



سیمنار دوره کارشناسی تغذیه

عنوان:

تاثیر رژیم کتوژنیک بر کاهش وزن

استاد راهنما:

سرکار خانم حسینی

ارائه دهنده:

امید زراعت دوست

اردیبهشت ۱۳۹۸



فهرست مطالب

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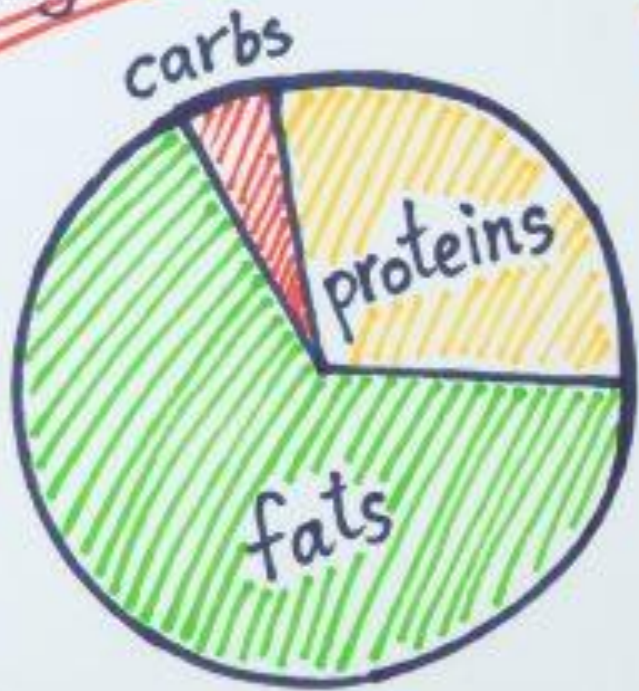


فهرست اختصارات

| اختصارات | عبارت |
|----------|--------------------------------------|
| VLCKD | Very low calorie ketogenic diet |
| LCD | Low calorie diet |
| WC | waist circumferences |
| KB | Ketones bodies |
| BOCF | baseline observation carried forward |
| AcAc | acetoacetate |
| DXA | Dual x-ray absorptiometry |
| RQ | Respiratory quotient |
| SEE | Sleeping energy expenditure |
| BD | Baseline diet |
| DLW | Doubly labeled water |
| BIA | Bioelectrical Impedance Analysis |
| BMI | Body mass index |
| BHB | Beta-hydroxybutyric acid |



Ketogenic Diet



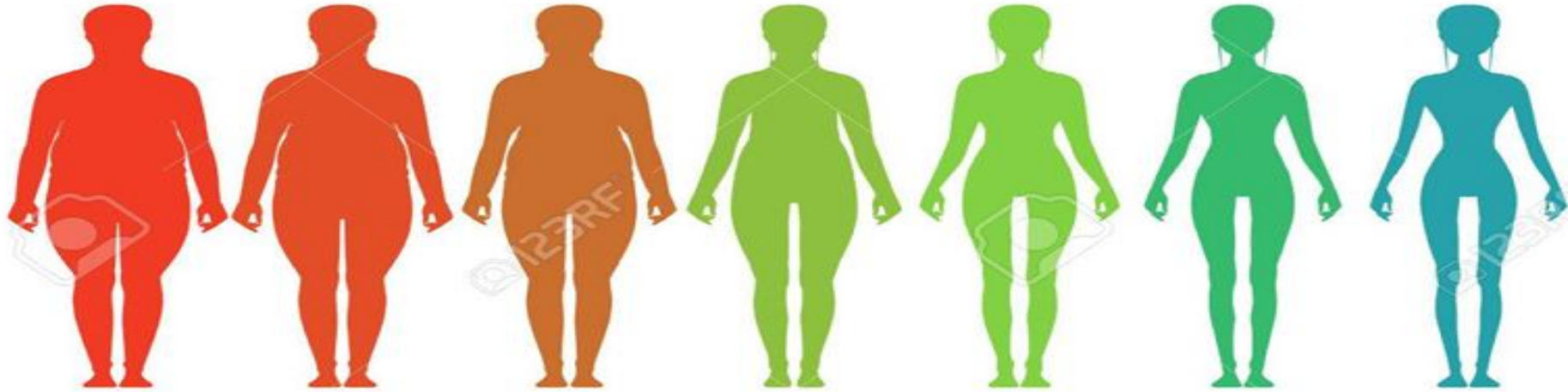
مقدمه

چاقی

مقدمہ

BODY MASS INDEX

$$\text{BMI} = \frac{\text{BODY MASS}}{\text{HEIGHT}}$$



40>
obesity
third
degree

35-40
obesity
second
degree

30-35
obesity
first
degree

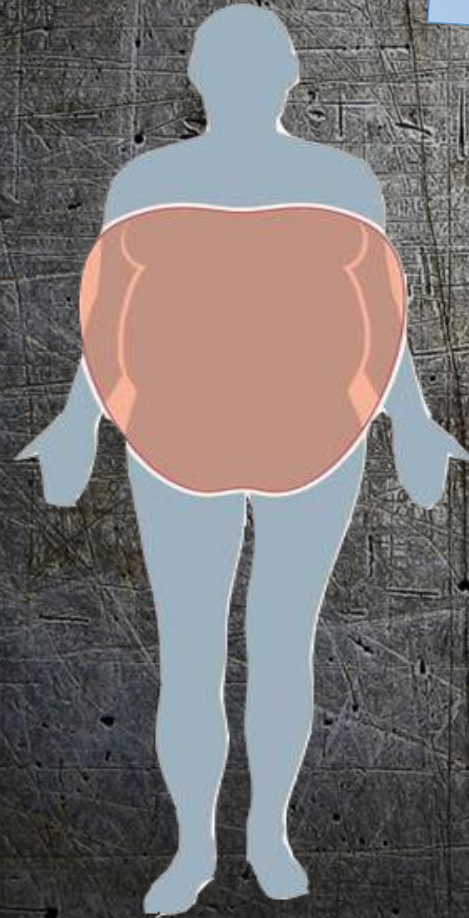
25-30
weight
over

18,5-24
norm

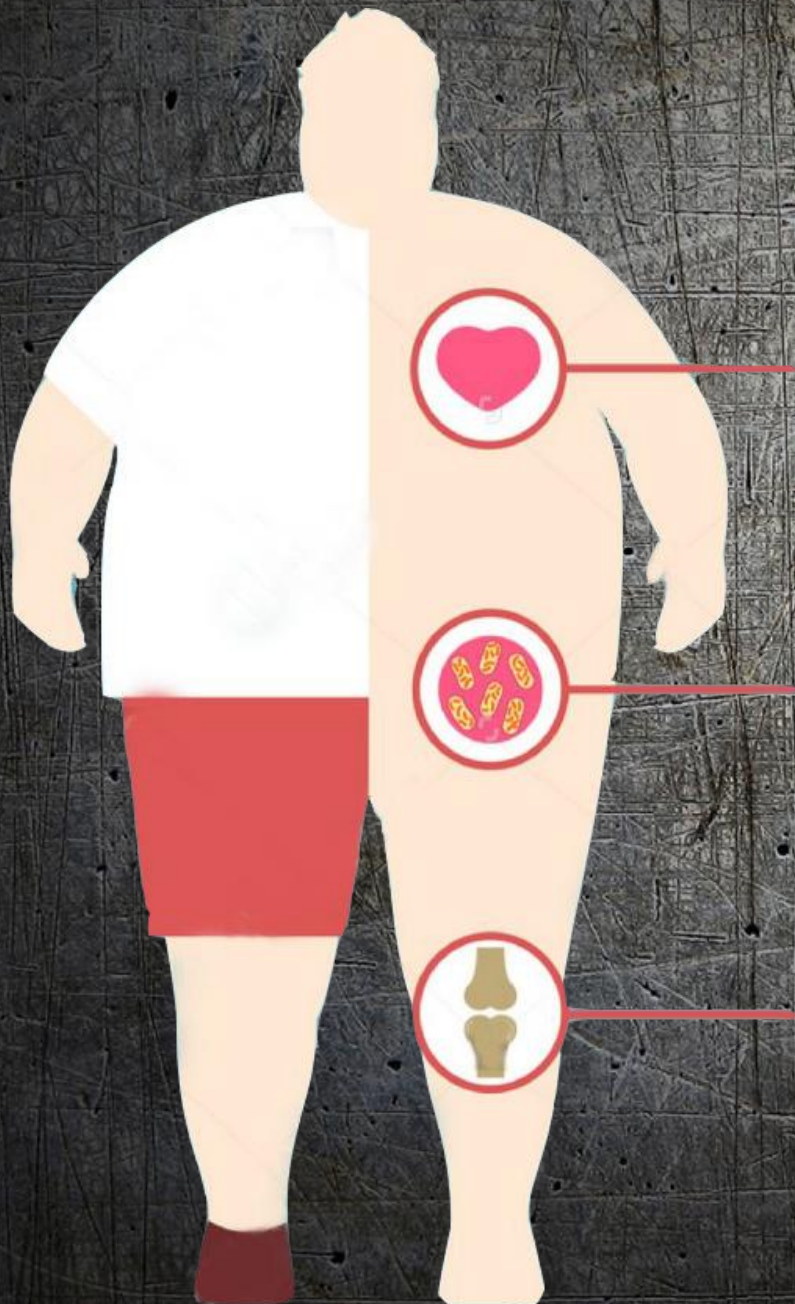
16-18,5
body
weight
deficit

16<
body
mass
deficit
pronounced

انواع چاقی



ریسک فاکتورها



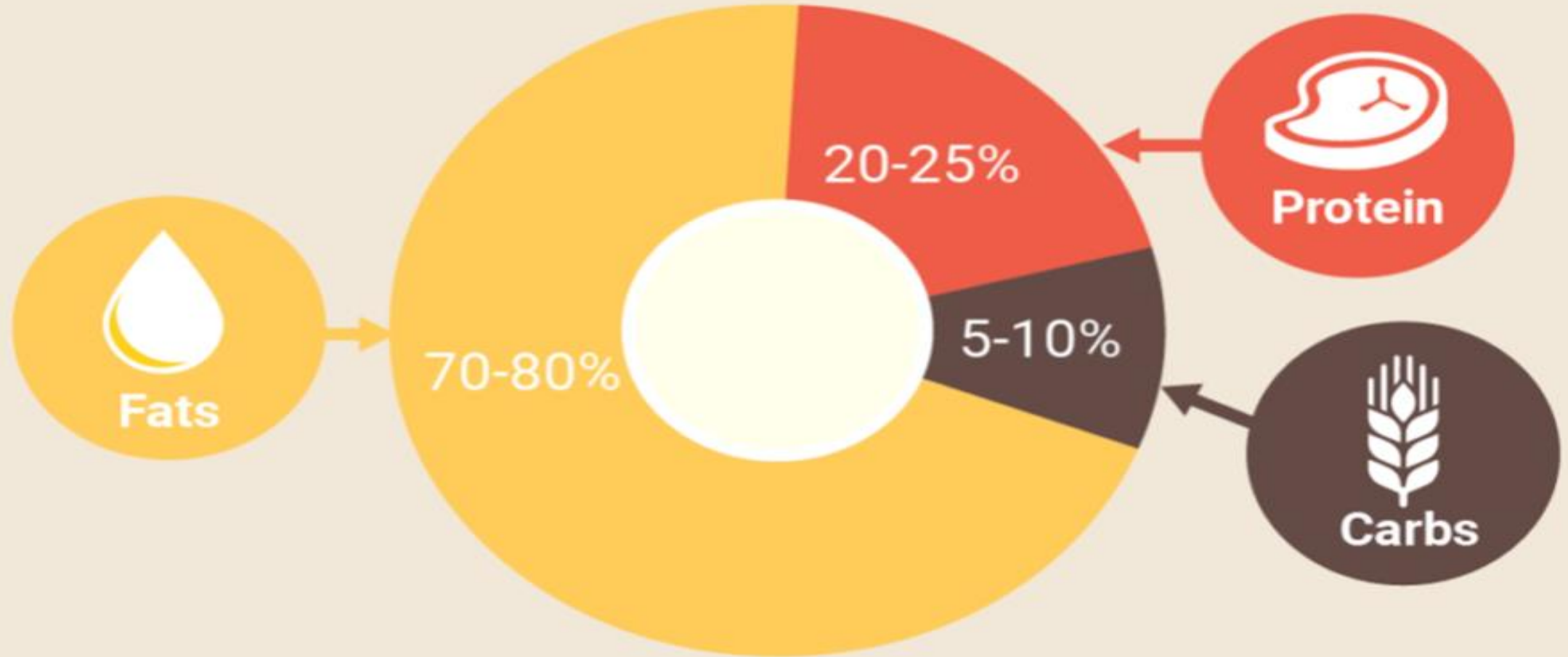
سکته قلبی
سکته مغزی
فشار خون
آترواسکلروز

دیابت
پانکراتیت
التهاب معده
التهاب کیسه صفرا
یبوست
سنگ کلیه

نقرص
استئوآرتریت
استئوکندروز
اسپوندیلوز



رژیم کتوژنیک

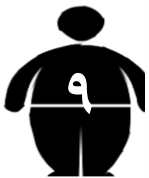
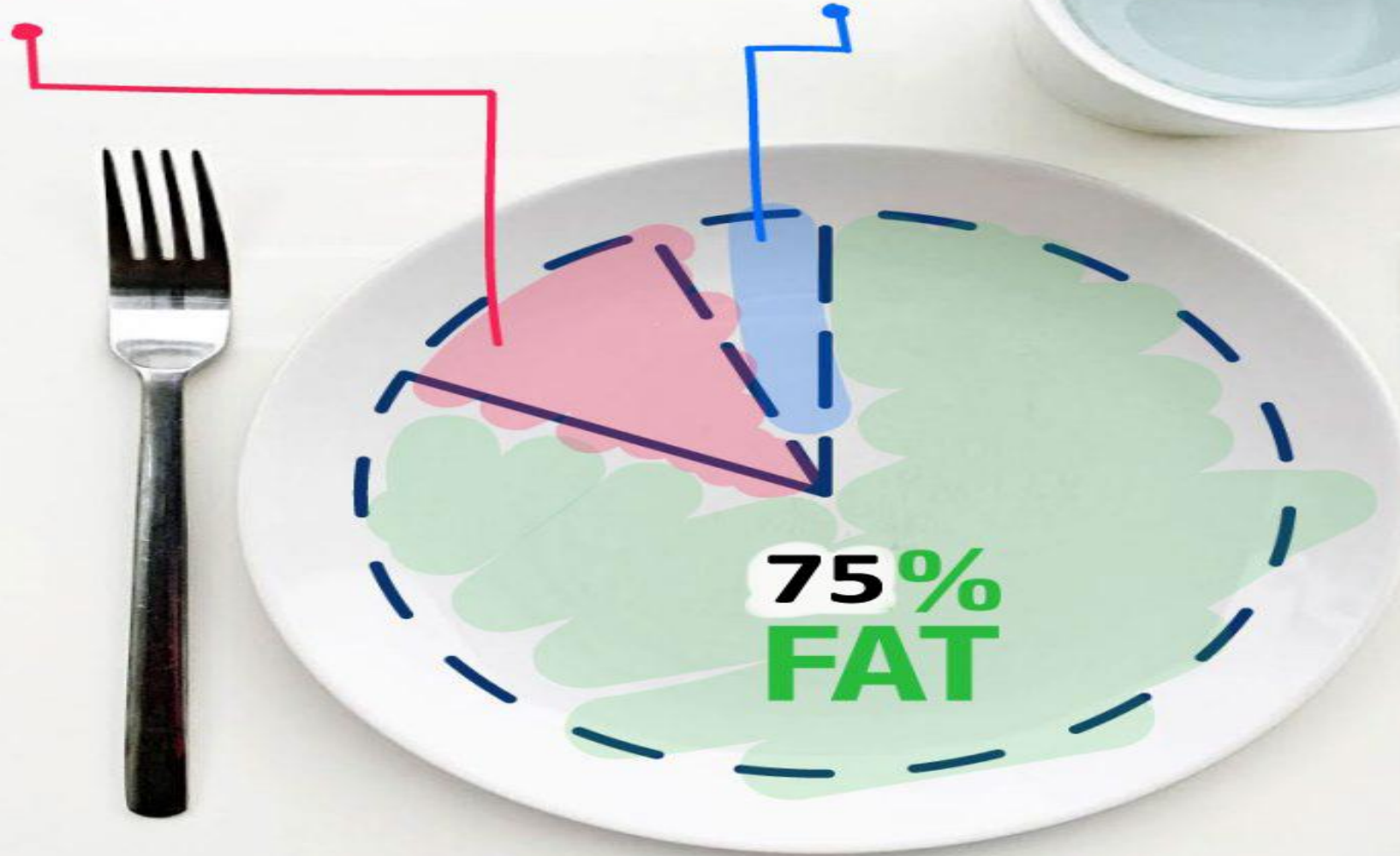


Standard ketogenic diet (SKD)

مقدمه (ادامه)

15-20%
PROTEIN

5-10 %
CARB

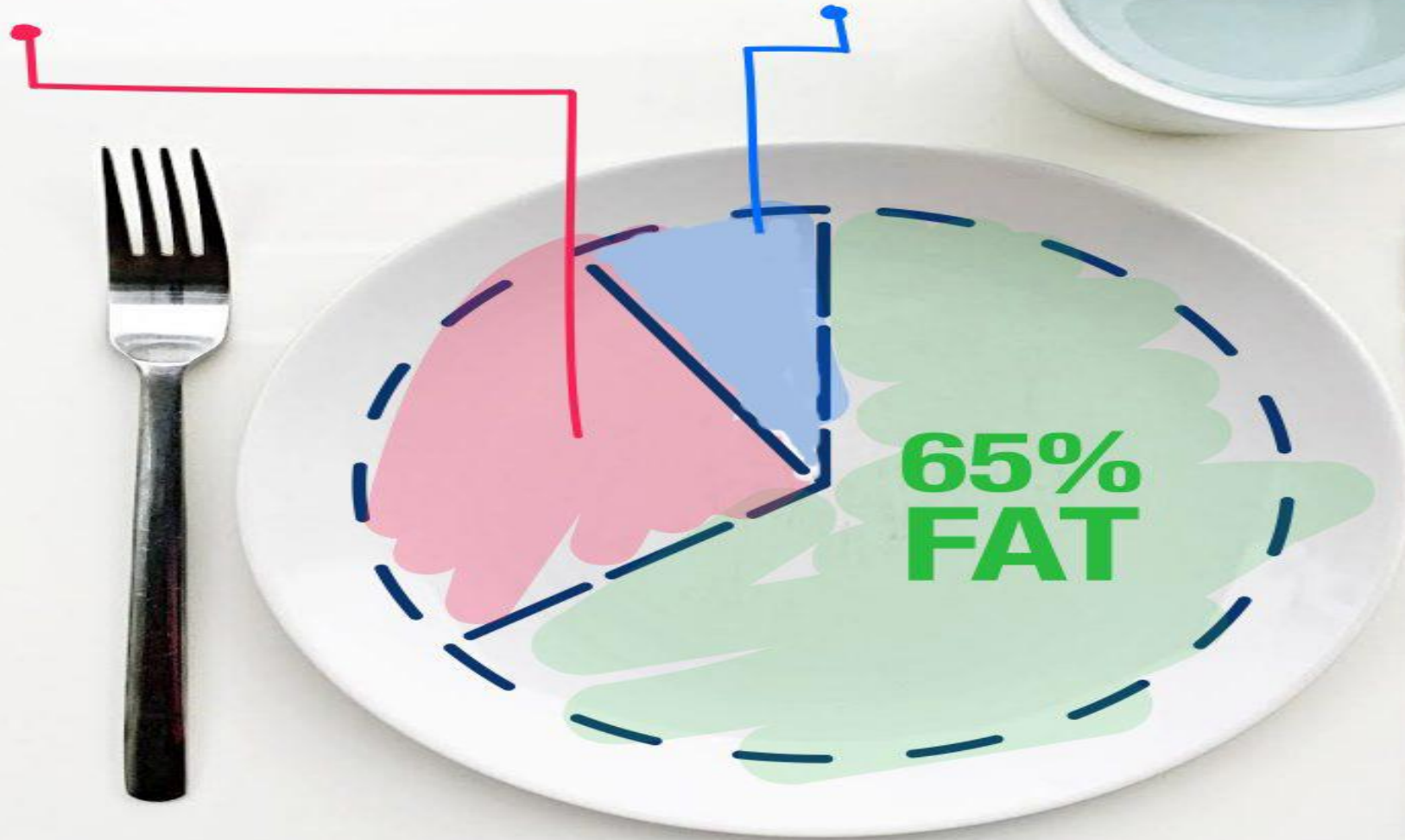


Targeted keto diet (TKD)

مقدمه (ادامه)

**20 %
PROTEIN**

**10-15 %
CARB**



Cyclical keto diet (CKD)

مقدمه (ادامه)

25 %
PROTEIN

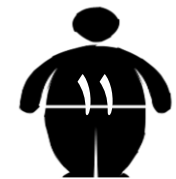
25 %
CARB

50 %
FAT

15-20%
PROTEIN

5-10 %
CARB

75 %
FAT



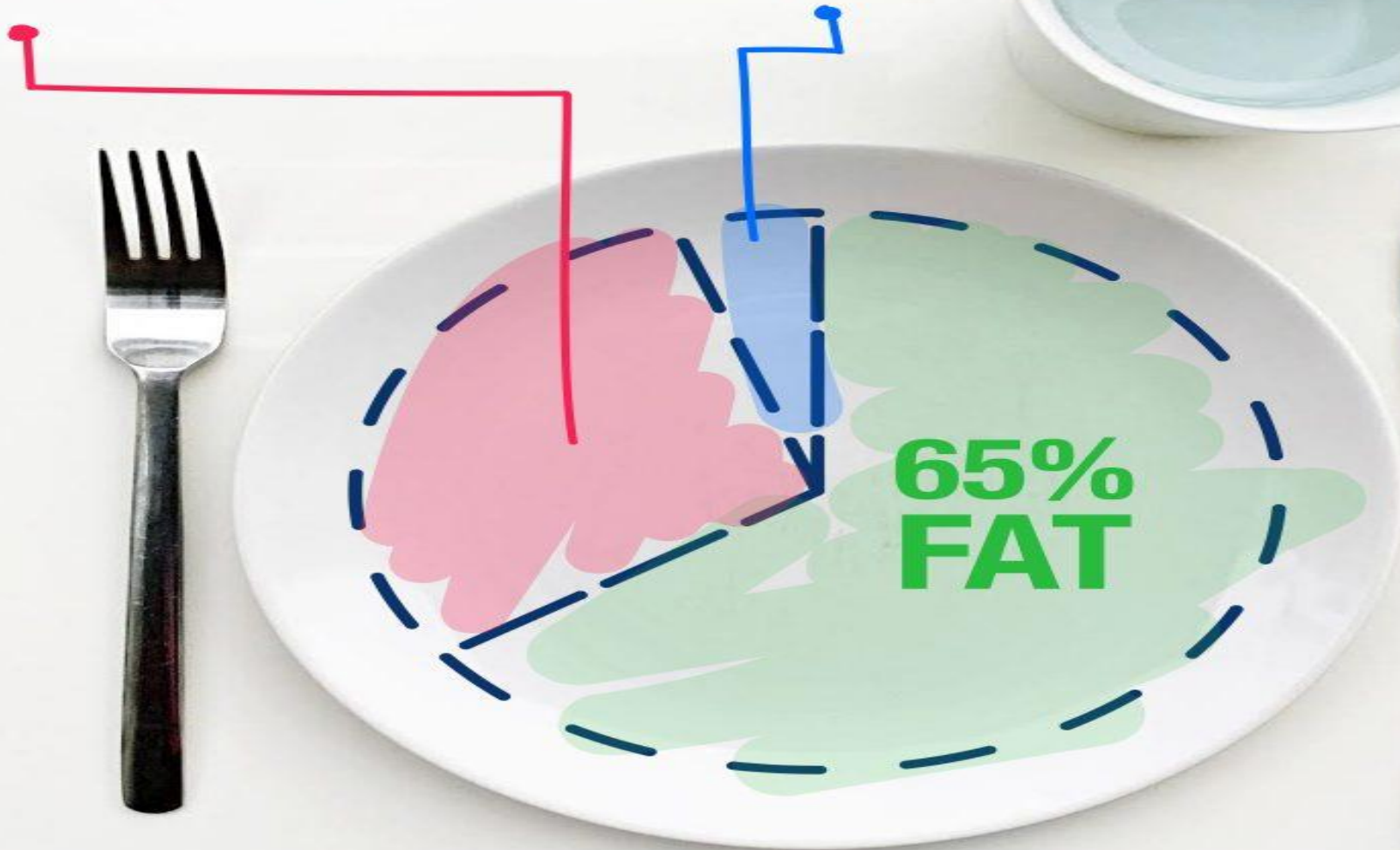
High-Protein Keto Diet (HPKD)

مقدمه (ادامه)

**30%
PROTEIN**

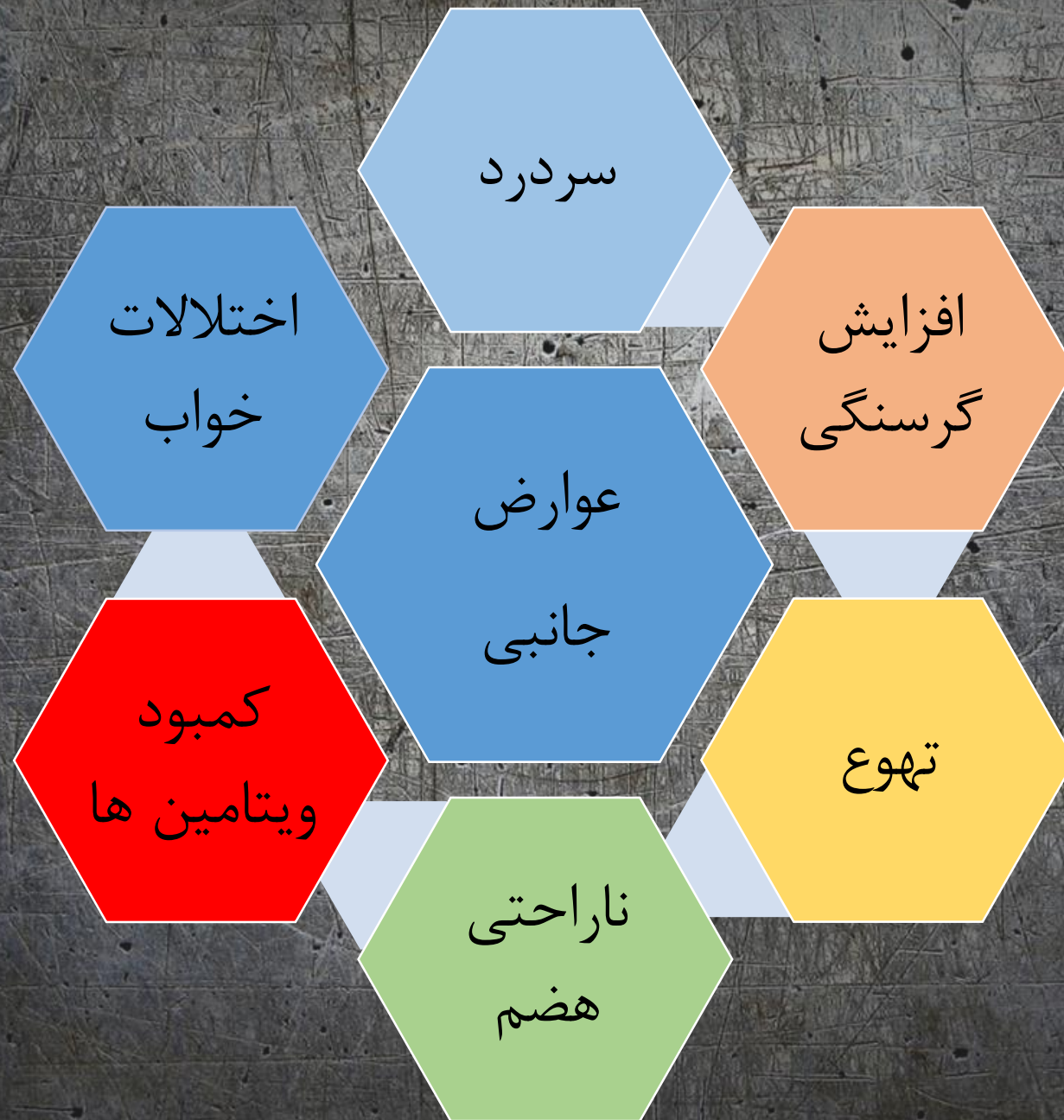
**5%
CARB**

**65%
FAT**



در رژیم کتوژنیک، چه غذاهایی نباید بخورید





مقدمه (ادامه)

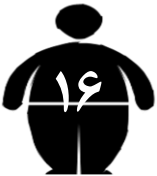
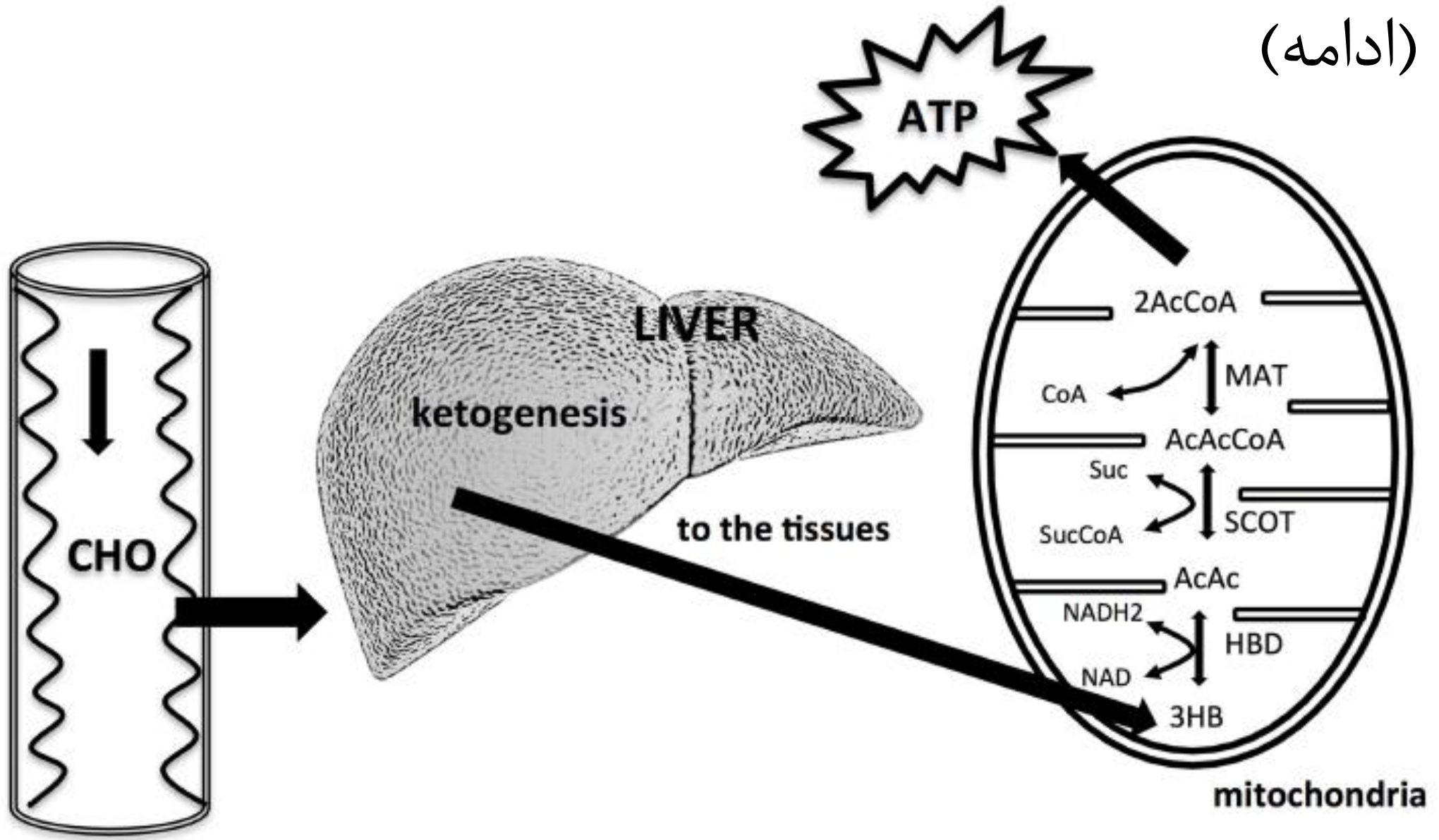
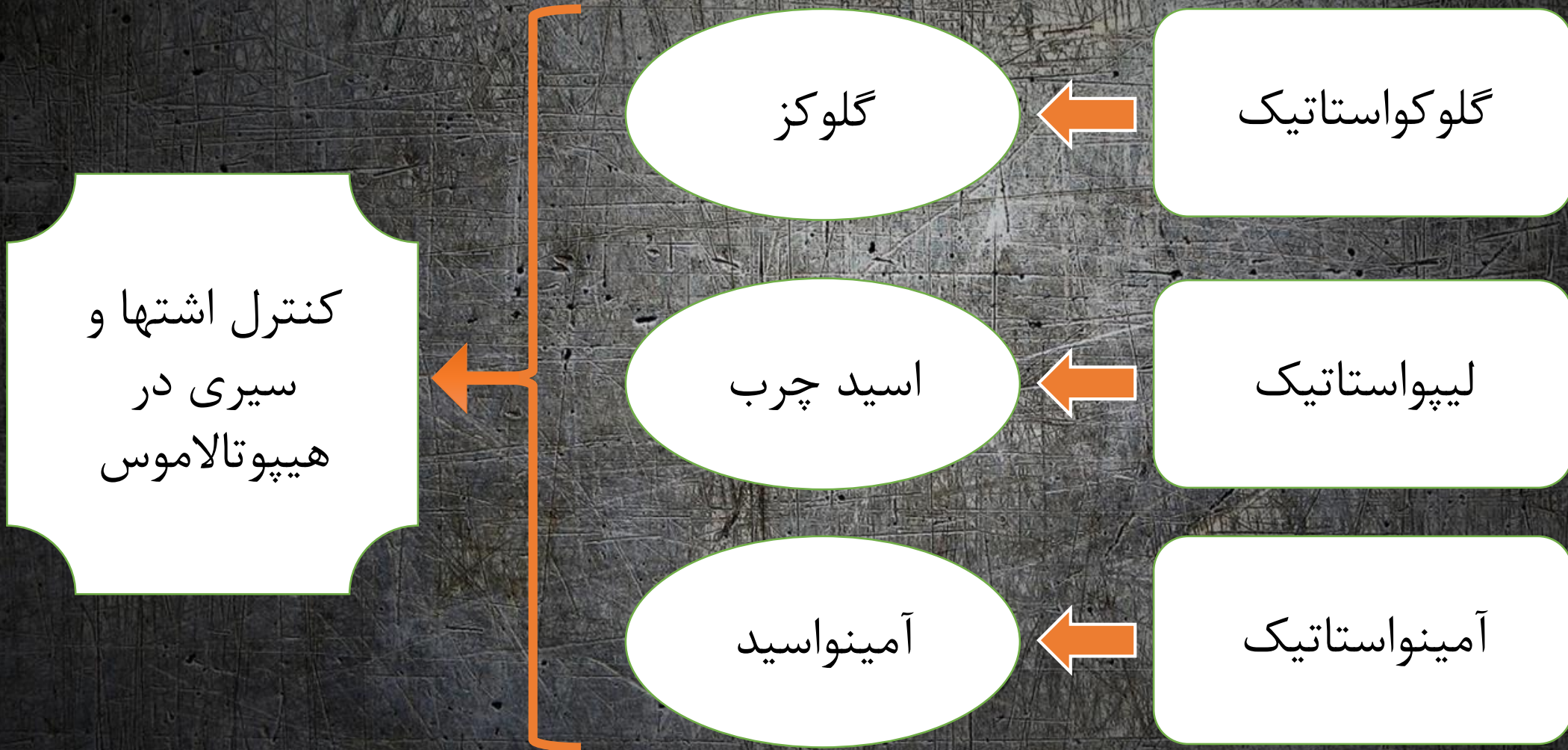


Table 1 | Blood levels during a normal diet, ketogenic diet, and diabetic ketoacidosis (Paoli et al., 2012).

| Blood levels | Normal diet | Ketogenic diet | Diabetic ketoacidosis |
|----------------------|--------------------|-----------------------|------------------------------|
| Glucose (mg/dL) | 80–120 | 65–80 | >300 |
| Insulin (μ U/L) | 6–23 | 6.6–9.4 | $\cong 0$ |
| KB conc (mmol/L) | 0.1 | 7–8 | >25 |
| pH | 7.4 | 7.4 | <7.3 |

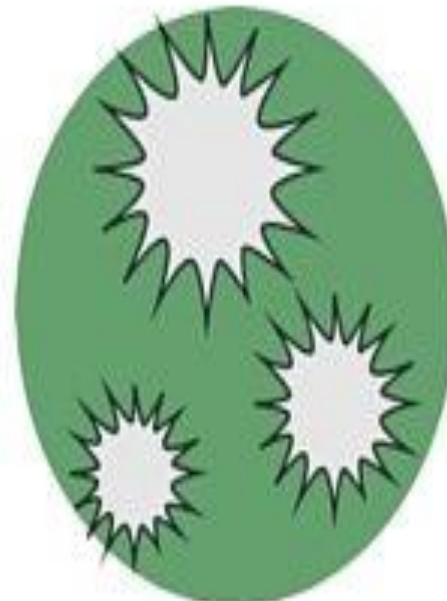




CARBOHYDRATE-INSULIN HYPOTHESIS OF OBESITY



CARBS

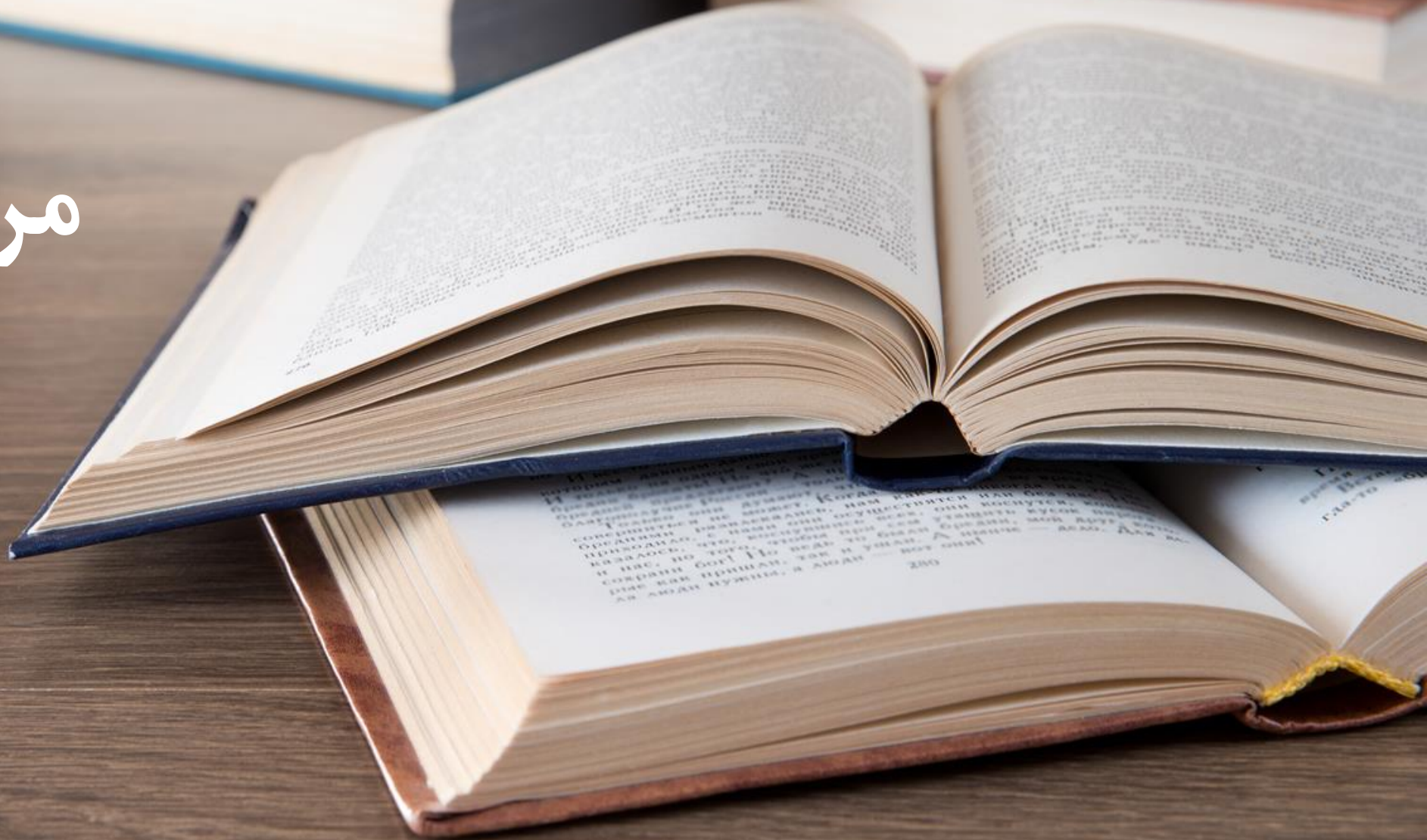


INSULIN



FAT

مرور متون



مقاله ۱

عنوان :

- Obesity treatment by very low-calorie-ketogenic diet at two years: reduction in visceral fat and on the burden of disease

نویسندگان : Basilio Moreno, et al

سال : ۲۰۱۶

نوع مطالعه : مداخله ای



۴۵
شرکت
کننده

۲۲ نفر
رژیم VLCD

۲۳ نفر
رژیم VLCKD

همه شرکت
کنندگان چاق
و سالم و پیش
دیابت

۱۵-۲۵٪ پروتئین
۴۵-۵۵٪ کربوهیدرات
۲۵-۳۵٪ چربی
۲۰-۴۰ گرم فیبر

۱۵ گرم پروتئین
۴ گرم کربوهیدرات
۳ گرم چربی
در هر سروینگ
۱۰۰ کالری

ترکیب بدن با DEXA
آنالیز با CORESCAN



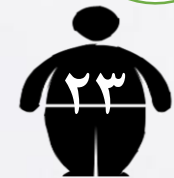
| | | | | | |
|--|---------|---------|--|--|--|
| 80% of target weight loss | | | 20% of target weight loss | | Long-term maintenance of weight loss |
| Multidisciplinary team (dietary counselling / physical activity / psychological support) | | | | | |
| Stage 1 Active Stage | | | Stage 2 Dietary re-education | | Stage 3 Maintenance |
| Phase 1 | Phase 2 | Phase 3 | Gradual re-introduction of different foods | | Balanced diet |
| VLCK diet (600-800 kcal/day) | | | LC diet (800-1500 kcal/day) | | Maintenance diet (1500-2250 kcal/day) |

مکمل پروتئین
۵ بار در روز
وسبزیجات بانمایه
گلیسمی پایین

جایگزینی یک
واحد پروتئین
طبیعی با
مکمل

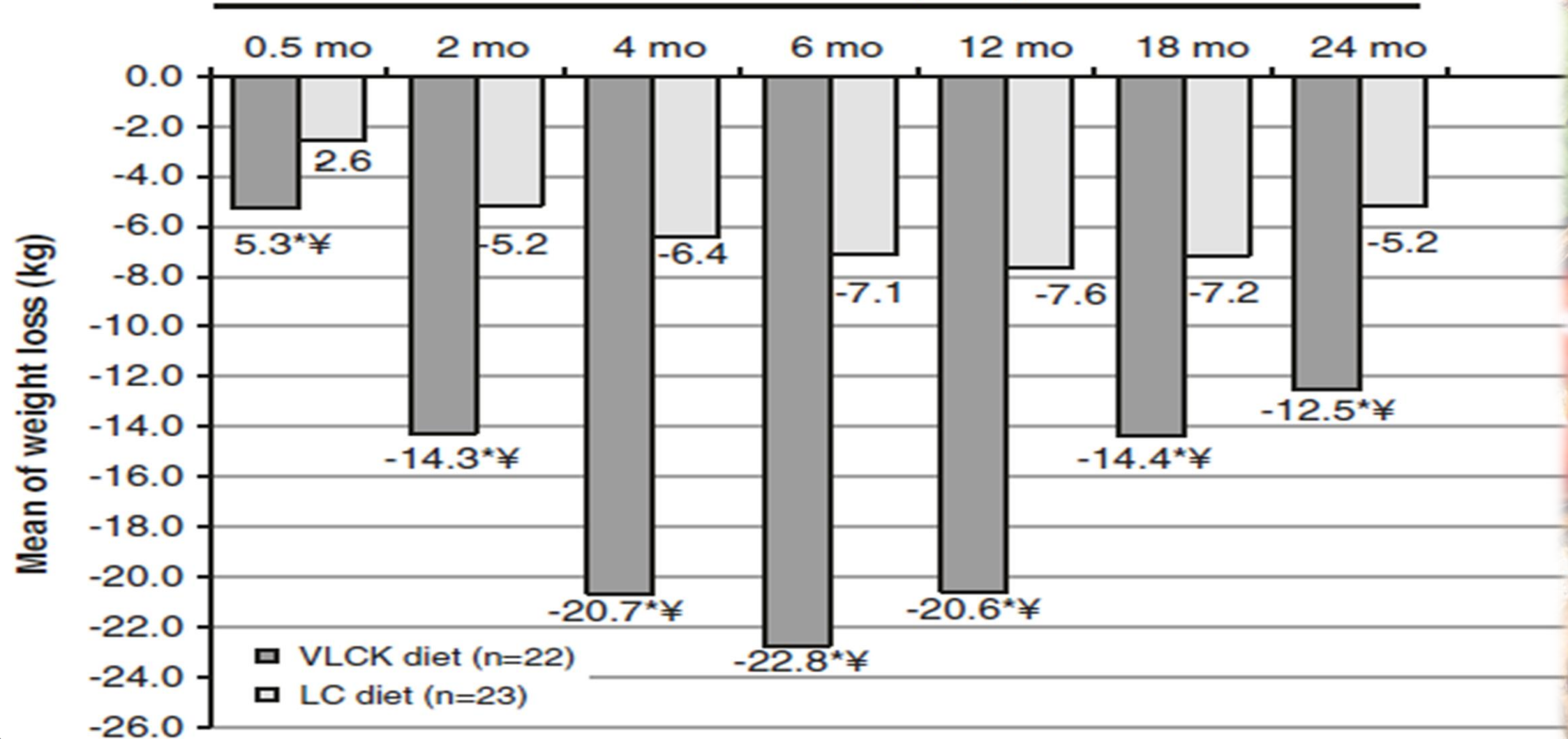
جایگزینی
پروتئین کم چرب
با دو واحد مکمل

45-55%cho
15-25%pro
25-35%fat



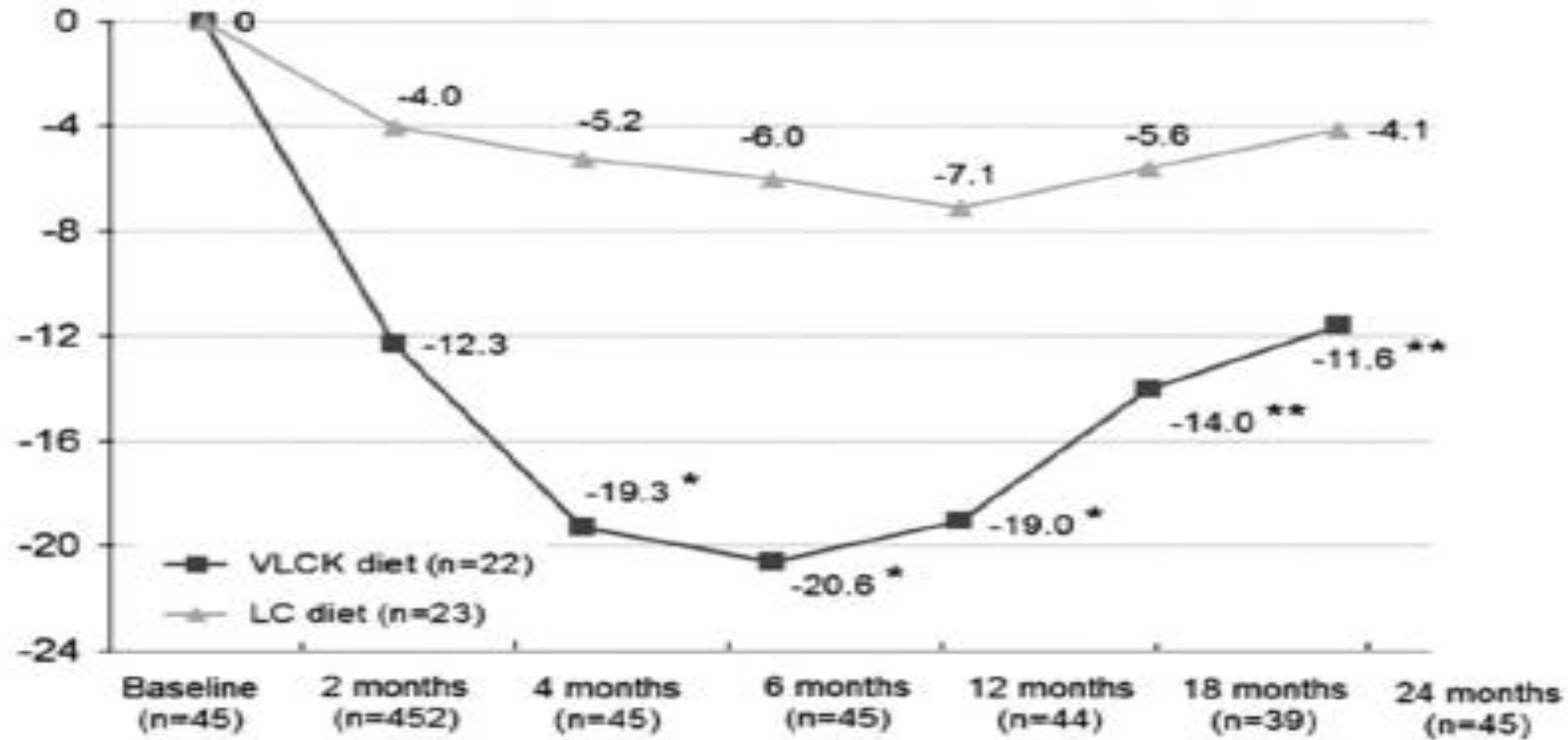
Weight loss

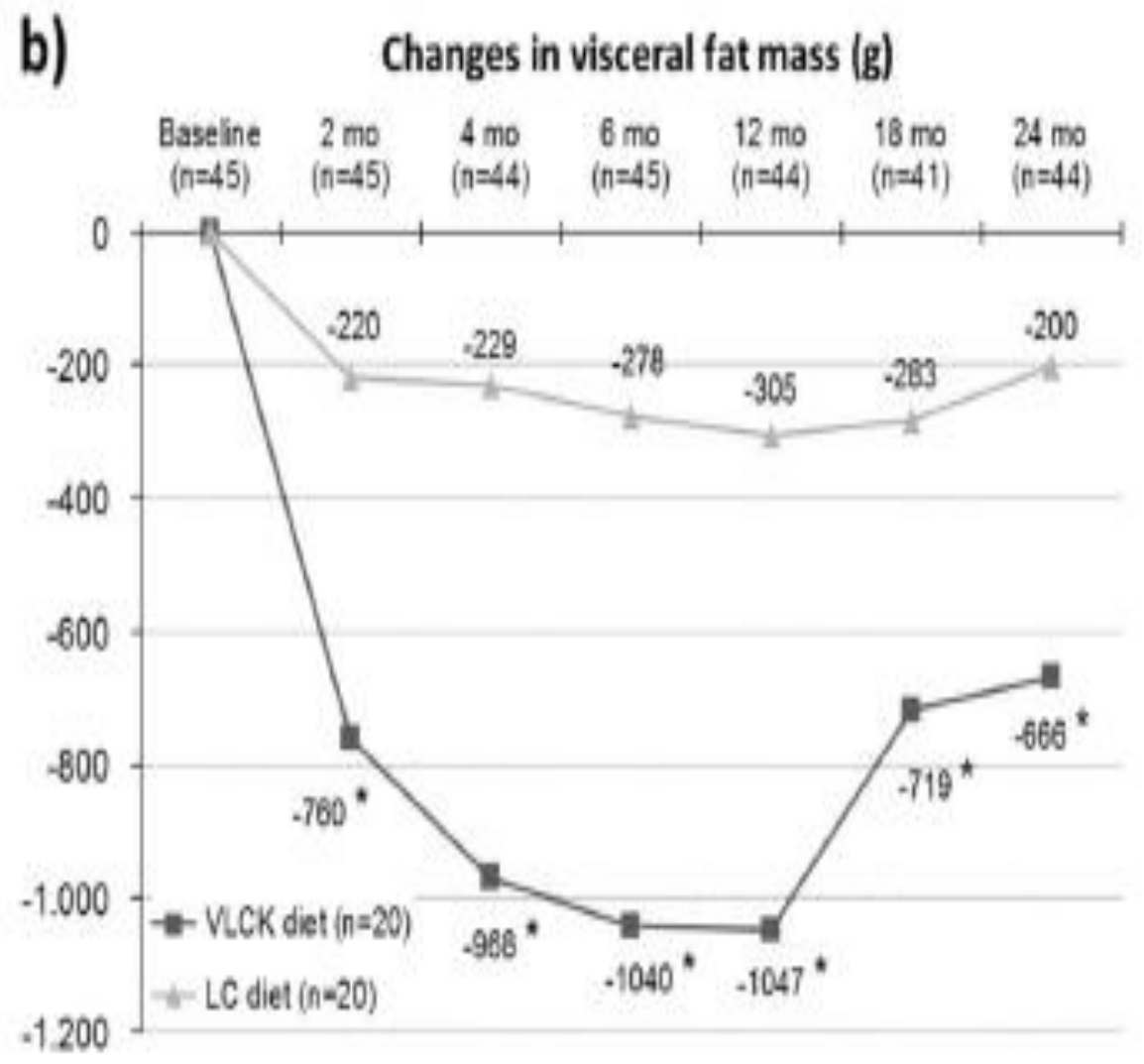
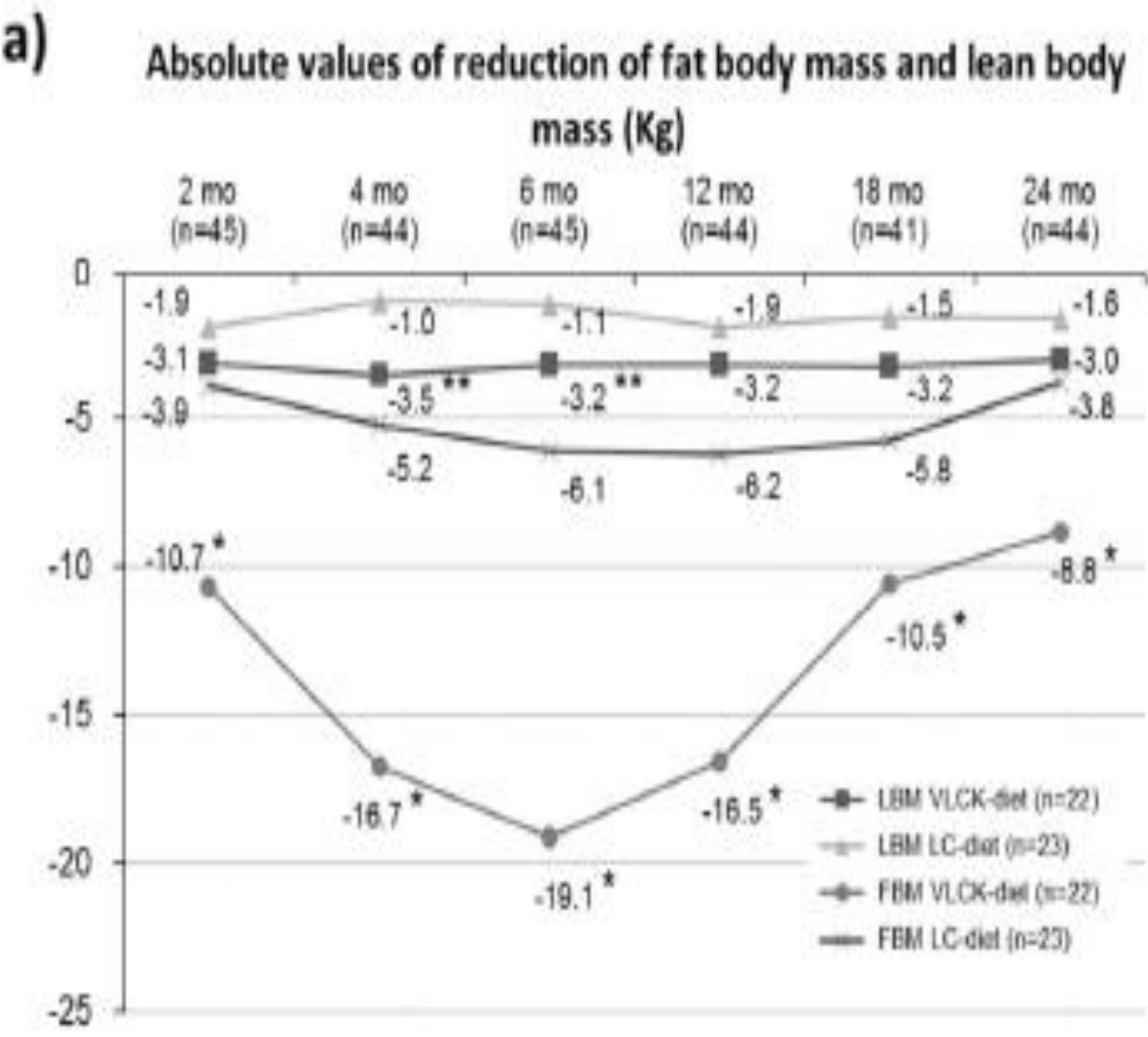
COMPLETERS (n=45)



c)

Changes in waist circumference (cm)





• مقاله ۲

• عنوان :

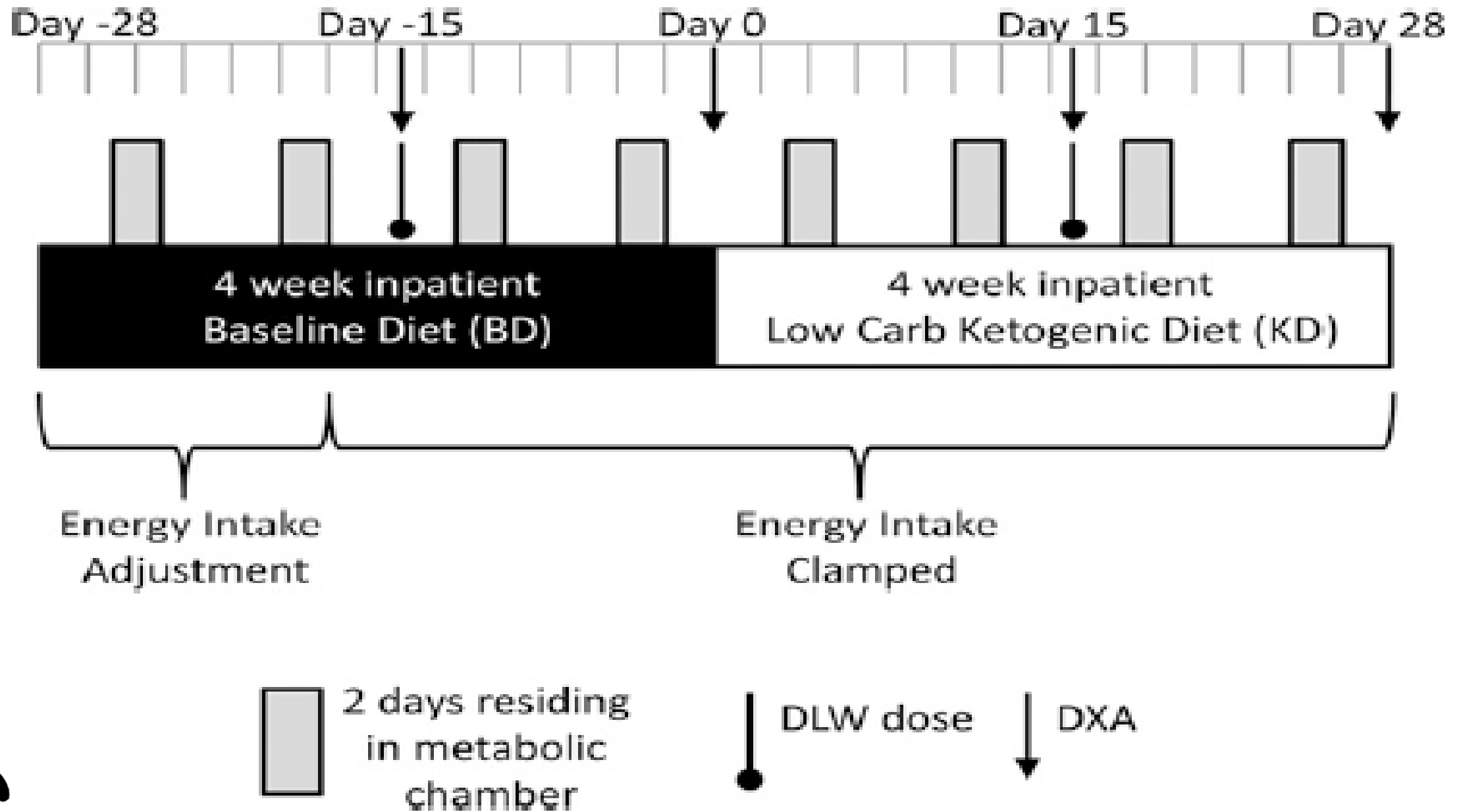
- Energy expenditure and body composition changes after an isocaloric ketogenic diet in overweight and obese men

• نویسندگان: Kevin D Hall, et al

• سال: ۲۰۱۶

• نوع مطالعه: مداخله ای





هر هفته دو روز متوالی در اتاق متابولیک

انرژی مصرفی در خواب

کل انرژی مصرفی

حجم تنفسی

اندازه گیری
ترکیب بدن با
DXA, DLW



TABLE 1Daily diet composition of the 7-d, 2400-kcal rotating menus for the BD and KD¹

| | BD | KD |
|---------------------------|-------------------------|------------|
| Energy, kcal | 2398 | 2394 |
| Protein, g | 91 | 91 |
| Carbohydrate, g | 300 | 31 |
| Fat, g | 93 | 212 |
| Sodium, mg | 3060 | 5060 |
| <i>trans</i> Fat, g | 1.2 | 2.3 |
| Monounsaturated fat, g | 31.8 | 100.2 |
| Polyunsaturated fat, g | 19.9 | 32.5 |
| Saturated fat, g | 33.0 | 65.6 |
| Fiber, g | 26 | 12 |
| Total sugar, g | 147 | 10 |
| Protein, % of energy | 15 | 15 |
| Carbohydrate, % of energy | 50 | 5 |
| Fat, % of energy | 35 | 80 |
| Chemical analysis | | |
| Protein, % of energy | 16.1 ± 0.4 ² | 16.9 ± 0.5 |
| Carbohydrate, % of energy | 48.1 ± 0.7 | 5.9 ± 1.1 |
| Fat, % of energy | 35.6 ± 0.6 | 77.3 ± 1.0 |
| Sodium, mg | 2665 ± 157 | 4910 ± 610 |
| Fiber, g | 23.7 ± 2.2 | 13.2 ± 2.1 |



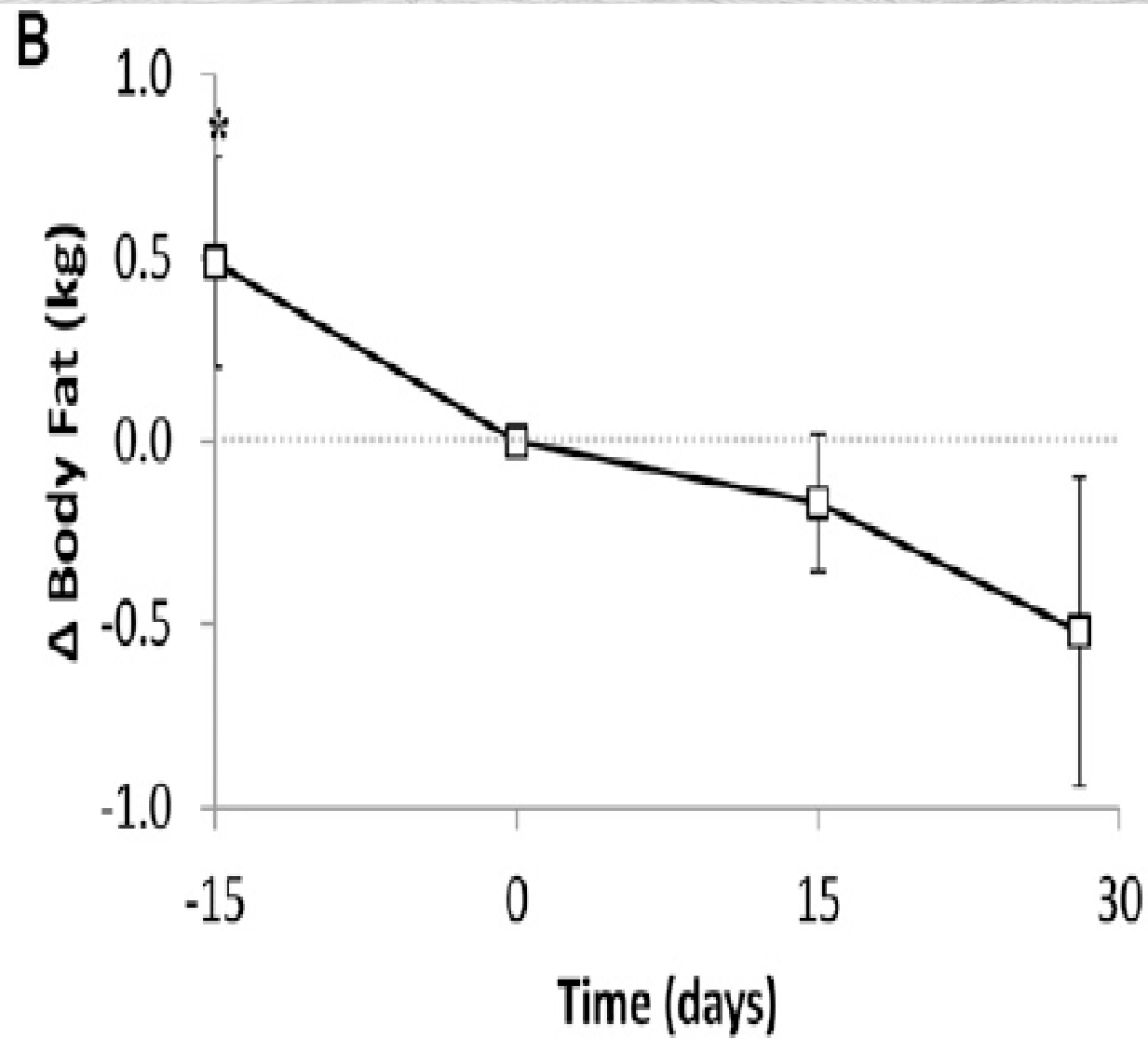
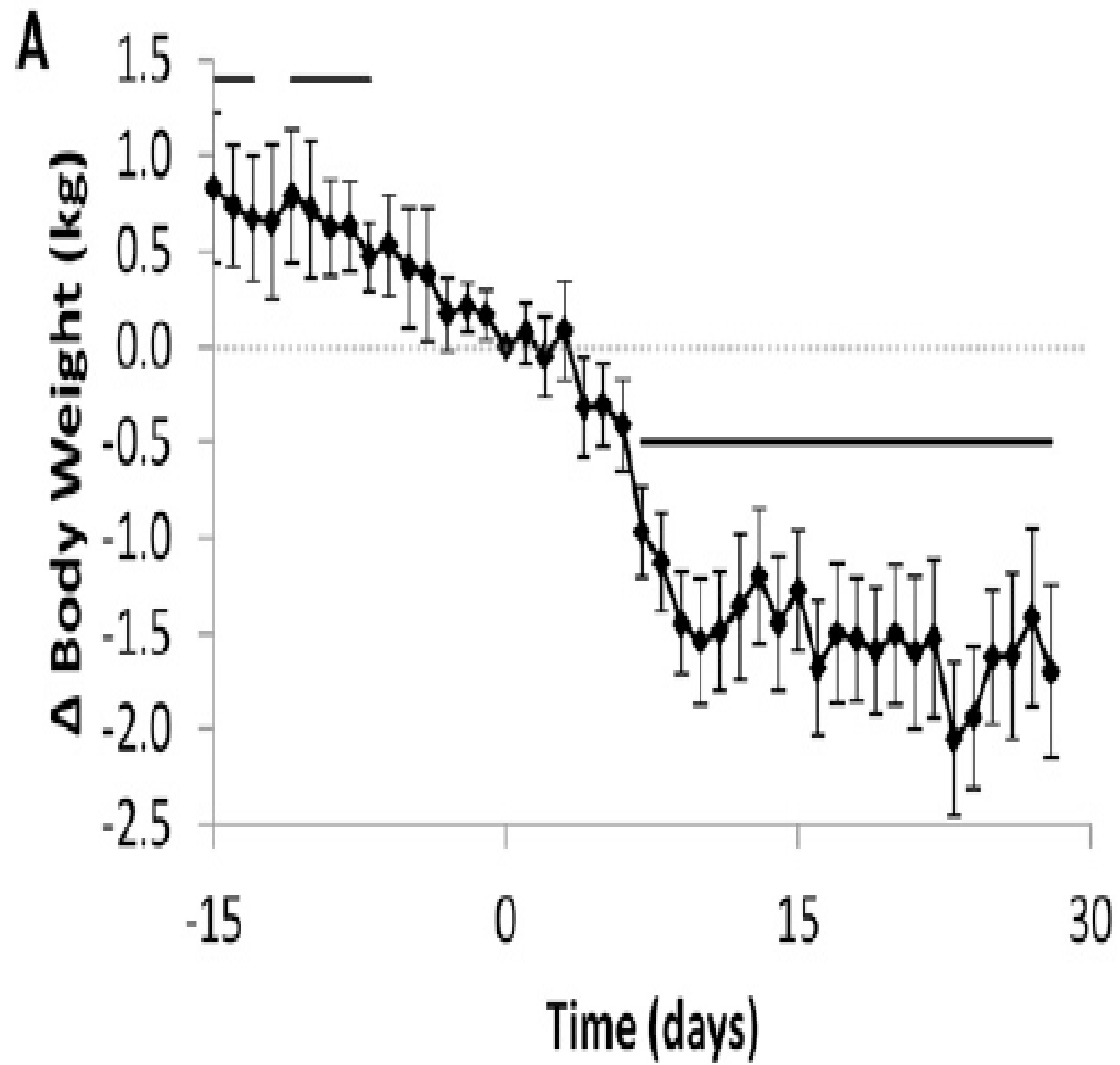


TABLE 4Overnight fasted plasma concentrations measured during the BD and KD periods¹

| | BD (<i>n</i> = 17) | KD (<i>n</i> = 17) | <i>P</i> ² |
|--------------------------------|---------------------|---------------------|-----------------------|
| Acetoacetate, mmol/L | 0.108 ± 0.075 | 0.781 ± 0.069 | <0.0001 |
| BHB, mmol/L | 0.103 ± 0.071 | 0.758 ± 0.066 | <0.0001 |
| FFAs, mmol/L | 0.479 ± 0.035 | 0.803 ± 0.029 | <0.0001 |
| Glycerol, mg/L | 7.21 ± 0.78 | 11.1 ± 0.66 | 0.0006 |
| Glucose, mg/dL | 81.4 ± 1.5 | 81.9 ± 1.4 | 0.664 |
| Glucagon, pg/mL | 93.6 ± 8.9 | 126 ± 8.6 | <0.0001 |
| C-peptide, ³ ng/mL | 1.47 ± 0.11 | 1.15 ± 0.11 | <0.0001 |
| Insulin, ³ μU/mL | 7.92 ± 0.93 | 6.27 ± 0.9 | 0.0039 |
| Triglyceride, mg/dL | 104 ± 6.4 | 85.4 ± 6 | 0.001 |
| Leptin, ng/mL | 8.94 ± 1.1 | 7.13 ± 1.1 | <0.0001 |
| TSH, μIU/mL | 1.84 ± 0.19 | 1.98 ± 0.18 | 0.0448 |
| Free thyroxine, ng/dL | 1.18 ± 0.033 | 1.32 ± 0.032 | <0.0001 |
| Total thyroxine, μg/dL | 6.56 ± 0.3 | 6.76 ± 0.3 | 0.109 |
| Free tri-iodothyronine, pg/mL | 2.85 ± 0.097 | 2.5 ± 0.094 | <0.0001 |
| Total tri-iodothyronine, ng/dL | 95.1 ± 3.6 | 75.7 ± 3.4 | <0.0001 |

• مقاله ۳

• عنوان :

- Impact of a 6-week non-energy-restricted ketogenic diet on physical fitness, body composition and biochemical parameters in healthy adults

• نویسندگان : Paul Urbain, et al

• سال : ۲۰۱۷

• نوع مطالعه : مداخله ای



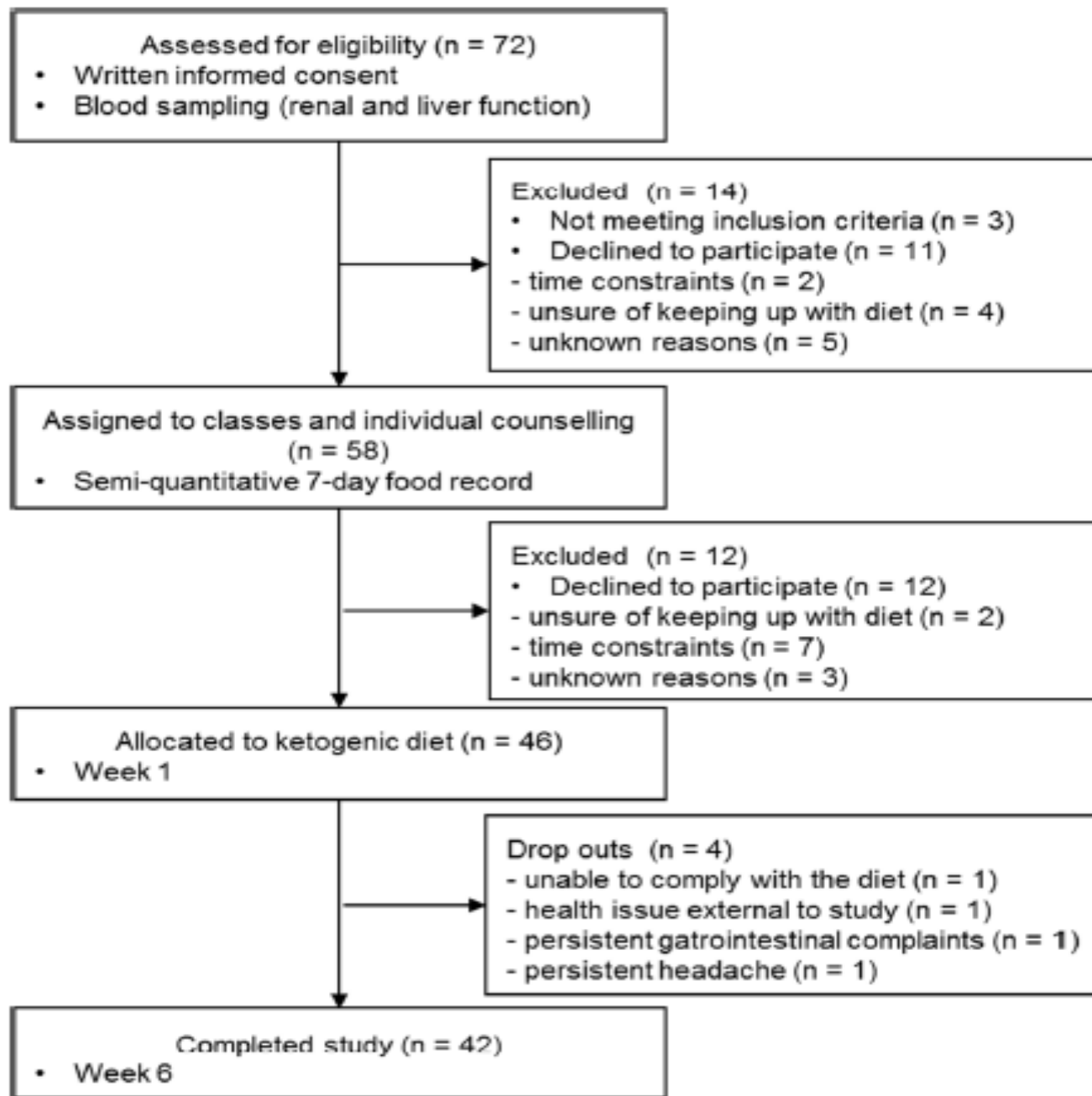


Fig. 1 Flow diagram of the study participants from eligibility criteria screening to study completion



self-testing
strips

اندازه گیری
روزانه کتون
ادراری

هندگریپ
نمونه خون

ثبت روزانه
رژیم

انداز گیری
FFM و FM
با ADP

رژیم دلخواه با میزان
معین

- پروتئین : ۱۵ تا ۲۰ درصد
- چربی : ۷۵ درصد
- کربوهیدرات : ۵ تا ۱۰ درصد

Ad
libitum



Table 3 Weight and body composition

| | Unit | PRE | POST | P-value |
|---|------|------------------|------------------|---------|
| Weight | kg | 70.3 ± 11.5 | 68.4 ± 10.3 | <0.001 |
| Whole-body air displacement plethysmography (ADP) | | | | |
| FM | kg | 22.6 ± 8.7 | 21.7 ± 8.2 | <0.001 |
| FFM | kg | 44.7 (36.7–72) | 43.9 (36.1–70.5) | <0.001 |
| Bioelectrical impedance analysis (BIA) | | | | |
| FM | kg | 20.9 ± 6.9 | 19.4 ± 6.3 | <0.001 |
| FFM | kg | 47.3 (38.6–76.1) | 46.7 (38.3–75.3) | 0.182 |
| Body cell mass | kg | 24.3 (20.0–43.3) | 24.4 (19.0–43.4) | 0.427 |
| Phase angle ^a | ° | 6.1 (4.8–8.5) | 6.3 (4.8–8.2) | 0.030 |

Abbreviations: FFM fat-free mass, FM fat mass

^aPhase angle, one of the raw data obtained at a frequency of 50 kHz

Radian, Unit system SI derived unit, Unit of Angle, Symbol rad or °, Symbol for the unit of bioelectrical phase angle is °



Table 4 Fasting blood parameters

| | Unit | PRE | POST | Reference range | P-value |
|--------------------|--------|-------------------|-------------------|-----------------|---------|
| Glucose and lipids | | | | | |
| Glucose | mg/dl | 91.4 ± 7.3 | 88.7 ± 5.3 | 74–106 | 0.009 |
| TG | mg/dl | 64 (38–212) | 62 (39–172) | <150 | 0.089 |
| HDL-C | mg/dl | 71.3 ± 14.3 | 73.6 ± 15.6 | >40 | 0.088 |
| LDL-C | mg/dl | 110.9 ± 31.3 | 122.8 ± 33.6 | <160 | 0.001 |
| TC | mg/dl | 186.5 ± 34.7 | 195.3 ± 34.7 | <200 | 0.019 |
| LDL-C/HDL-C | | 1.47 (0.50–3.62) | 1.58 (0.56–2.92) | <4.5 | 0.084 |
| TG/HDL-C | | 0.89 (0.43–4.24) | 0.76 (0.48–3.37) | <2 | 0.039 |
| Hormones | | | | | |
| TSH | μU/ml | 1.81 (0.01–7.26) | 1.87 (0.15–10.29) | 0.27–4.20 | 0.202 |
| ft3 | pmol/l | 4.91 (3.84–10.87) | 4.11 (2.91–8.80) | 3.4–6.8 | <0.001 |
| ft4 | pmol/l | 15.7 (11.9–37.1) | 16.4 (12.6–36.2) | 10.6–22.7 | 0.008 |
| Insulin | pmol/l | 55.3 ± 23.7 | 43.0 ± 19.7 | 18–173 | 0.001 |
| IGF-1 | ng/ml | 175 (52–427) | 140 (31–337) | 72–457 | <0.001 |

Abbreviations: CRP C-reactive protein, C cholesterol, GOT glutamic-oxaloacetic transaminase, GPT glutamic-pyruvic transaminase, HDL high-density lipoprotein, IGF-1 insulin-like growth factor 1, LDL low-density lipoprotein, MCH mean corpuscular haemoglobin, MCHC mean corpuscular haemoglobin concentration, MCV mean corpuscular volume, ft3 free triiodothyronine, ft4 free thyroxine, TC total cholesterol, TG triglycerides, TSH thyroid stimulating hormone

Orbera – IGB Positioning (n= 80 pts)

LCD

1000 Kcal

-carbohydrates: 65%

-Lipids: 35%

-proteins: 0.8-1 mg/kg iw

AFTER 4 MONTHS

Group A (n= 40 pts)

VLCKD

< 800 Kcal

- carbohydrates: < 50%

-lipids: 10-15 g/day

-proteins: 1.2 mg/Kg iw

۲ ماه

Group B (n= 40 pts)

LCD 1000 Kcal

1000 Kcal

-carbohydrates: 65%

-Lipids: 35%

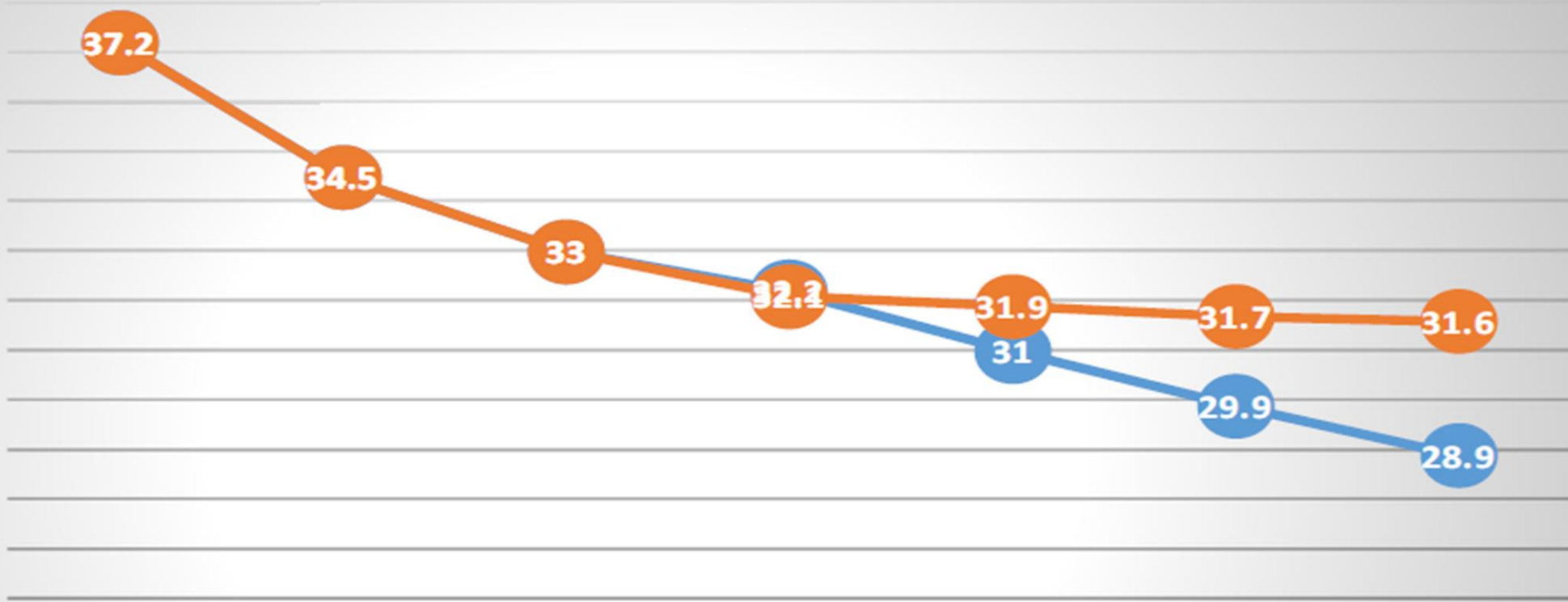
-proteins: 0.8-1 mg/kg iw

BMI=37

مدت ۶ ماه

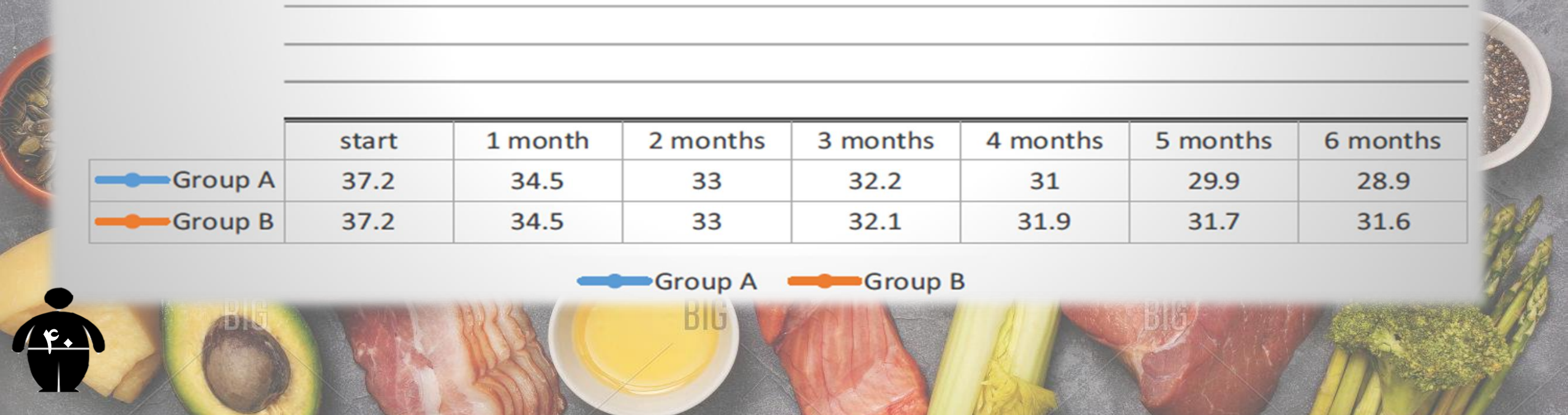


BMI KG/m²



| | start | 1 month | 2 months | 3 months | 4 months | 5 months | 6 months |
|---------|-------|---------|----------|----------|----------|----------|----------|
| Group A | 37.2 | 34.5 | 33 | 32.2 | 31 | 29.9 | 28.9 |
| Group B | 37.2 | 34.5 | 33 | 32.1 | 31.9 | 31.7 | 31.6 |

Group A Group B



کاهش وزن ۱۹ کیلوگرم



• گروه A

کاهش وزن ۱۲ کیلوگرم



• گروه B



• مقاله ۵

• عنوان :

• **Very-low-calorie ketogenic diet with aminoacid supplement versus very low restricted-calorie diet for preserving muscle mass during weight loss: a pilot double-blind study.**

• نویسندگان : G. MERRA,et al

• سال : ۲۰۱۶

• نوع مطالعه : کیس کنترل دو سوکور



۲۵ فرد سالم و
چاق

اندازه گیری تن
سنجی و هندگریپ
و ترکیب بدن
(Dxa)

۷ نفر
خارج شدن

۹ نفر رژیم VLCKD

۳ هفته
رژیم

۹ نفر رژیم VLCD



VLCD

450-500

**650-700
kcal/day**

VLCKD

پروتئین ۴۵-۵۰٪

کربوهیدرات ۱۵-۲۰

چربی ۳۵-۴۰٪

پروتئین ۵۵-۶۰٪

کربوهیدرات ۵٪

چربی ۳۵-۴۰٪

۵۰ درصد پروتئین
مصرف روزانه
مکمل وی پروتئین

Table I. Comparison between the body composition before and after administration of very-low-carbohydrate ketogenic diet for 3 weeks.

| n = 9 | Baseline (T0) media (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/m ²) ^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 |

^apaired *t*-test a or a non-parametric Wilcoxon test^b.



Table II. Comparison between the body composition before and after administration of very low restricted-calorie diet for 3 weeks.

| n = 9 | Baseline (T0) media (SD) | After 3 weeks of VLKD (T1) media (SD) | p |
|---|-------------------------------------|--|----------|
| Weight (kg) ^a | 74.77 (5.04) | 68.80 (4.24) | 0.00* |
| BMI (kg/m ²) ^a | 29.21 (1.07) | 26.90 (1.34) | 0.00 |
| Waist circumference (cm) ^b | 84.72 (2.73) | 83.75 (7.05) | 0.34 |
| Abdomen circumference (cm) ^a | 99.92 (3.18) | 96.67 (3.34) | 0.02* |
| Hip circumference (cm) ^a | 109.42 (3.61) | 105.98 (2.61) | 0.00* |
| Trunk Body Fat (kg) ^b | 16.20 (1.86) | 15.32 (2.11) | 0.1 |
| Trunk Body Lean (kg) ^b | 18.32 (1.09) | 16.98 (1.25) | 0.03* |
| Android Body Fat (kg) ^a | 2.76 (0.41) | 2.39 (0.45) | 0.00* |
| Android Body Lean (kg) ^a | 2.70 (0.21) | 2.38 (0.20) | 0.00 |
| Gynoid Body Fat (kg) ^b | 6.71 (2.05) | 5.42 (0.64) | 0.03* |
| Gynoid Body Lean (kg) ^a | 5.85 (0.57) | 5.53 (0.46) | 0.04* |
| Total Body Fat (kg) ^a | 33.06 (3.60) | 30.59 (3.65) | 0.00* |
| Total Body Lean (kg) ^a | 39.00 (3.03) | 35.70 (3.09) | 0.00* |
| Percentage Body Fat (%) ^a | 44.37 (3.35) | 44.53 (4.14) | 0.74 |

paired *t*-test ^a or a non-parametric Wilcoxon test ^b.



بحث



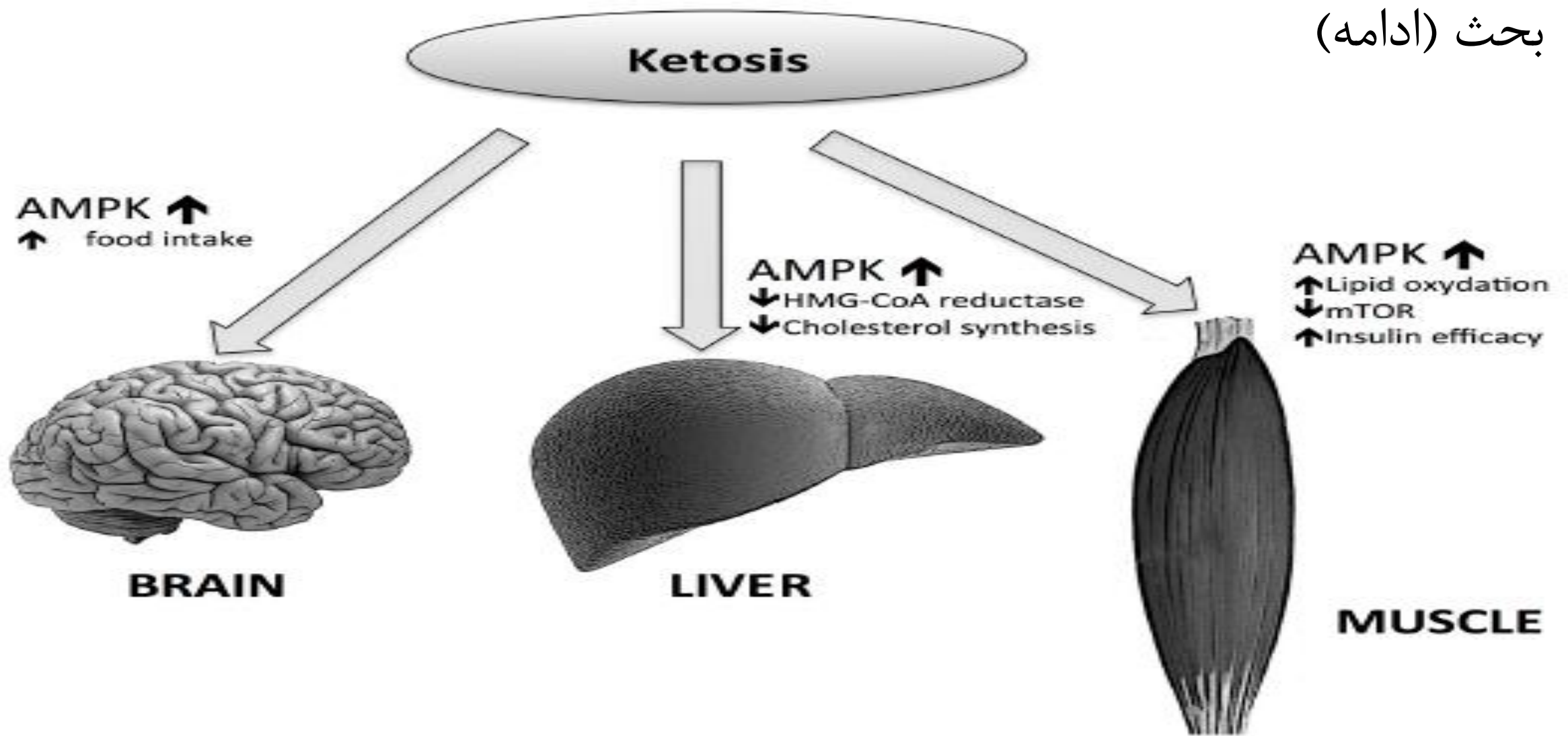


FIGURE 3 | Effects of ketone bodies on AMP-activated protein kinase (AMPK) actions in different tissues.



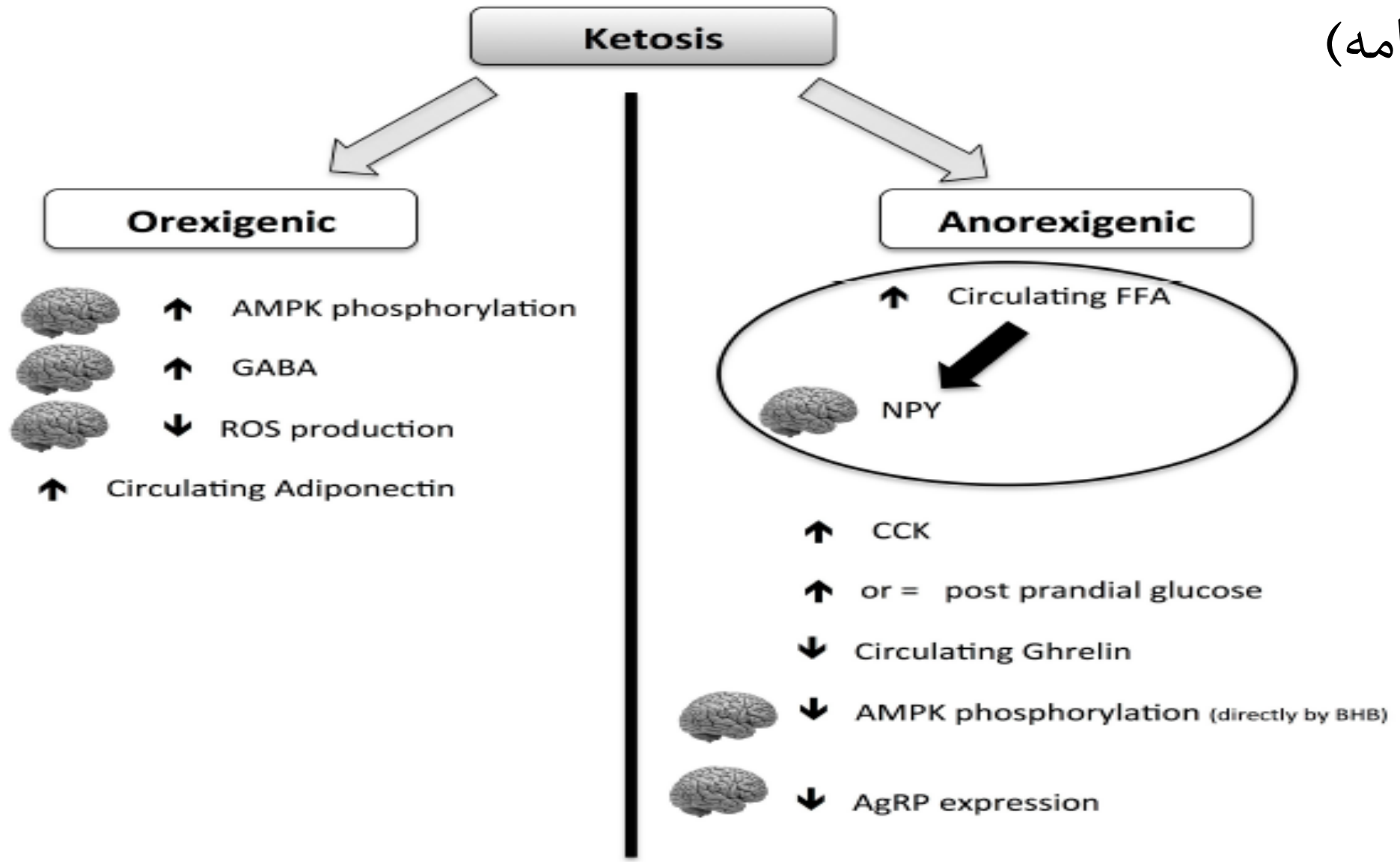


FIGURE 4 | Scheme of orexigenic and anorexigenic effects of ketosis. The picture is highly schematic. For more details please see the text. AMPK, activated protein kinase; CCK, cholecystokinin; GABA,

gamma-aminobutyric acid; BHB, β -hydroxybutyric acid; FFA, free fatty acids; ROS, reactive oxygen species; NPY, neuropeptide Y; AgRP, agouti gene-related protein.



کتون بادی ها

GUT
MICROBIOTA

عضله قلب



نتیجه گیری

Results



با بررسی مطالعات در مدت زمان ۲ تا ۳ ماه رژیم کتوژنیک در کاهش وزن موثر است و در دراز مدت اختلاف زیادی بین این رژیم با رژیم های محدوده کننده کالری وجود ندارد.



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