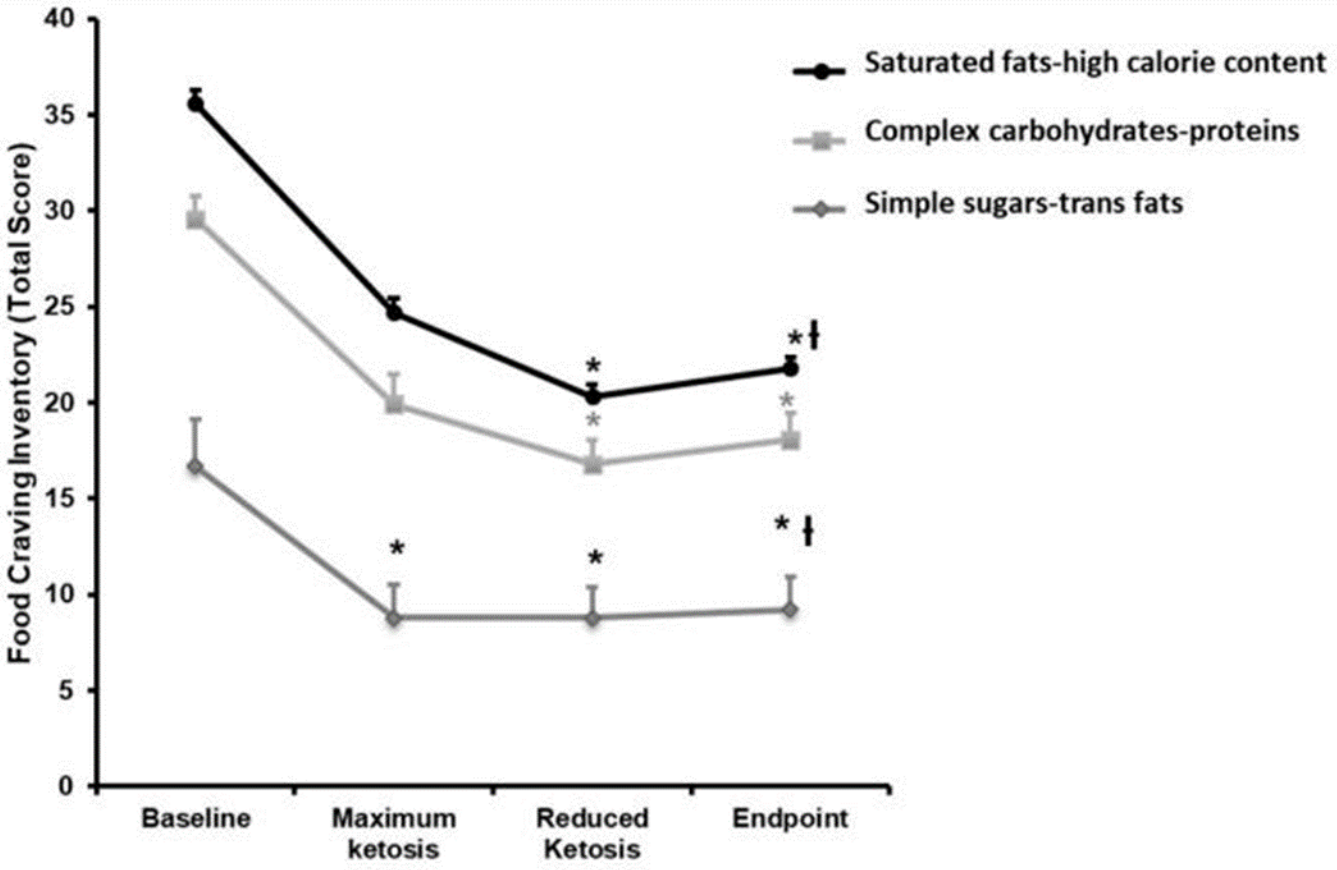
Puchalska P and Crawford PA, Cell Metabolism 2017

Effetto della VLCKD sul “craving”

Al Castro et al. Nutrients 2018

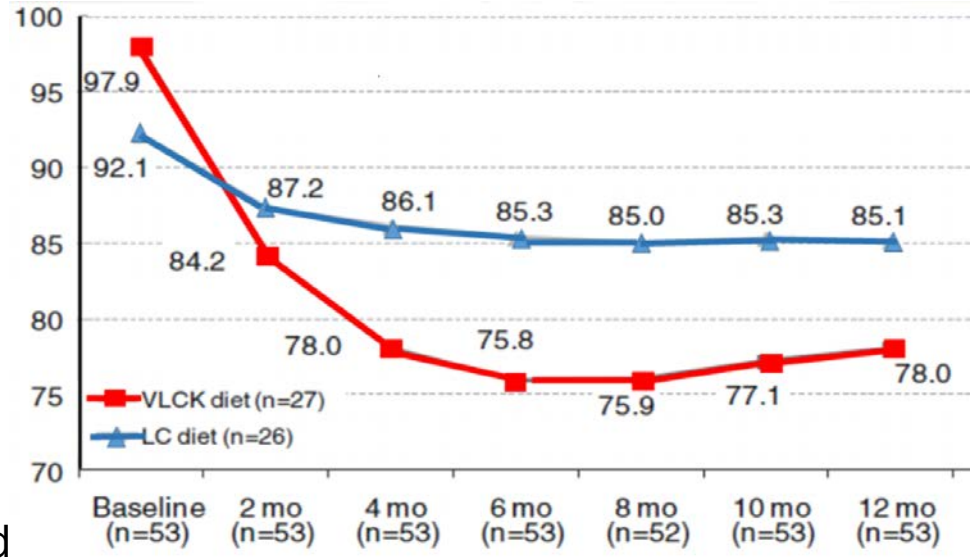
“A battery of psychological test was performed in 22 obese patients (12 females, 47.2 10.2 year and BMI of 35.5 4.4) through the course of a 4-month VLCKD on four subsequent visits: baseline, maximum ketosis, reduced ketosis, and endpoint”.

“Relevantly, a statistically significant decrease was also observed in the craving for specific nutrients from baseline to endpoint. The craving for simple sugars and trans fats was modified earlier than the other items, since maximum ketosis compared with baseline”.



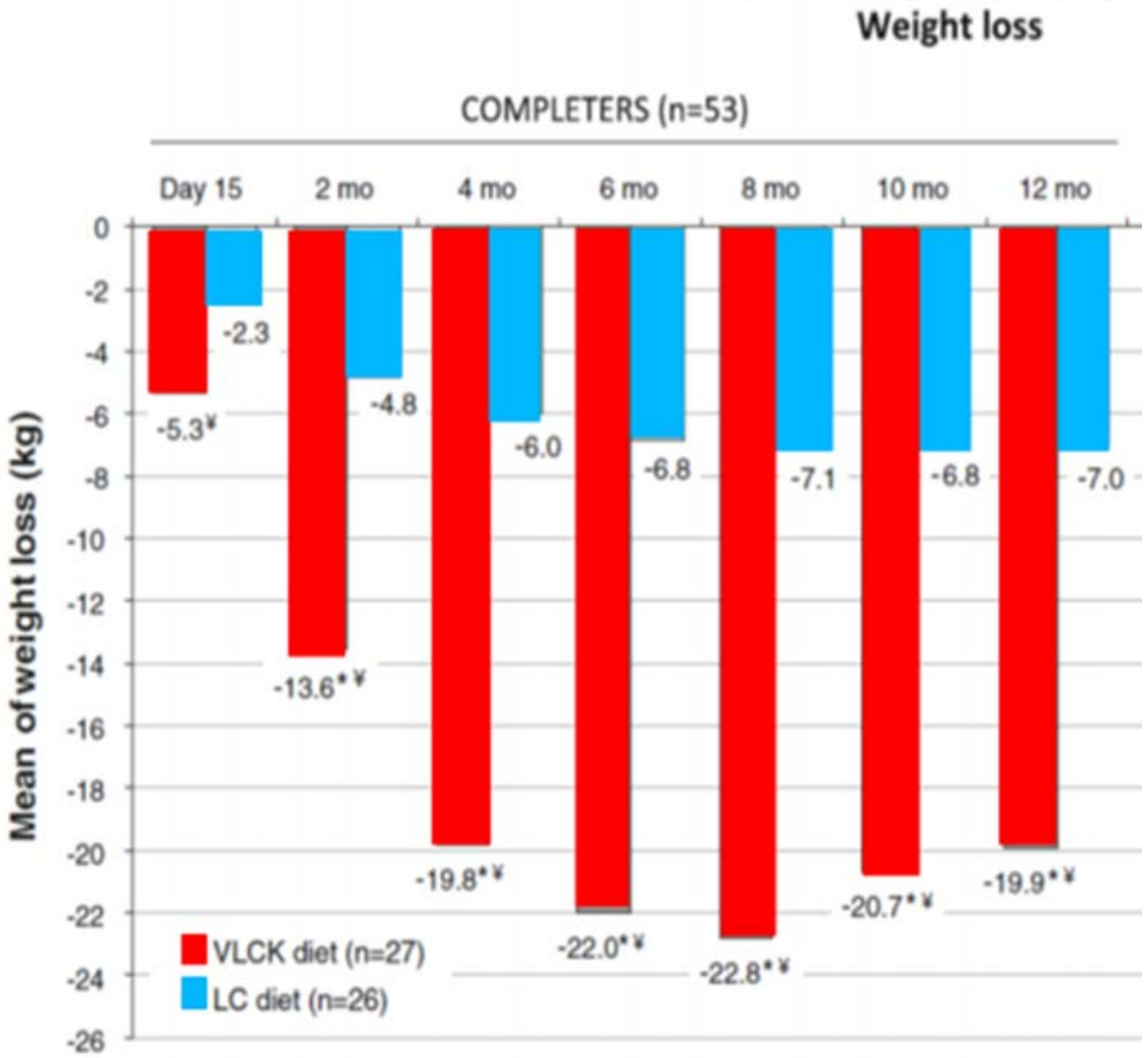
Dieta chetogenica vs Dieta Ipocalorica
Riduzione peso corporeo (Kg) in valore assoluto

Moreno, B., Bellido, D., Sajoux, I. et al. Endocrine (2014) 47: 793.



A **group of obese patients were randomized** into two groups: the **VLCK diet group** and a **standard low-calorie diet** (LC group). The follow-up period was **12 months**. Both groups received external support, counseling, to perform physical activity and adhered to the diet. The VLCK diet induced a 30–45 days of mild ketosis and significant effects on body weight within 15 days. At 2 months, the weight reductions in the VLCK diet and LC diet groups were 13.6 ± 3.9 and 4.8 ± 2.7 kg, respectively (p\0.0001). At the end of the study, at 12 months, the weight reductions were19.9 ± 12.3 and 7.0 ± 5.6 kg, respectively (p\0.0001),and more than 88 % of patients in the VLCK diet group lost more of 10 % of their initial weight. Lean mass was practically unaffected. The VLCK diet was well tolerated and the side effects were moderate and transitory. **The VLCK diet was significantly more effective than a standard LC diet.**

Dieta chetogenica vs Dieta Ipocalorica
Evoluzione della perdita di peso



At one year follow up in the group with VLCK diet, most loss more than 10 % of their initial weight and lean mass was preserved.

Moreno, B., Bellido, D., Sajoux, I. et al. Endocrine (2014) 47: 793.

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CONSENSUS STATEMENT

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VLCKD and bariatric surgery

Recommendations

- We recommend a 2- to 4-week preoperative weight-loss program with VLCKD for patients who are candidate to bariatric surgery to induce a weight loss of approximately 5% and a reduction in liver volume of at least 10% (1 ØØØO).
- We suggest a 2- to 6-week preoperative weight-loss program with VLCKD for patients who are candidate to bariatric surgery to reduce visceral adipose tissue (2 ØOOO).

4. Trattamento perioperatorio

E.29 La riduzione preoperatoria del peso corporeo è consigliata nei pazienti candidati alla chirurgia bariatrica, soprattutto se in presenza di BMI molto elevato o di grave obesità viscerale, anche attraverso la prescrizione di una dieta a basso contenuto calorico/chetogena nel periodo preoperatorio (LIVELLO DI EVIDENZA: 2; GRADO DI RACCOMANDAZIONE: A).

La diminuzione del peso corporeo riduce notevolmente le dimensioni del grasso viscerale e del fegato facilitando l'esecuzione degli interventi laparoscopici[1,2], riducendo il tempo di esecuzione e il rischio di conversione[3,4], e migliora i risultati a breve e lungo termine[5-7] soprattutto nei pazienti super-obesi[8]. Diversi metodi sono stati proposti per favorire la perdita di peso preoperatoria e dalle evidenze in letteratura pare chiaro come l'impiego di una dieta a basso contenuto calorico/chetogena da 15 a 30 giorni prima dell'intervento ottenga risultati soddisfacenti in minor tempo, con un costo minore e meno effetti collaterali rispetto al palloncino intragastrico[8-14].

S.I.C.OB. Società Italiana di Chirurgia dell'Obesità e delle malattie metaboliche

LINEE GUIDA DI CHIRURGIA DELL'OBESITÀ

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VLCKD, skeletal muscle and bone health

Recommendations

- We recommend the use of VLCKD in the context of sarcopenic obesity without relevant concerns for loss of lean body mass (1 ØØØO).
- We suggest the use of VLCKD in the context of severe obesity without relevant concerns for bone health (2 ØØØO).

Merra et al Eur Rev Med Pharmacol Sci 2016

n = 9	Baseline (T0) mdia (SD)	After 3 weeks of VLKD (T1) media (SD)	*p*
Weight (kg)[a]	99.78 (4.57)	92.80 (4.78)	0.00*
BMI (kg/m²)[a]	33.69 (3.51)	31.36 (3.59)	0.00*
Waist circumference (cm)[a]	103.90 (5.98)	98.40 (5.91)	0.00*
Abdomen circumference (cm)[a]	111.82 (5.42)	108.20 (6.73)	0.03*
hip circumference (cm)[a]	114.30 (6.42)	111.30 (7.73)	0.01*
Trunk Body Fat (kg)[a]	20.37 (5.59)	19.78 (4.99)	0.59
Trunk Body Lean (kg)[a]	25.06 (5.55)	26.23 (4.74)	0.69
Android Body Fat (kg)[a]	3.3046 (1.11)	3.2078 (0.92)	0.76
Android Body Lean (kg)[a]	3.75 (1.09)	3.92 (0.61)	0.75
Gynoid Body Fat (kg)[a]	6.01 (1.50)	5.70 (1.10)	0.30
Gynoid Body Lean (kg)[a]	8.06 (2.18)	8.59 (1.81)	0.67
Total Body Fat (kg)[a]	37,24 (9.31)	34.79 (9.38)	0.02*
Total Body Lean (kg)[a]	53.01 (12.86)	54.93 (8.96)	0.75
Percentage Body Fat (%)[a]	40.30 (8.25)	37.52 (9.63)	0.30

Paired *t*-test a or a non-parametric Wilcoxon test[b].

A randomized case-control- 25 healthy subjects.

A diet low in carbohydrates, associated with a decreased caloric intake, is effective in weight loss.

After VLCKD, versus VLCD, no significant differences in body lean of the trunk, body lean distribution (android and gynoid), total body lean

After VLCKD, sarcopenia did not increase

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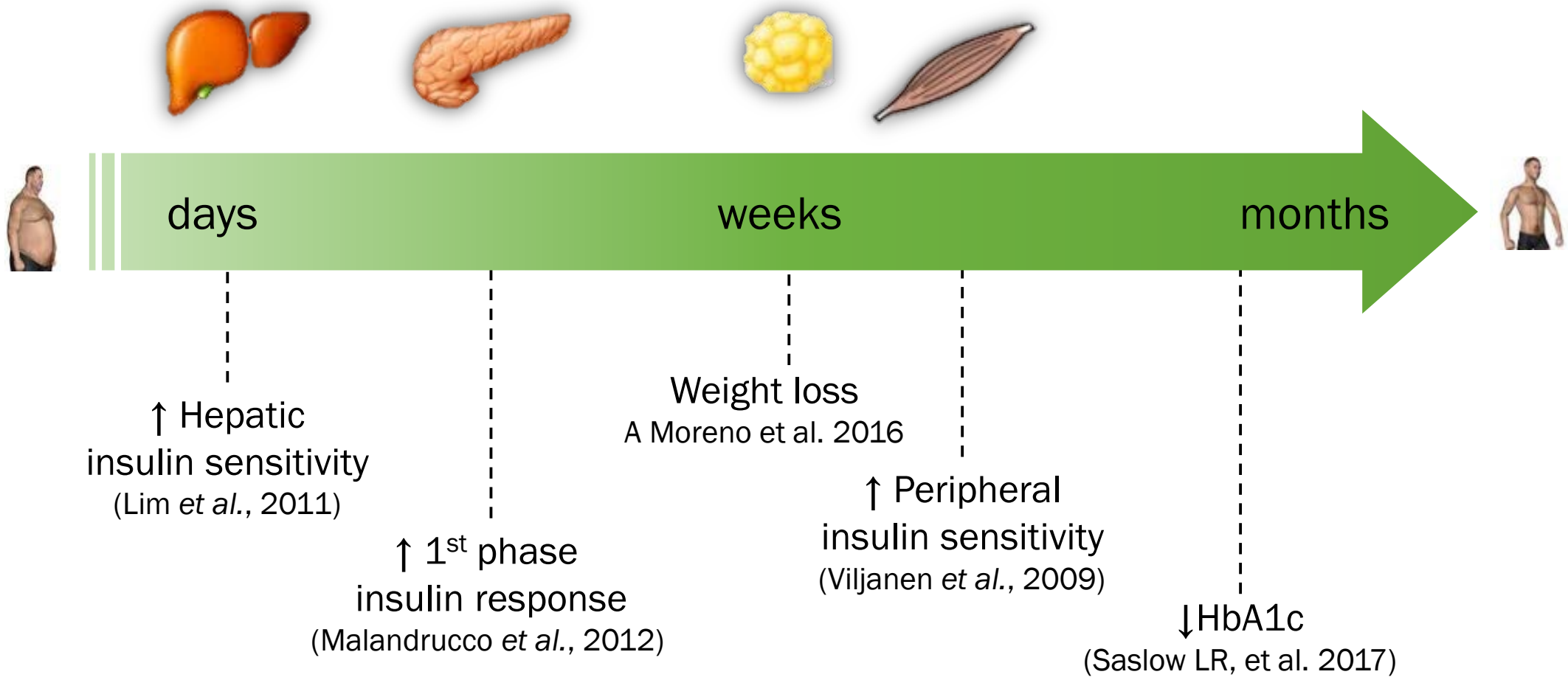
VLCKD, insulin resistance and type 2 diabetes

Recommendations

- VLCKD should be considered to obtain an early efficacy on glycemic control, particularly in obese patients with short duration of the disease (1 ØØØO).
- VLCKD should be considered to reduce the use of glucose-lowering agents, including insulin (1 ØØØO).

VLCKD effects on glucose metabolism in obese subjects

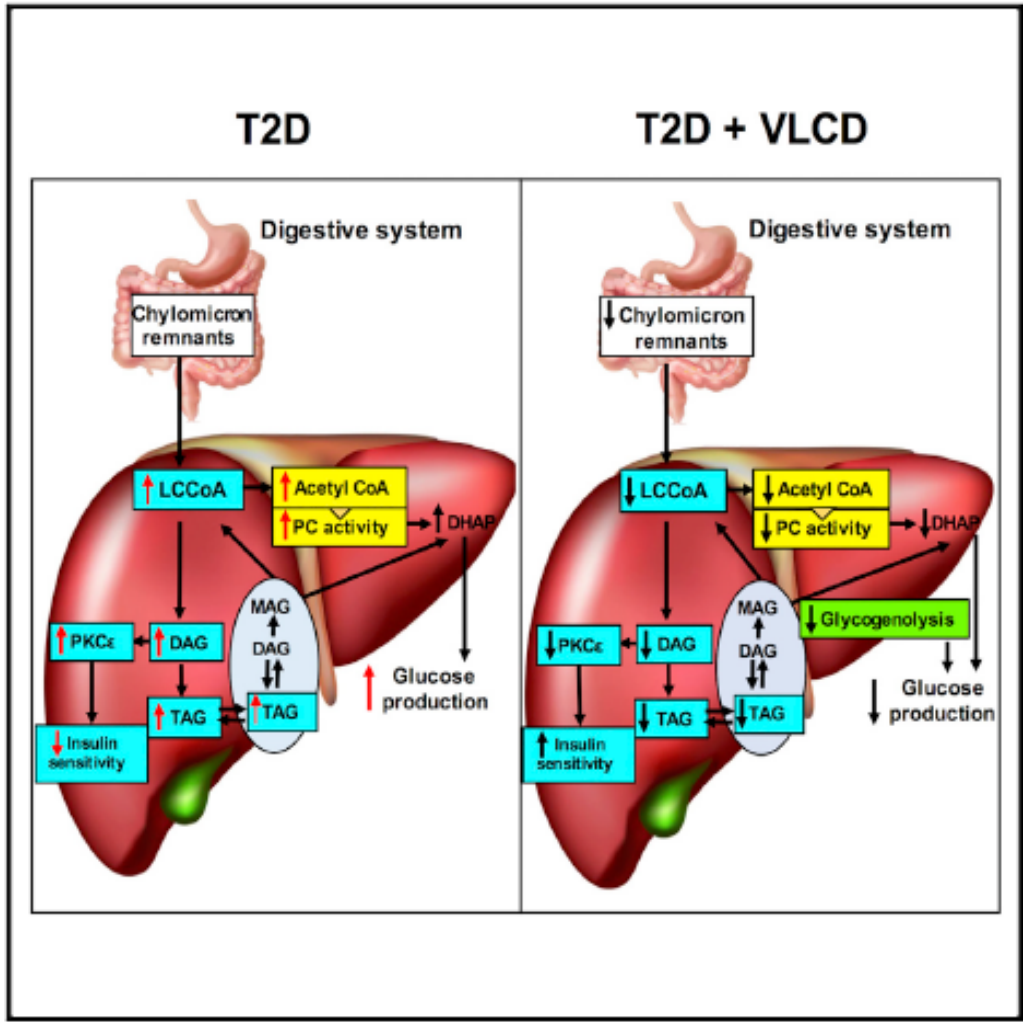


Cignarelli A, Giorgino F et al. JENI 2019

Cell Metabolism

Mechanisms by which a Very-Low-Calorie Diet Reverses Hyperglycemia in a Rat Model of Type 2 Diabetes

Caloric restriction rapidly reverses type 2 diabetes (T2D), but the mechanism(s) of this reversal are poorly understood. Here we show that 3 days of a very-low-calorie diet (VLCD, one-quarter their typical intake) lowered plasma glucose and insulin concentrations in a rat model of T2D without altering body weight. The lower plasma glucose was associated with a 30% reduction in hepatic glucose production resulting from suppression of both gluconeogenesis from pyruvate carboxylase (V_{PC}), explained by a reduction in hepatic acetyl-CoA content, and net hepatic glycogenolysis. In addition, VLCD resulted in reductions in hepatic triglyceride and diacylglycerol content and PKCε translocation, associated with improved hepatic insulin sensitivity. Taken together, these data show that there are pleotropic mechanisms by which VLCD reverses hyperglycemia in a rat model of T2D, including reduced DAG-PKCε-induced hepatic insulin resistance, reduced hepatic glycogenolysis, and reduced hepatic acetyl-CoA content, PC flux, and gluconeogenesis.



Perry et al 2018

Standards of Medical Care in Diabetes - 2017

STOP DIABETES

American Diabetes Association

Recommendations: Diet, physical activity & behavioral therapy

Short-term (3-month) interventions that employ **Very Low Calorie Diets** (<800 kcal/day) **and total meal replacements may be prescribed for select patients** by trained practitioners with close medical monitoring. To maintain weight loss, such programs must incorporate long-term, comprehensive, weight maintenance counseling.

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CONSENSUS STATEMENT

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VLCKD, cardiovascular risk factors and diseases

Recommendations

- We recommend VLCKD for a rapid reduction of cardiovascular risk factors in obese patients, not responsive to standard diets (1 ØØØO).
- We recommend VLCKD in obese hypertensive patients, not responsive to standard diets (1 ØØØO).
- We suggest VLCKD as an option for rapid reduction in body weight and cardiac overload in obese patients with heart failure (NYHA I-II), upon careful examination of cardiac function and fluid balance (2 ØOOO).

Prolonged Caloric Restriction in Obese Patients With Type 2 Diabetes Mellitus Decreases Myocardial Triglyceride Content and Improves Myocardial Function

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J Am Coll Cardiol 2008

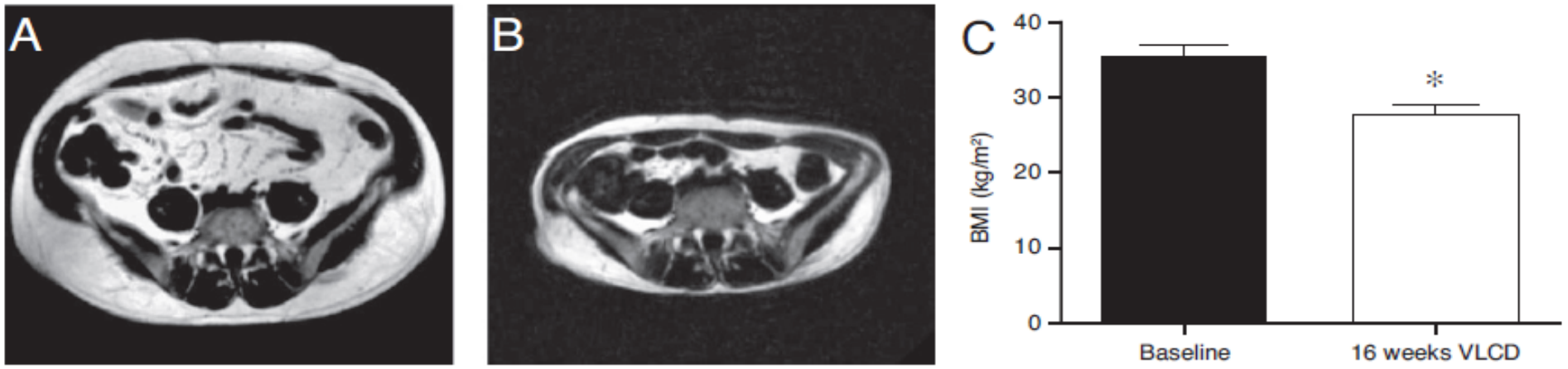

Figure 1 Fat Stores and Body Mass Index

Example of a transverse slice at the level of the 5th lumbar vertebrae showing visceral and subcutaneous fat depots, illustrating the effects of 16 weeks of caloric restriction in the same patient **(A and B)**. Body mass index (BMI) is decreased after prolonged caloric restriction **(C)**. *$p < 0.001$. VLCD = very-low-calorie diet.

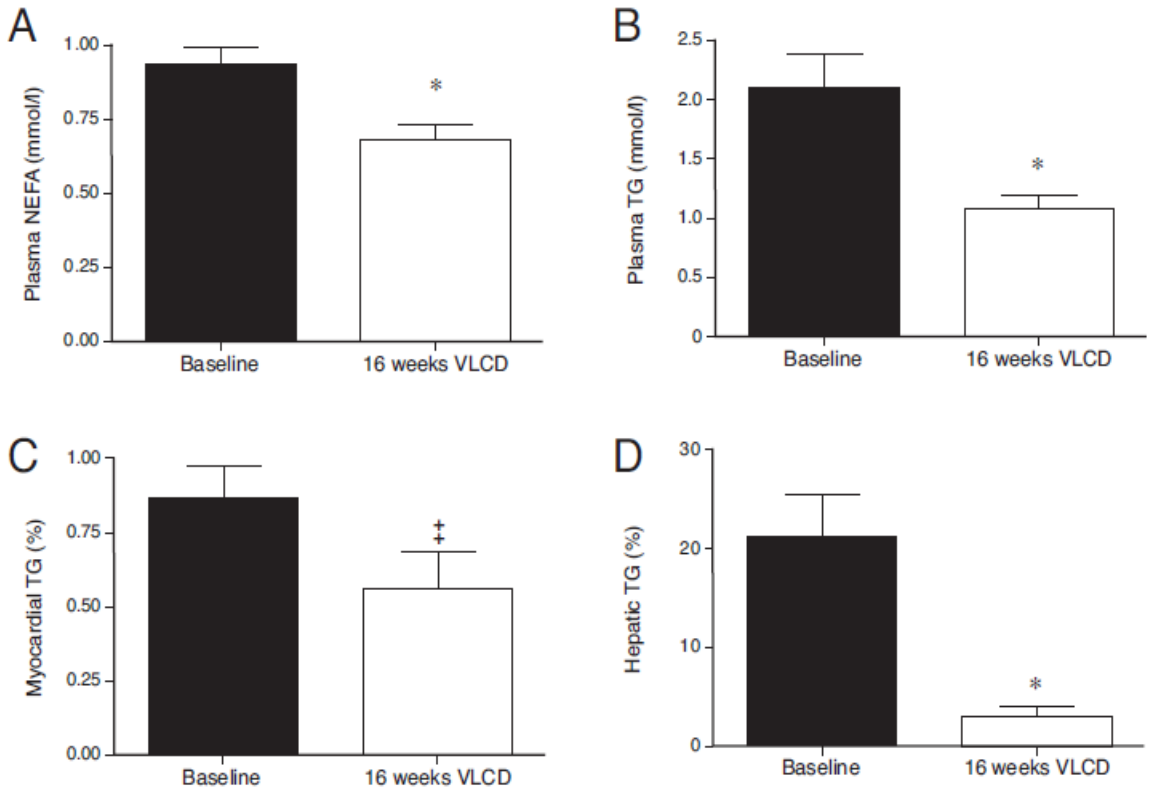

Figure 2 Metabolic Changes at Baseline and After 16 Weeks of VLCD

Changes in plasma NEFA **(A)**, plasma TG levels **(B)**, and myocardial **(C)**, and hepatic **(D)** TG content on prolonged caloric restriction. *$p < 0.001$; †$p < 0.05$. Data are mean ± SEM. NEFA = nonesterified fatty acids; TG = triglyceride; VLCD = very-low-calorie diet.

Table 2 Intraindividual Effects of 16 Weeks of Caloric Restriction on Systolic and Diastolic Function in Obese Patients With T2DM

	Baseline	After 16 Weeks of Caloric Restriction
Systolic blood pressure (mm Hg)	144 ± 8	118 ± 6*
Diastolic blood pressure (mm Hg)	81 ± 2	71 ± 2*
Heart rate (beats/min)	78 ± 3	61 ± 2*
LVEF (%)	57 ± 2	58 ± 2
Stroke volume (ml)	102 ± 6	103 ± 8
Stroke volume index (ml/m^2)	45 ± 2	51 ± 3†
Cardiac output (ml/min)	7,971 ± 601	6,508 ± 401‡
Cardiac index (l/min/m^2)	3.5 ± 0.2	3.2 ± 0.2
LV mass (g)	118 ± 7	99 ± 6*
LV mass index (g/m^2)	53 ± 3	49 ± 3†
ED volume (ml)	177 ± 8	177 ± 11
ED index (ml/m^2)	79 ± 3	88 ± 4†
ES volume (ml)	76 ± 4	74 ± 5
ES index (ml/m^2)	34 ± 2	37 ± 2
E deceleration (ml/s^2 × 10^{-3})	4.04 ± 0.50	4.30 ± 0.42
E/A peak ratio	1.02 ± 0.08	1.18 ± 0.06†
E/Ea	11.9 ± 1.2	11.4 ± 1.5

Conclusions

Prolonged caloric restriction in obese T2DM patients decreases BMI and improves glucoregulation associated with decreased myocardial TG content and improved diastolic heart function. Therefore, myocardial TG stores in obese patients with T2DM are flexible and amendable to therapeutic intervention by caloric restriction.

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CONSENSUS STATEMENT

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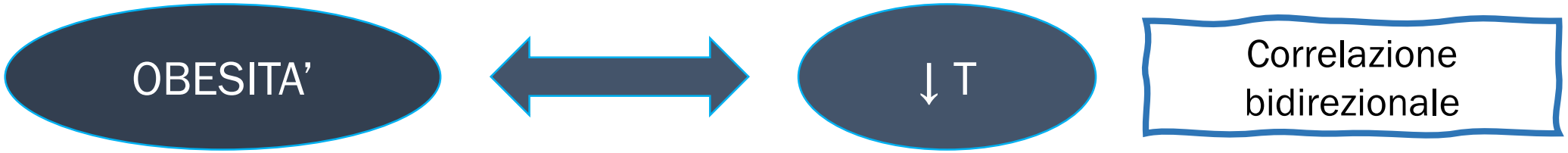
VLCKD and obesity-related hypogonadism in men

Recommendations

- We suggest a weight-loss program with VLCKD for obese male patients with hypogonadism to increase plasma androgen levels (2 ØØØO).
- We suggest a weight-loss program with VLCKD for obese male patients with hypogonadism to improve their sexual function (2 ØØOO).

Obesità e Funzione gonadica



Obesità → Ipogonadismo

- L'obesità determina un **aumento** della conversione di T in **E_2** (aromatasi) e una **riduzione** dei livelli di **SHBG**, di **inibina B** e di **T libero** e **totale** (Chavarro et al., 2010; Mah & Wittert, 2010; Ramlau-Hansen et al., 2010; Shukla et al., 2014)
- L'aumentata produzione di E_2 riduce la secrezione di LH determinando un ulteriore calo della produzione di T totale e libero (**ipogonadismo centrale**) (Shukla et al., 2014)
- Negli obesi l'aumento delle **endorfine** riduce la produzione di GnRH ipotalamico e, conseguentemente, dell'ampiezza della pulsatilità dell'LH (**ipogonadismo centrale**) (Blank et al., 1994)

VLCKD and sex hormone levels

Study, year Design	N	Age (y)	BMI (kg/mq)	Baseline T (nmol/L)	Therapy	Weeks	Weight loss	T increase (nmol/L)
Kaukua, 2003 RCT	38	46	39	11.1	VLED vs control	32	14%	3.0
Niskanen, 2004 Cohort	58	46	36	12	VLED	9	14%	5.0
Khoo, 2010 Case-control	19	58	35	10	VLED	8	8%	1.2
Ng Tang Full, 2016 RCT	100	52	37	8	VLED +Placebo Vs. VLED +TRT	56 (10 wk VLED phase)	Study	1.8

VLCKD and sexual function

Study, year Design	N	Age (y)	BMI (kg/mq)	Therapy	Weeks	Weight loss	IIEF-5 score	SDI score	IPSS score
Kaukua, 2003 RCT	38	46	39	VLED vs control	32	14%	ns		
Khoo (DM), 2010 Case-control	19	58	35	VLED	8	8%	2.1	10.4	-2.1
Khoo (non-DM), 2010 Case-control	25	44	36	VLED	8	11%	2.2	9.1	-6.4

Muscogiuri et al JTM 2019

Short term	Treatment
Dehydration	Proper water intake (at least 2 L of sugarless fluids daily) is mandatory mostly in the first 3 phases
Headache	Mild analgesics as pills instead of liquid formulations because they could contain sugar
Hyponatremia	If patient complain hypotension-related symptoms, it is advisable to increase salt intake wherever there are no contraindications
Hypomagnesemia	Supplementing with magnesium can help reduce muscle cramps, difficulty sleeping and irritability mostly in the active stage.
Transient hypoglycemia	If blood glucose is less than 40 mg/dL and hypoglycemia is symptomatic, it is suggested the assumption of carbo-hydrate-containing beverages such as orange juice.

Short term	Treatment
Transitory Letargy	If lethargy persists more than few days, medical investigations are recommended.
Halitosis	Chewing on a low-calorie mint or sugar free chewing gum
Gastrointestinal side effects (nausea/vomiting, diarrhea, or constipation)	**Nausea:** frequent intake of small food amounts, intermittent use of GI drugs such as antiemetics, GI tract regulators, and antacids **Constipation:** ensuring an adequate fluid intake and/or using low-calorie bulk laxative and/or intermittent enemas. The supplement of dietary fibre may improve constipation increasing the number of bowel movements.
Transitory Hyperuricemia	No treatment except for patients with a prior history of gout that could be more prone to develop exacerbations.

Long term	Treatment
Hypoproteinemia	Increase protein intake from 1 g/kg/day to 1.5 g/kg/day
Hypocalcemia and bone damage	Adequate high intake of calcium and vitamin D
Urolithiasis	The use of cholesterol-reducing medication should be taken into account if LDL does not normalize after returning to normal diet.
Hair loss	Increase in protein intake during fasting in order to preserve nitrogen balance
Gallstones	Fat intake of 7–10 g per day has been reported as a threshold for maintaining an efficient gallbladder emptying

- La VLCKD è un trattamento sicuro ed efficace nel calo ponderale del paziente affetto da obesità;
- Migliora il controllo glicometabolico nei soggetti diabetici
- Svolge un' azione anti-infiammatoria
- Riduce il rischio cardiovascolare
- Preserva la massa magra rivelandosi l'approccio nutrizionale ideale nell'obesità sarcopenica
- Migliora la qualità della vita
- Consente una personalizzazione del trattamento (combinazione con altre strategie nutrizionali/farmacologiche/chirurgiche)

Opera

Obesity Programs of nutrition, Education, Research and Assessment of the best treatment

III CONGRESSO NAZIONALE

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sie Società Italiana Endocrinologia

SIO Società Italiana dell'Obesità

EASO European Association for the Study of Obesity

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