아주대학교의료원
Ajou University Medical Center

Application of Male Hormone in Men with Obesity

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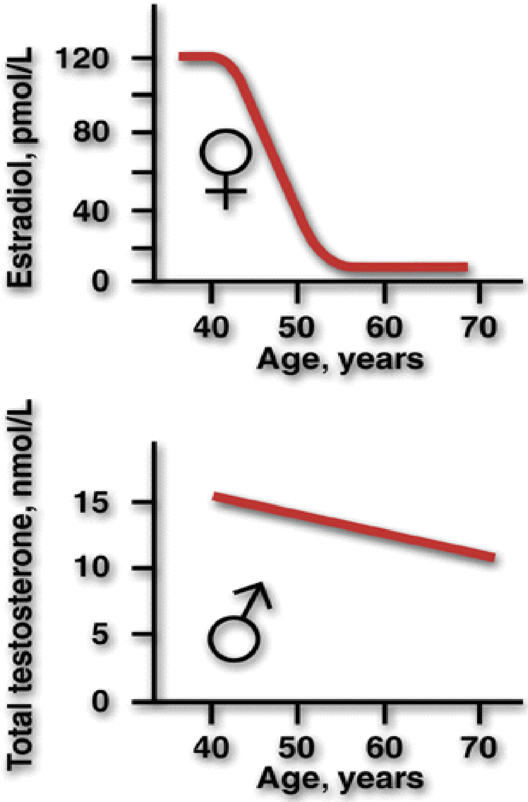
Low testosterone; Normal or Pathologic Process?

- Andropause: **Testosterone ↓ (1.6%/Y from mid 30s)**, Estrogen ↓
- Adrenopause: DHEA ↓, Cortisol ↑
- Somatopause: GH/IGF-1 ↓



Distribution of Testosterone

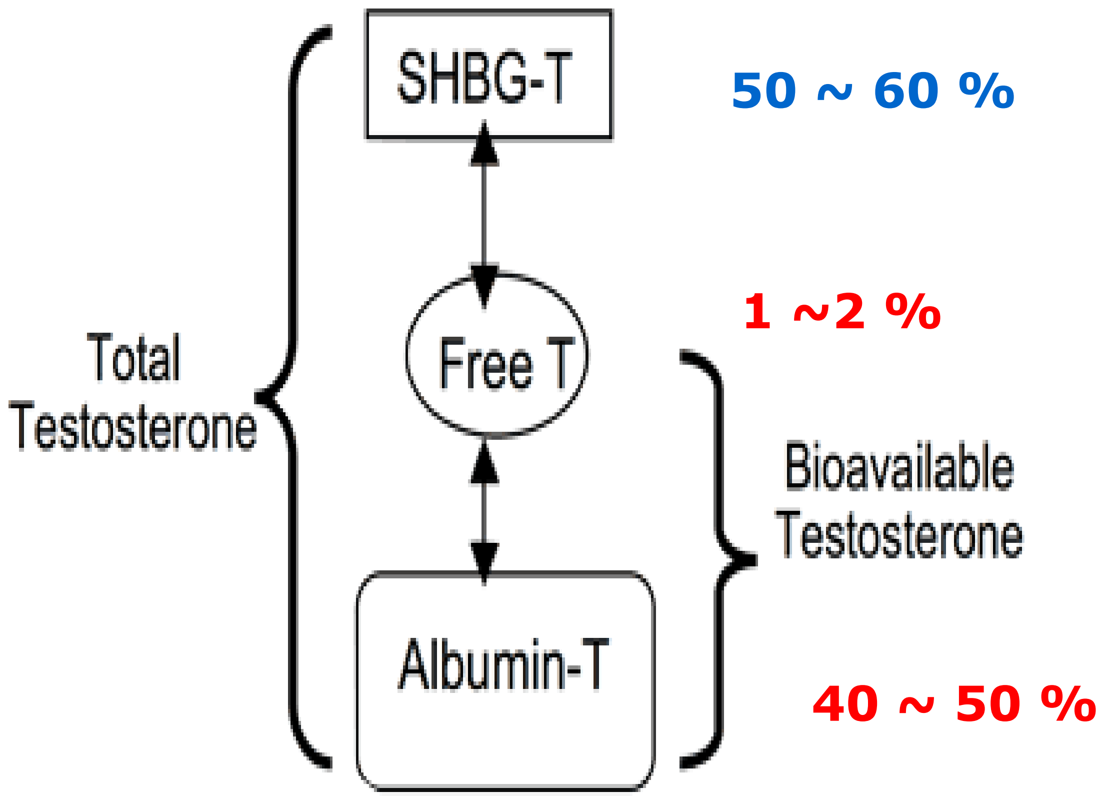
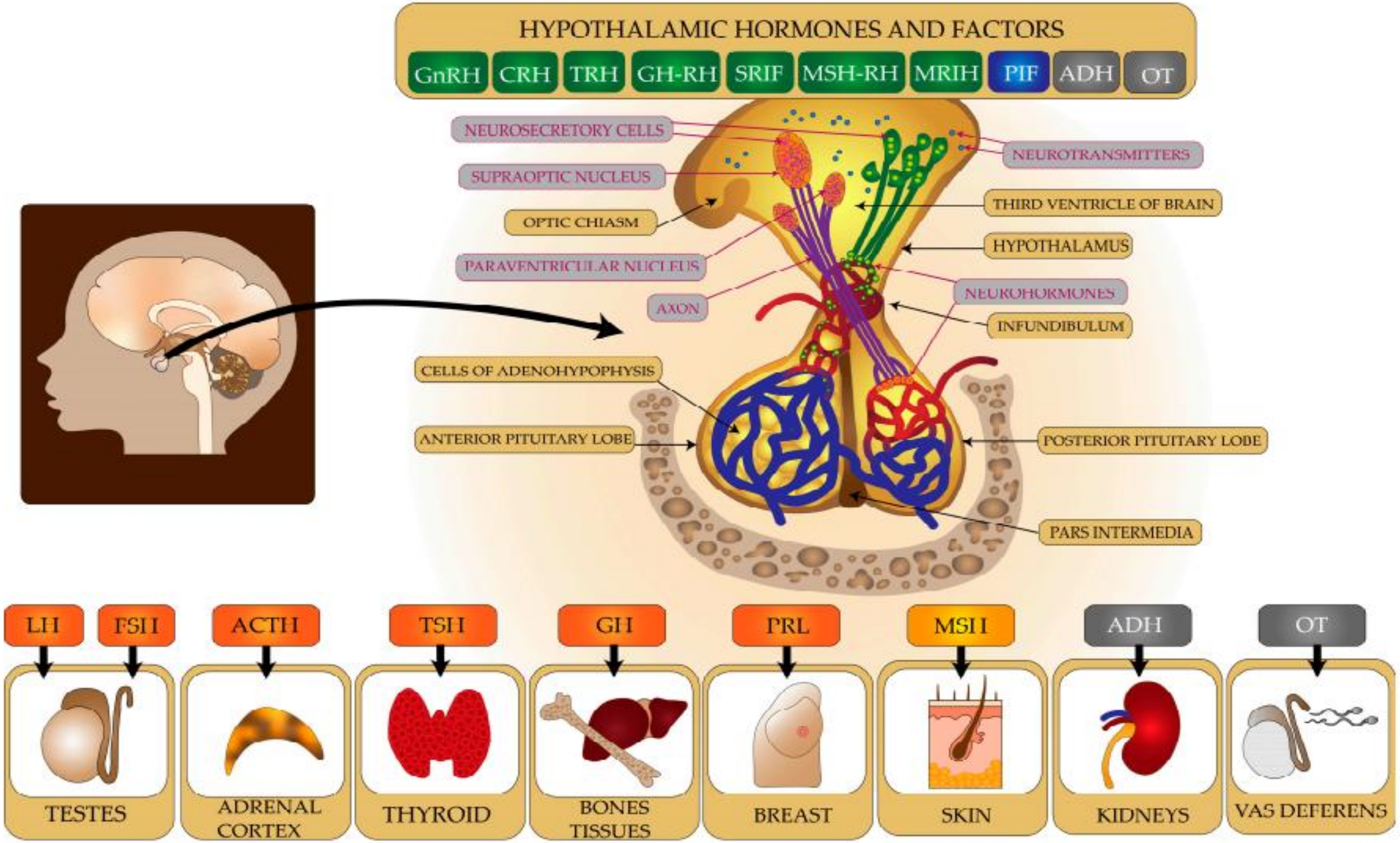


FIGURE 1.FORMS OF TESTOSTERONE IN THE BODY. SHBG-BOUND TESTOSTERONE IS HORMONALLY INACTIVE. T=TESTOSTERONE.

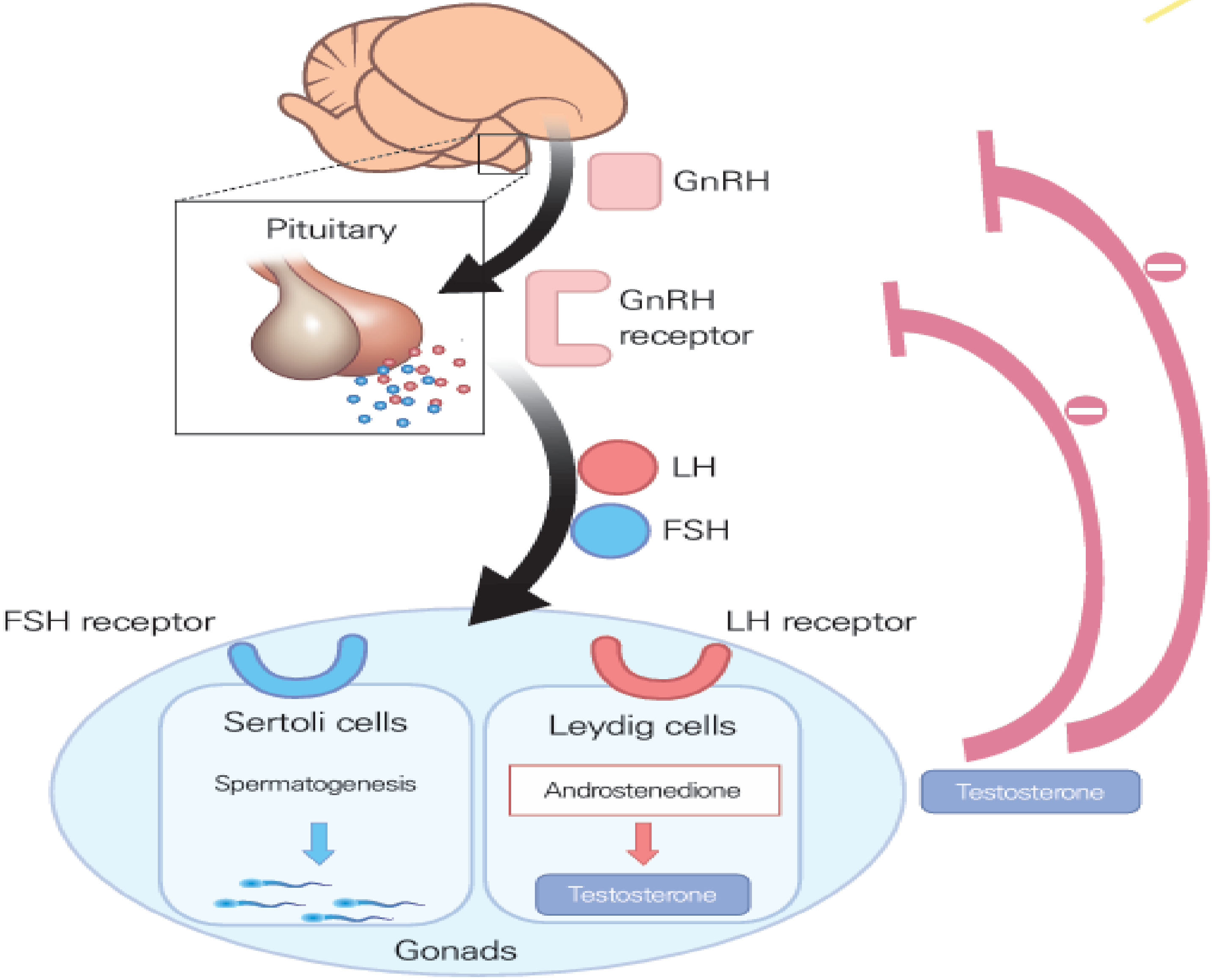
European Urology Supplements 2005:4;4-9

CNC & Endocrine organs



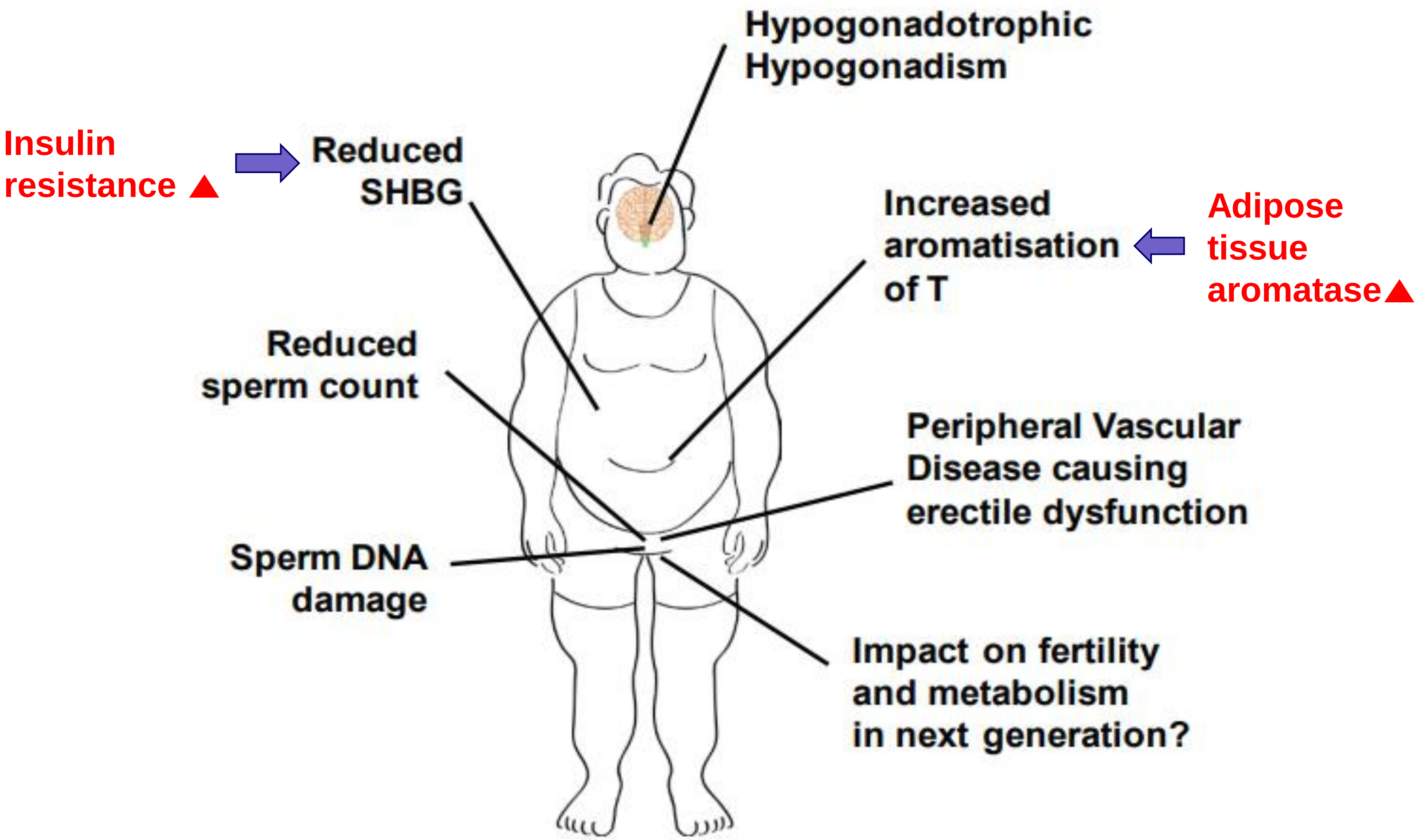
Int. J. Mol. Sci. **2023**, *24*, 6492

HPG Axis



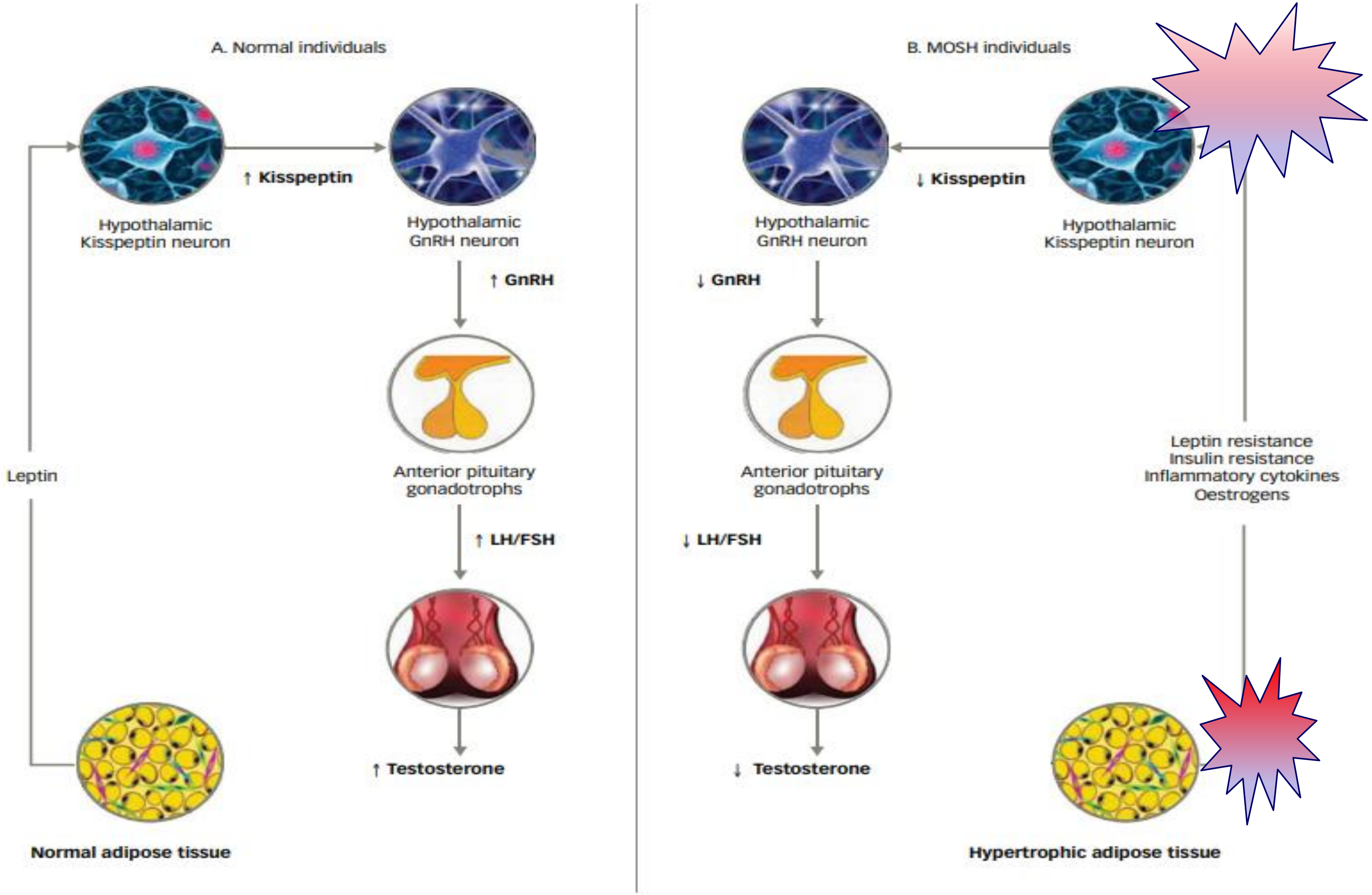
Int. J. Mol. Sci. **2023**, *24*, 6492

Obesity on reduced fertility



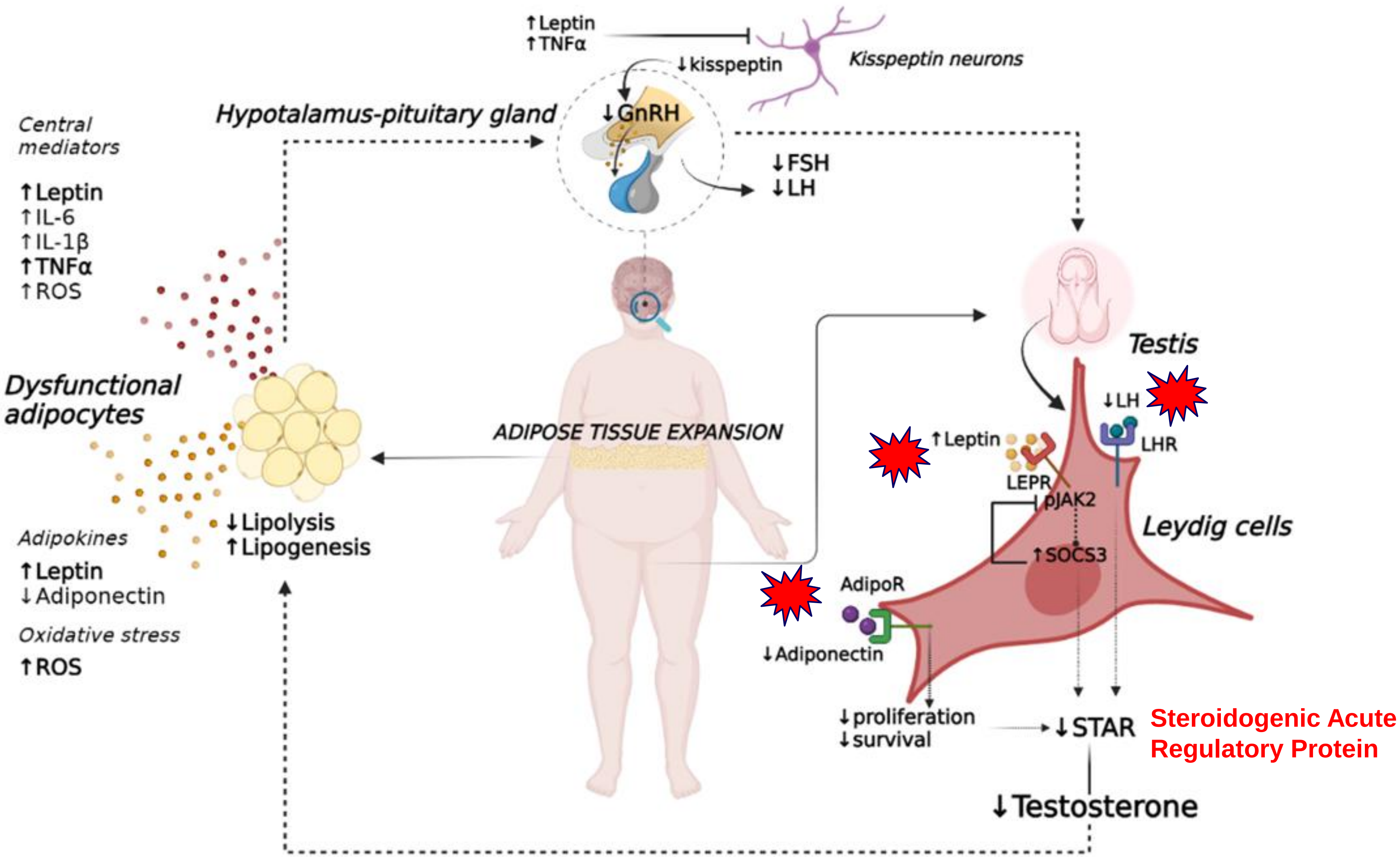
HORMONES 2015, 14(4):563-568

Testosterone regulation in Male Obesity-related Secondary Hypogonadism



European Endocrinology. 2019;15(2):83–90

The vicious cycle of Obesity-hypogonadism



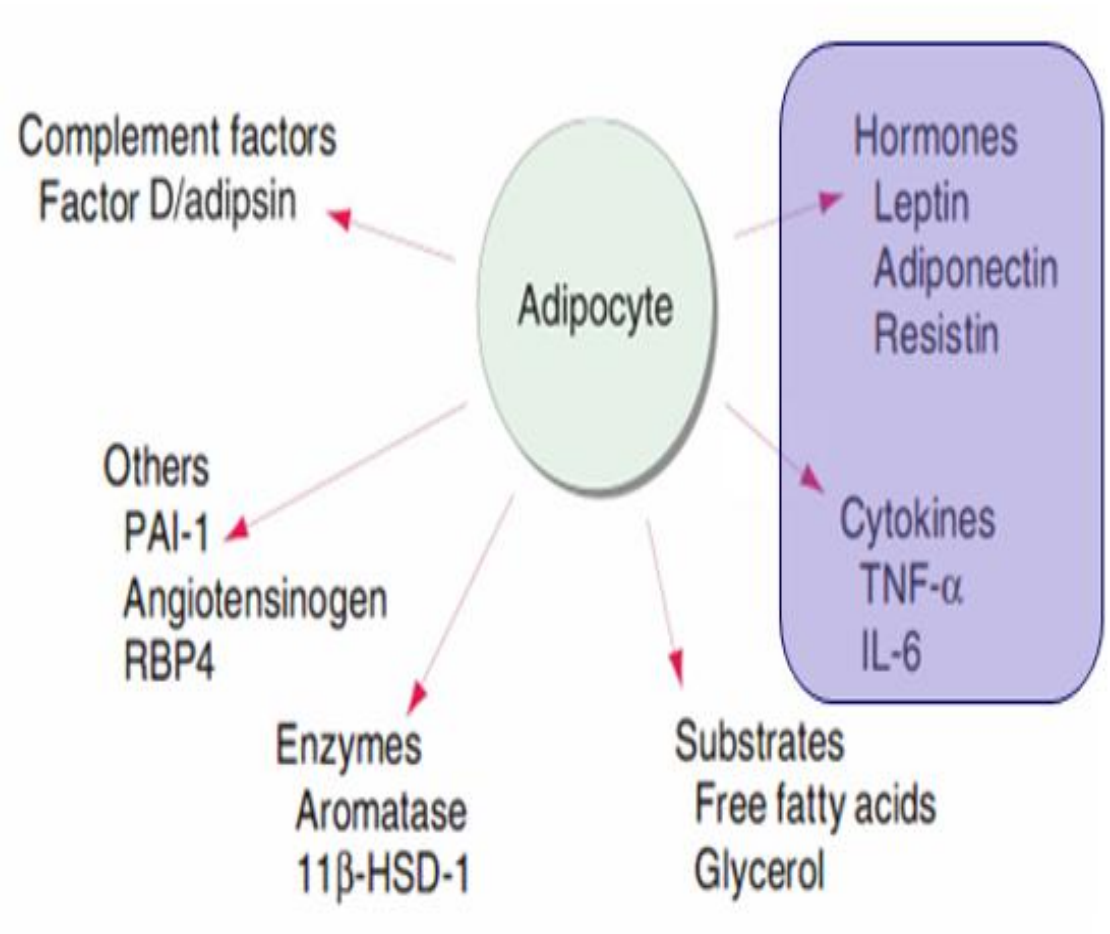
Int. J. Mol. Sci. **2022**, 23, 8194

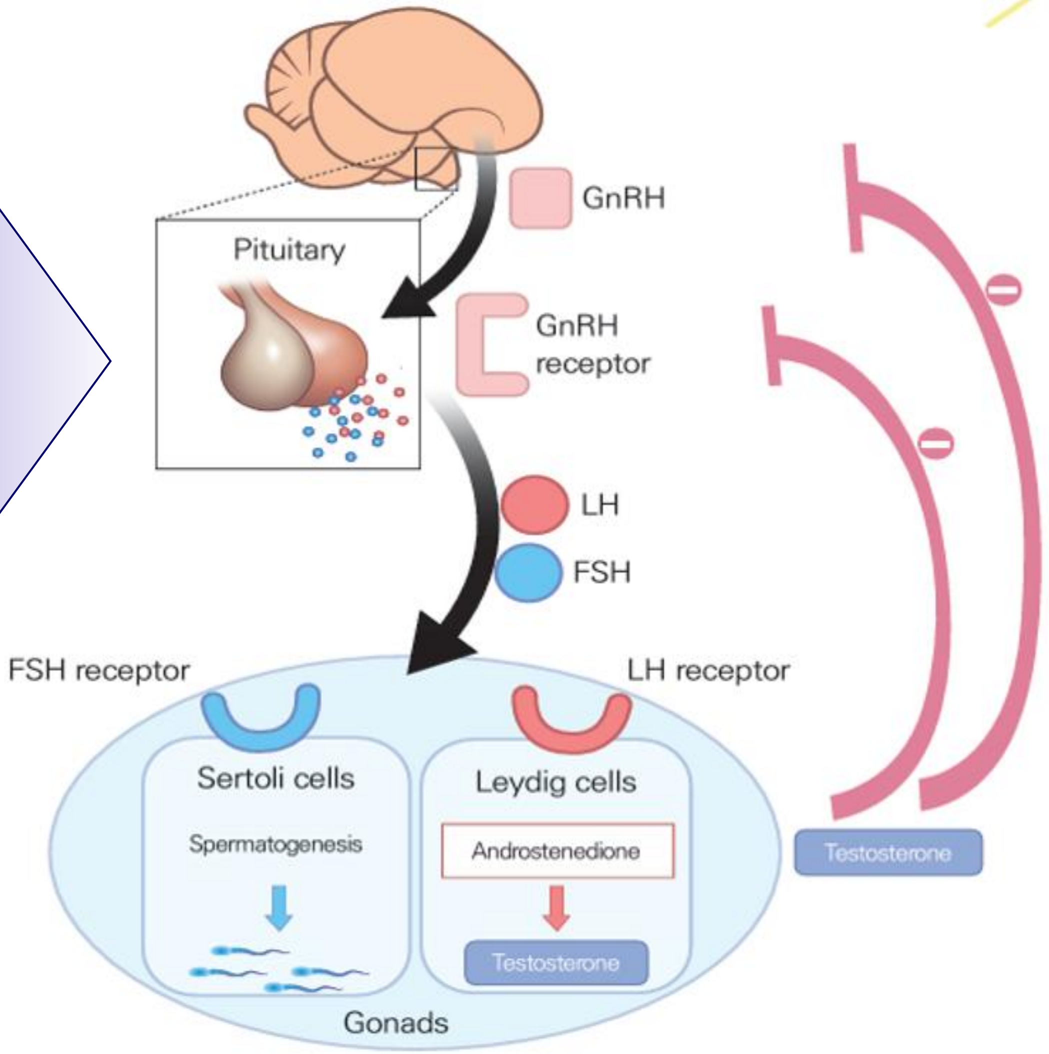
Obesity-induced HPG Axis Dysfunction

- **Central mechanisms**
  - Leptin
  - Inflammatory cytokines; IL-1, IL-6, TNF-a
  - Hypothalamic gliosis
  - Estrogen
- **Peripheral mechanisms**
  - Testis dysfunction
  - Adenosine
  - Iron retention
- **High fat diet**
- **Adipose tissue resistance by testosterone**
- **SHBG variation**

Rev Endocr Metab Dis. 2022;23:1233-42

Adipokines on HPG Axis

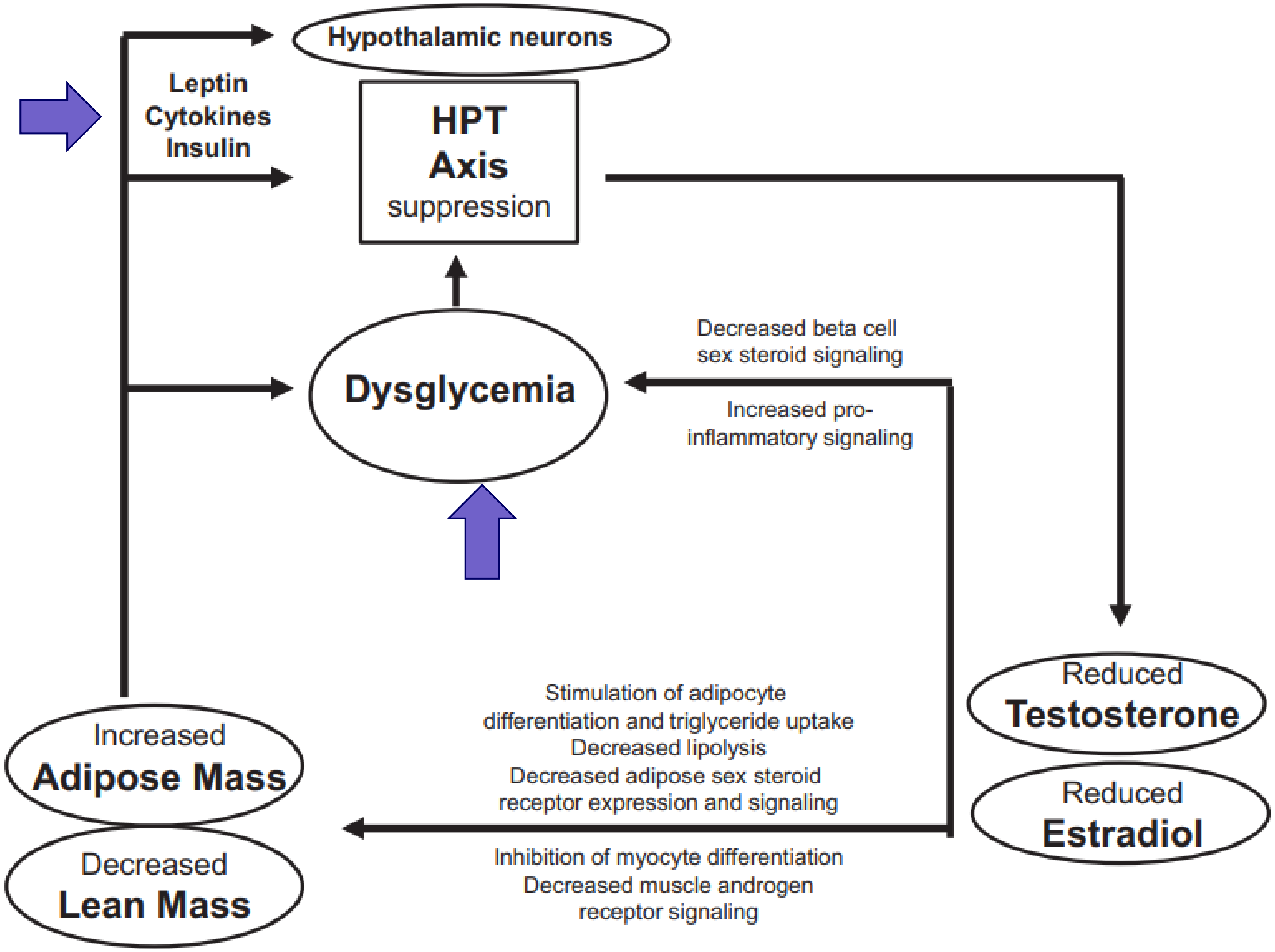




Harrison 20th

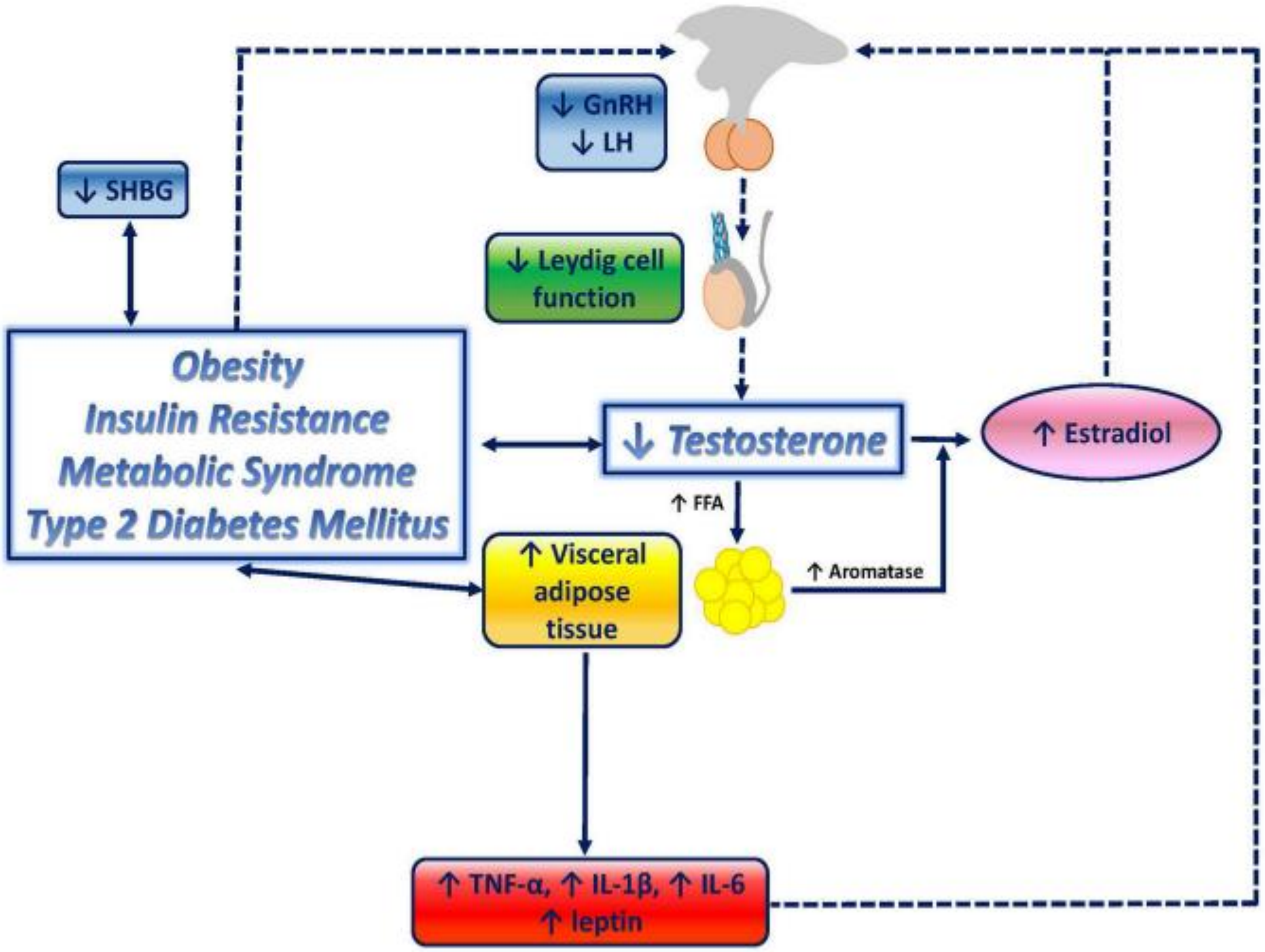
HORMONES 2015, 14(4):549-562

Lowered sex hormones & Diabesity



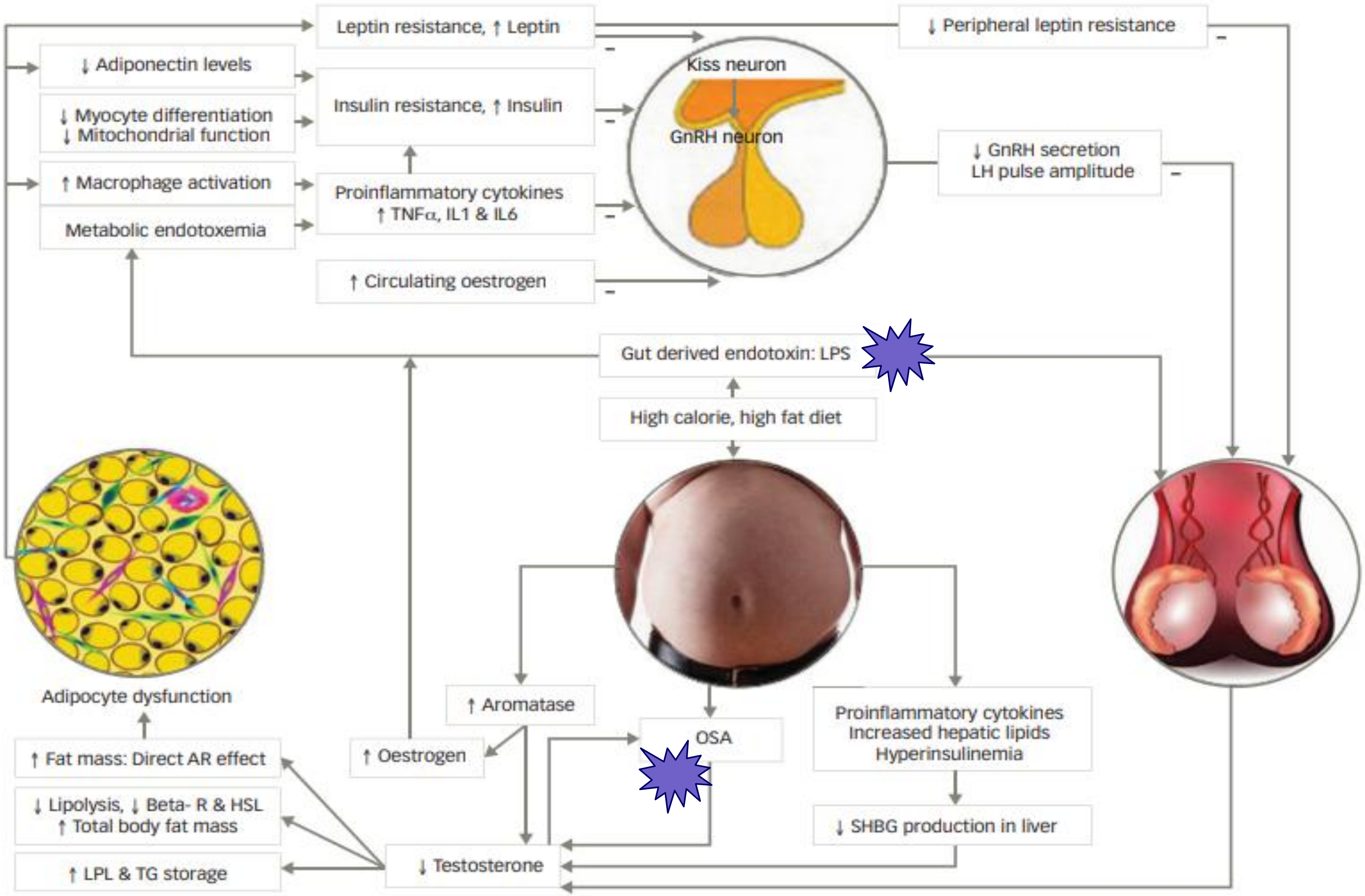
Andrology, 2020, 8, 1519–1529

Testosterone deficiency & metabolic disorder



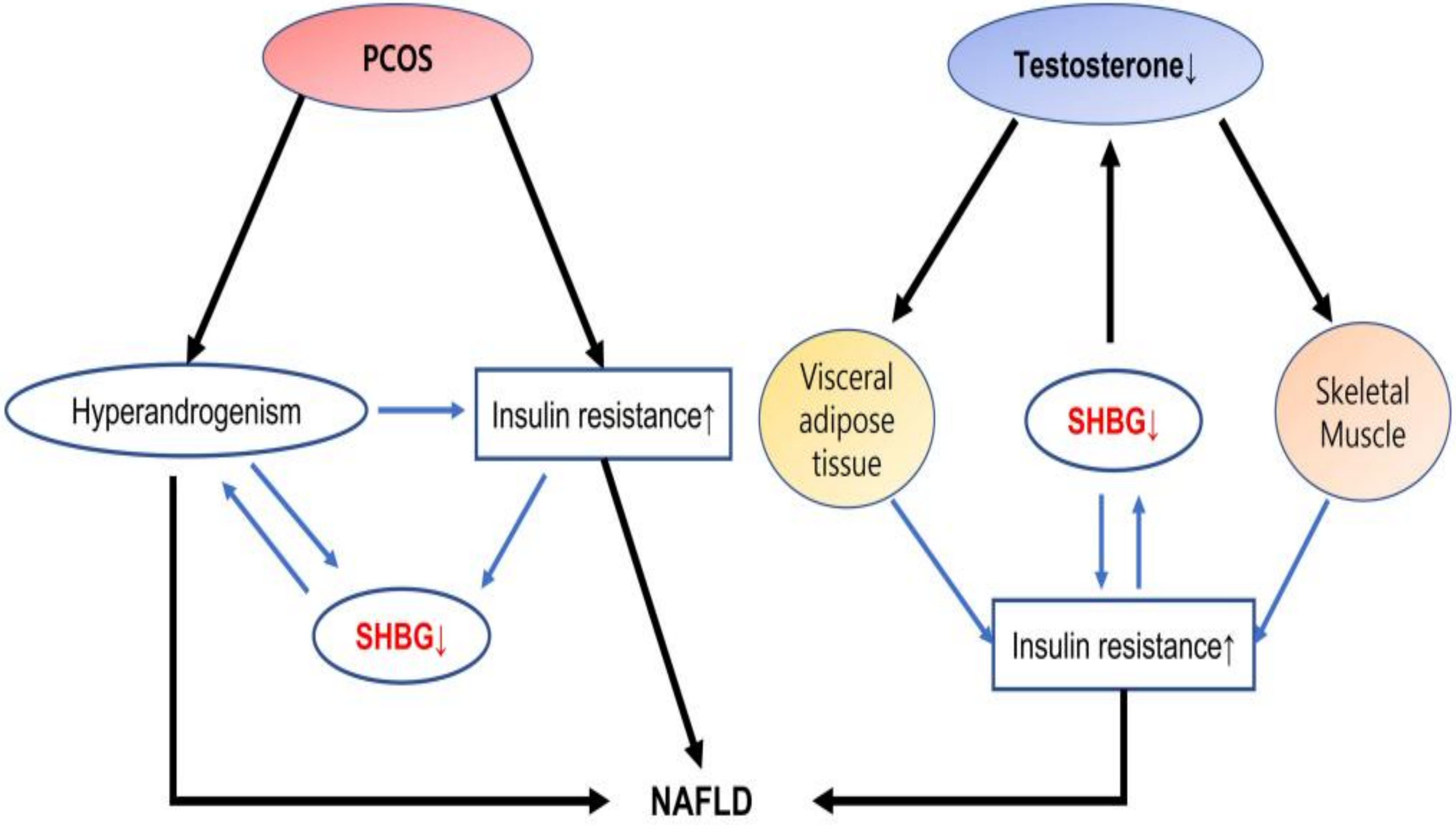
Front. Endocrinol. 10:345.
doi: 10.3389/fendo.2019.00345

Obesity-related secondary Hypogonadism



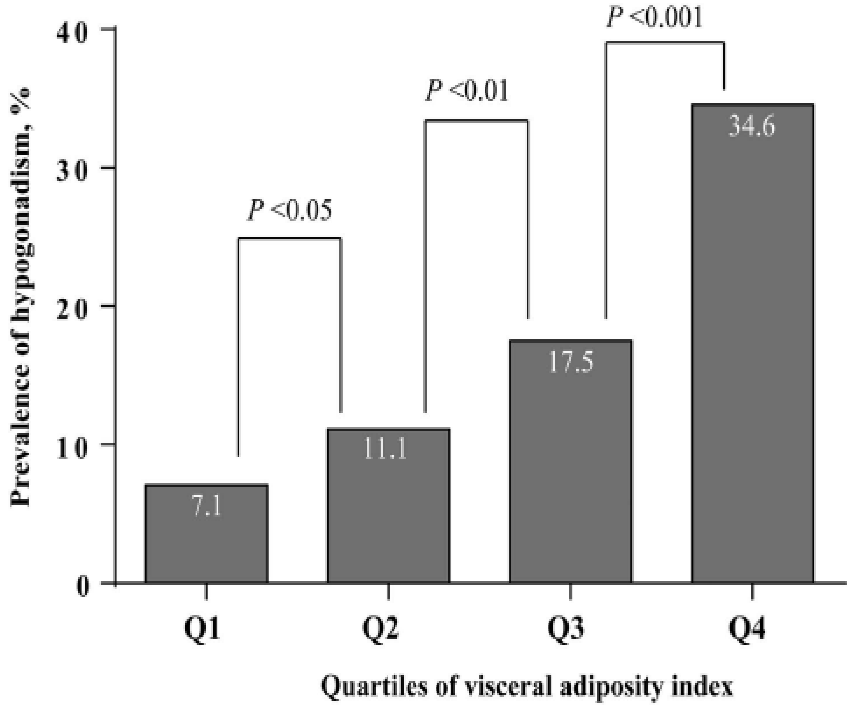
European Endocrinology. 2019;15(2):83–90

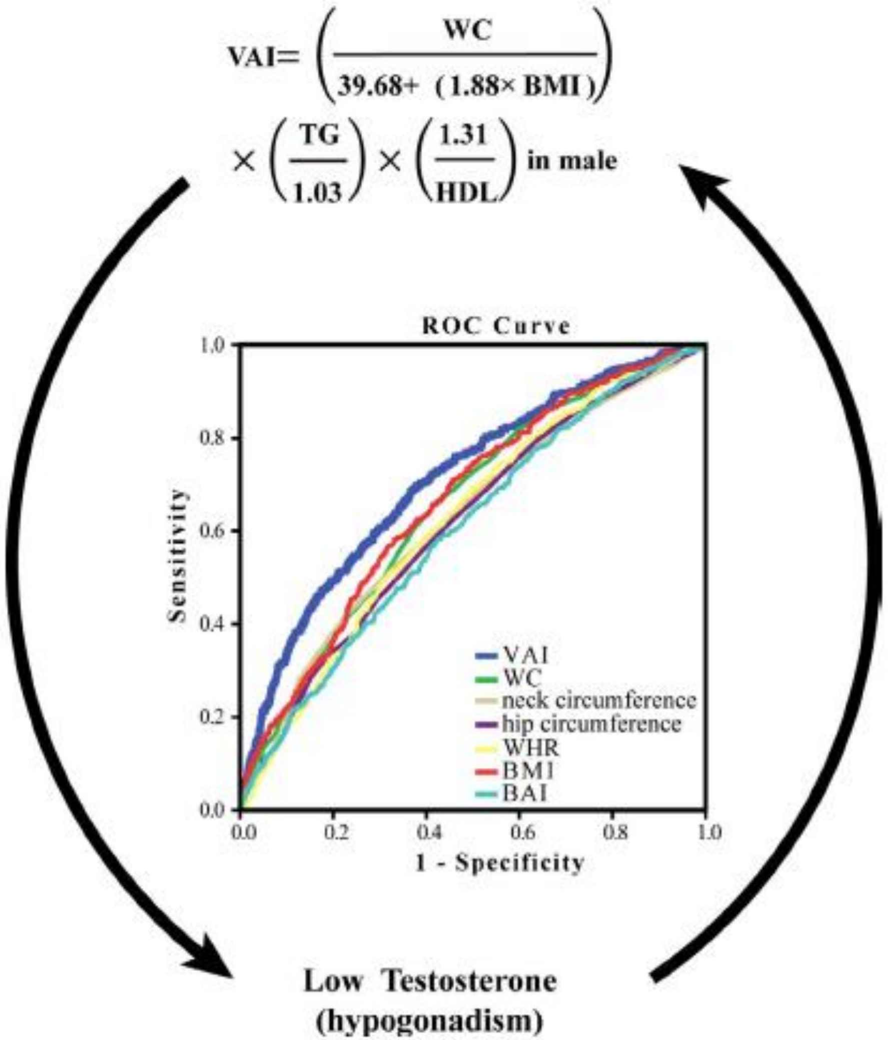
Low T, Low SHBG ▶ NAFLD



Front. Endocrinol. 13:1053709.
doi: 10.3389/fendo.2022.1053709

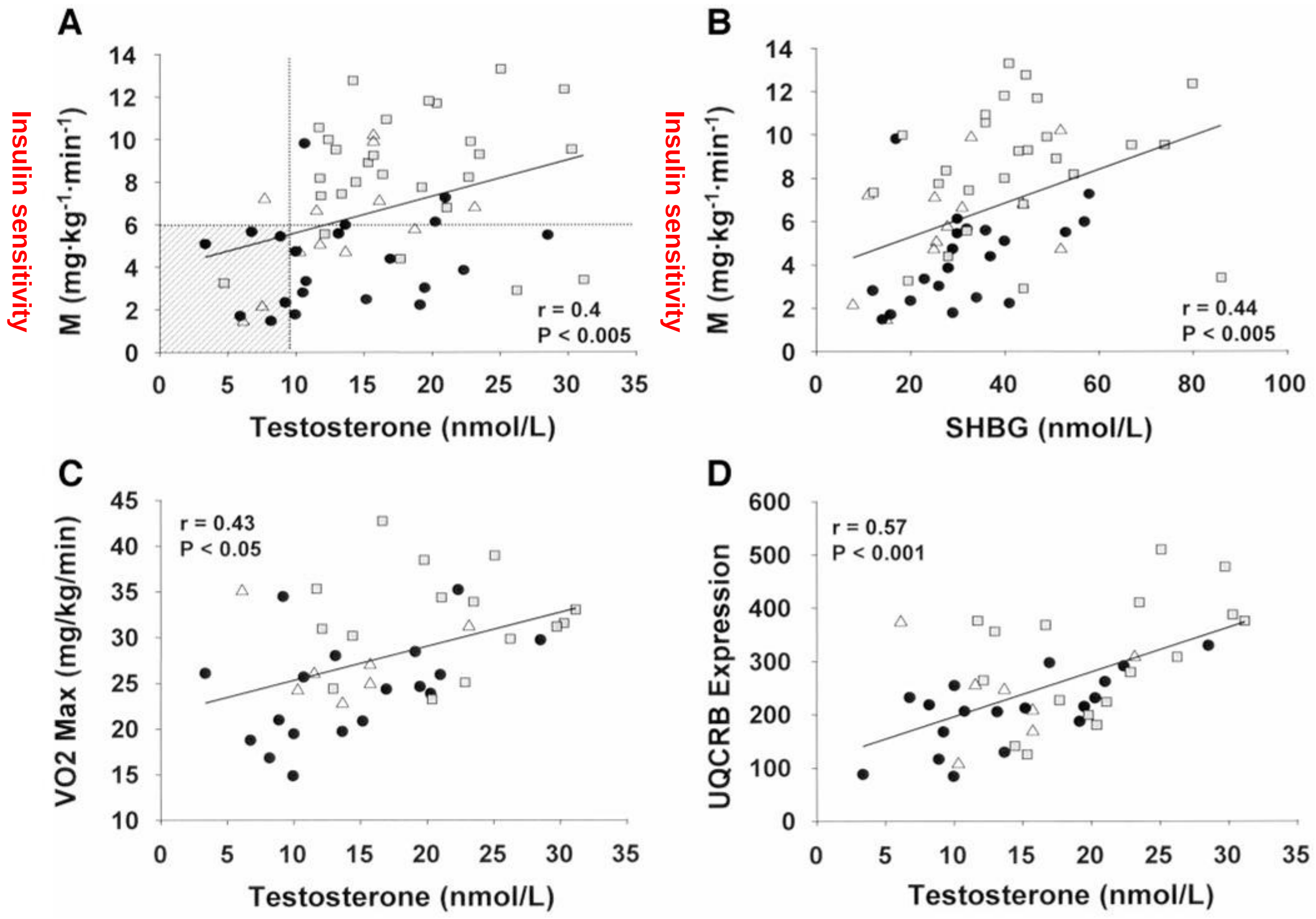
Visceral fat vs. Hypogonadism (2,759 Chinese men)





Scientific Reports 2016;6:19844

Relationship Between Testosterone Levels, Insulin Sensitivity, and Mitochondrial Function in Men



Diabetes Care 2005;28:1636–42

DIABETES RESEARCH AND CLINICAL PRACTICE 123 (2017) 97–105

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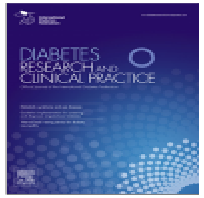
Contents available at ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

International Diabetes Federation



Low testosterone and clinical outcomes in Chinese men with type 2 diabetes mellitus – Hong Kong Diabetes Registry

CrossMark

-1.239 Men with T2D
-Median duration; 9Y
-4.8 Y f/u

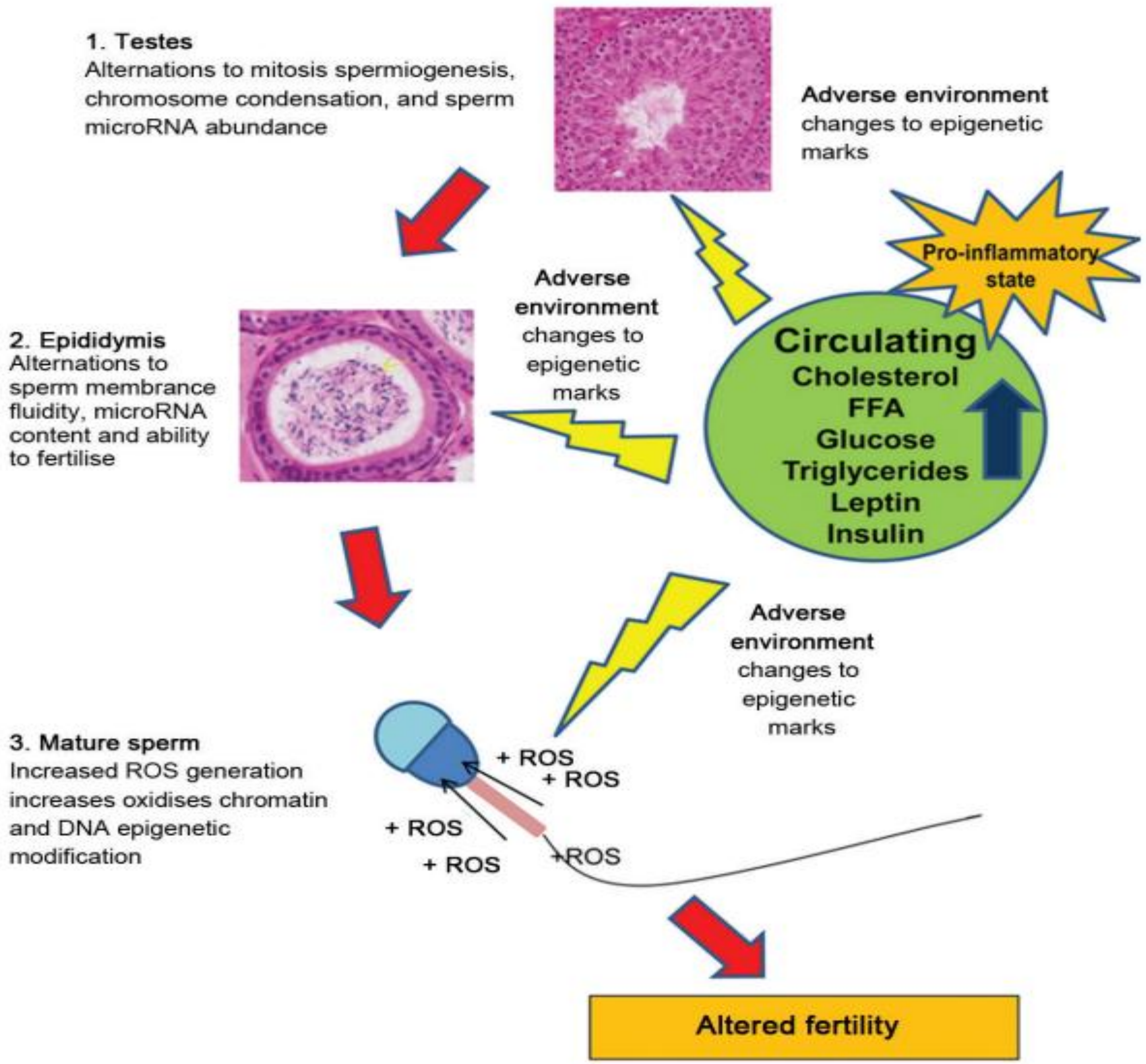
Table 2 – Multivariate logistic regression showing the association of the metabolic syndrome with low testosterone using serum total testosterone < 9 nmol/L as cutoff value after adjustment for covariables in Chinese men with type 2 diabetes mellitus.

	Odds ratio	95% confidence intervals	P
Testosterone			
Testosterone < 9 (nmol/L) <3.0ng/ml	2.63	1.56–4.61	<0.001
Covariables			
Age	1.01	1.00–1.02	0.167
Body mass index	1.43	1.36–1.51	<0.001
HbA1c	1.07	0.97–1.18	0.169
Log urinary albumin to creatinine ratioa[a]	1.28	1.17–1.39	<0.001
Coronary heart disease at baseline	1.41	0.87–2.31	0.166

Other covariables not selected by the model included disease duration, current or ex-smoker, family history of diabetes, total cholesterol, LDL-C, eGFR, chronic kidney disease, history of retinopathy, sensory neuropathy, microalbuminuria, macroalbuminuria, congestive heart disease, cerebrovascular disease, and peripheral vascular disease

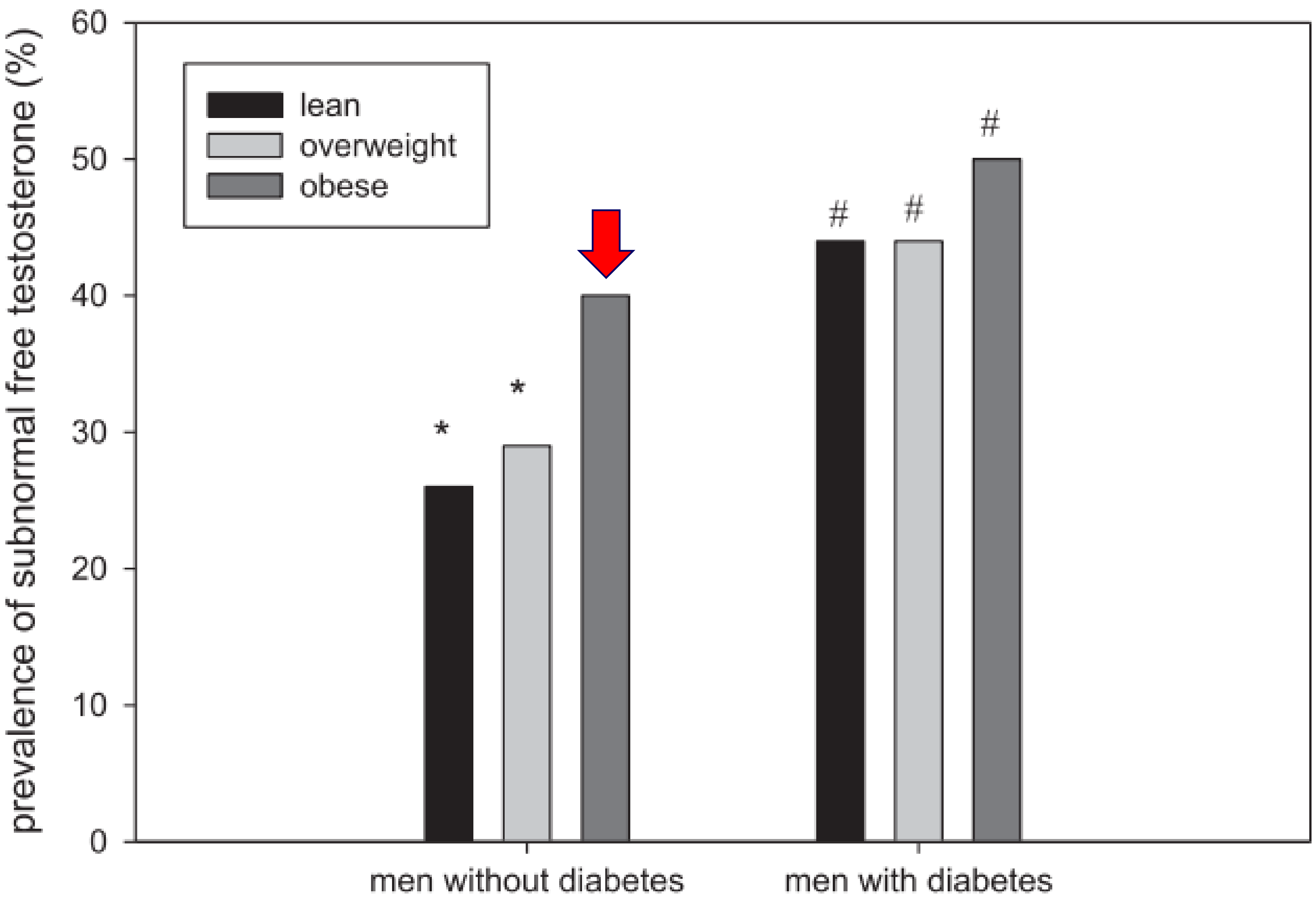
[a] Urinary albumin to creatinine ratio was logarithmically transformed due to skewed distribution.

Metabolic derangements on subfertility



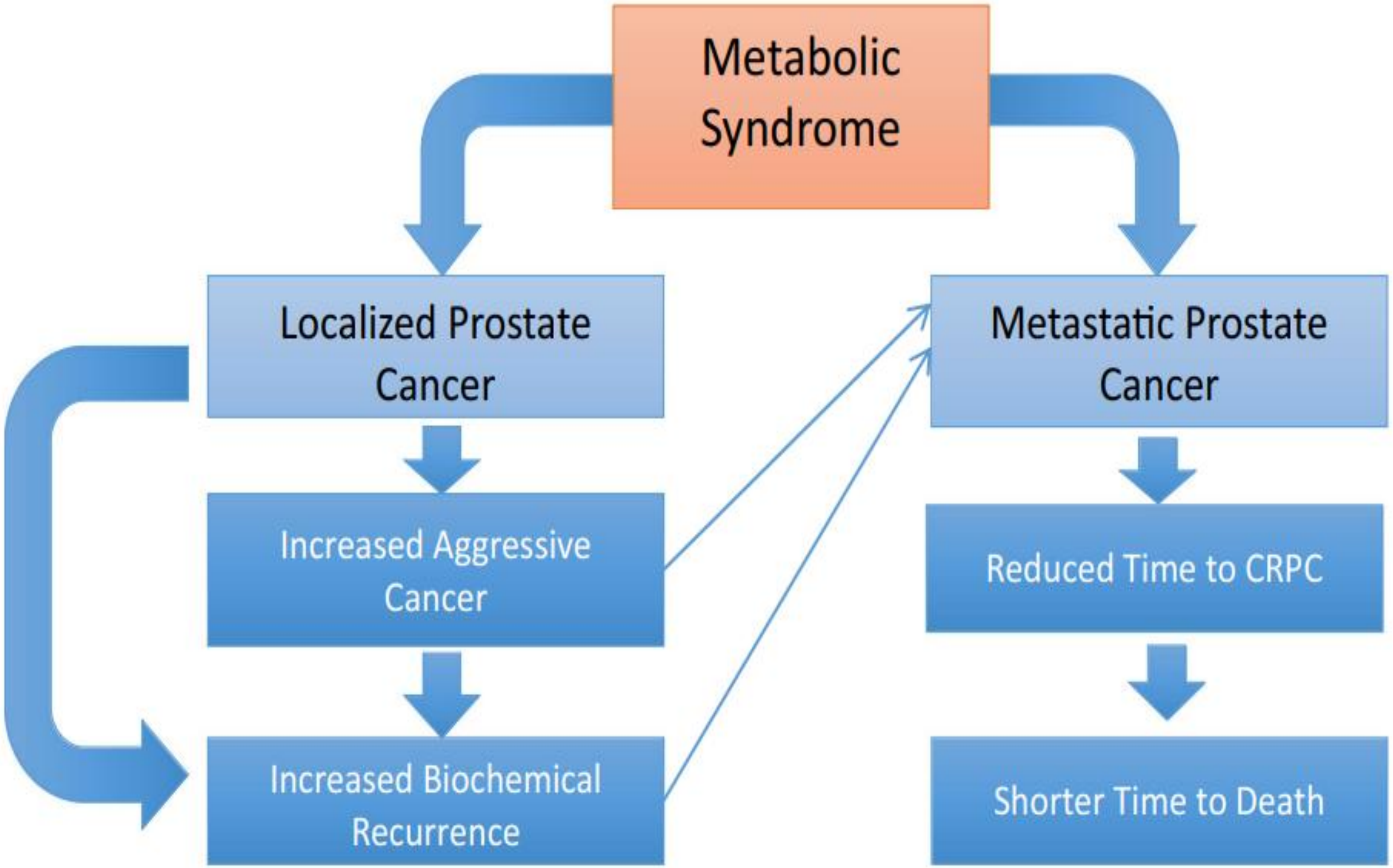
Asian Journal of Andrology (2015) 17, 450–458

Subnormal Free Testosterone



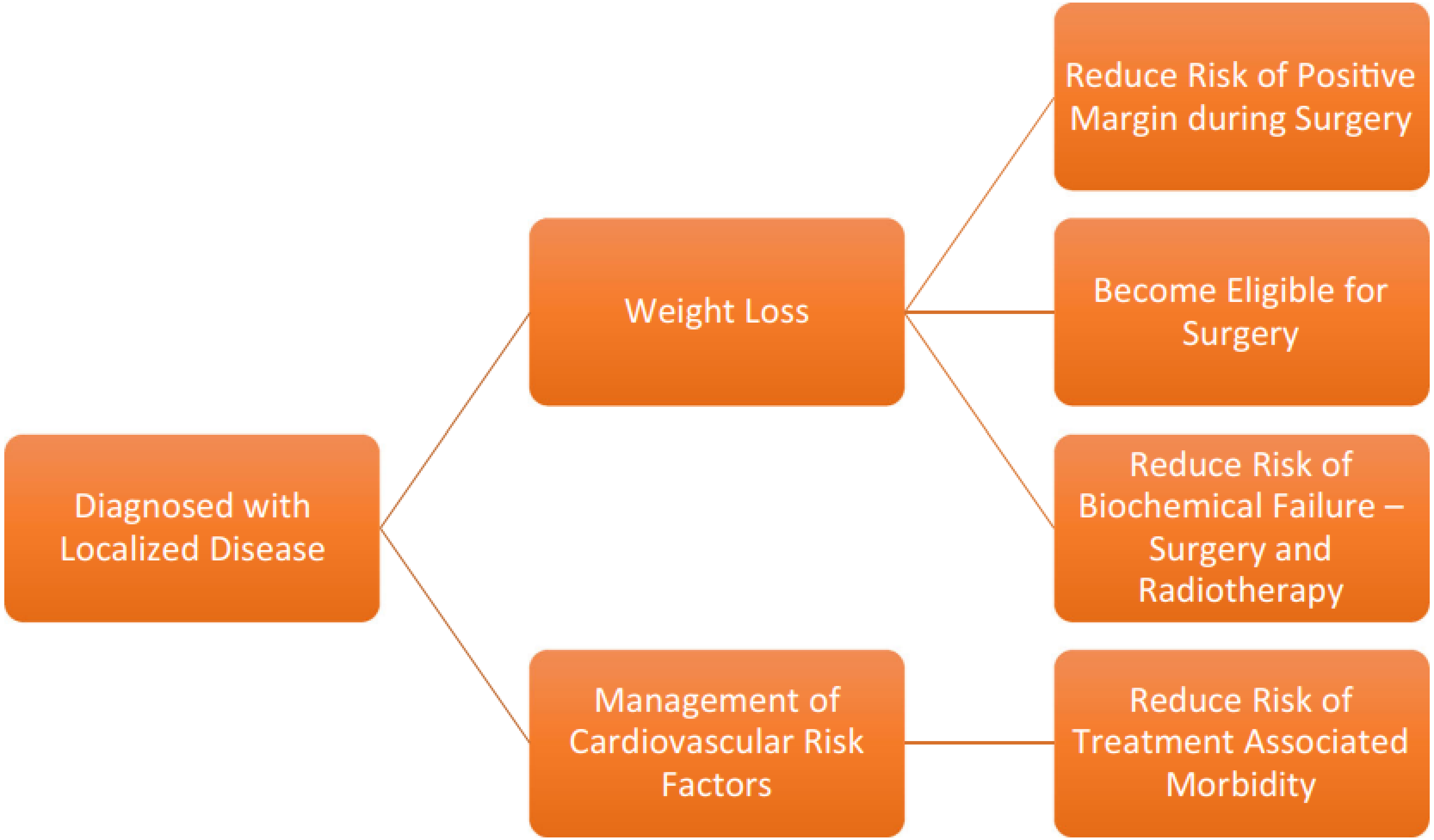
Diabetes Care 2018;41:1516–1525

MS on Prostate cancer



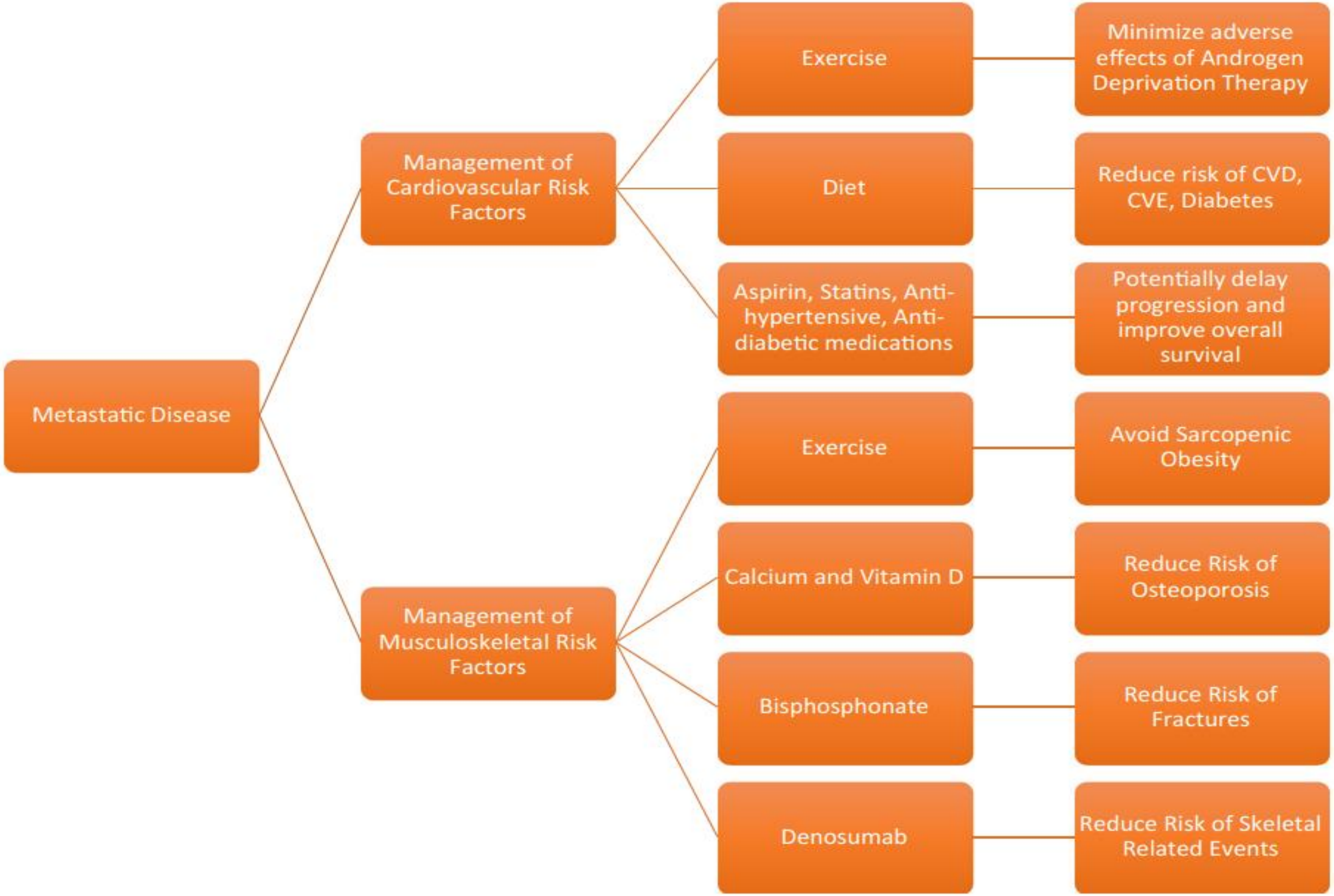
HORM CANC (2016) 7:75–83

Recommendation in localized disease



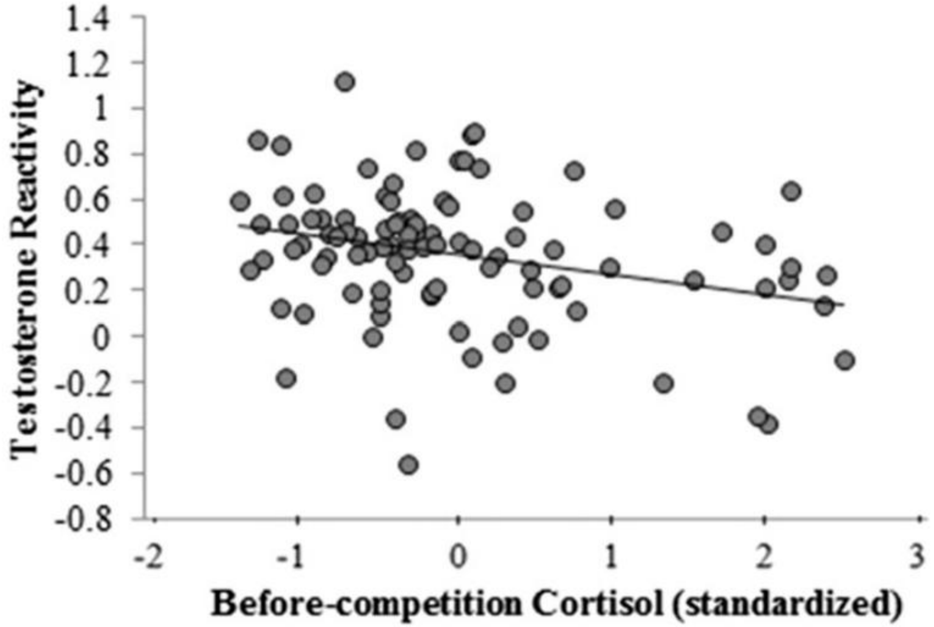
HORM CANC (2016) 7:75–83

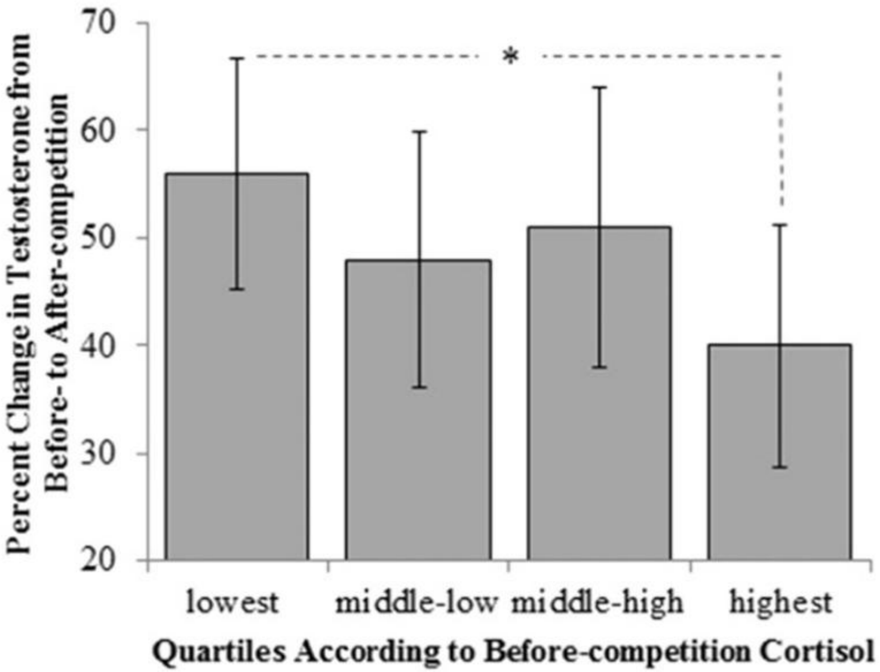
In case of metastatic disease



HORM CANC (2016) 7:75–83

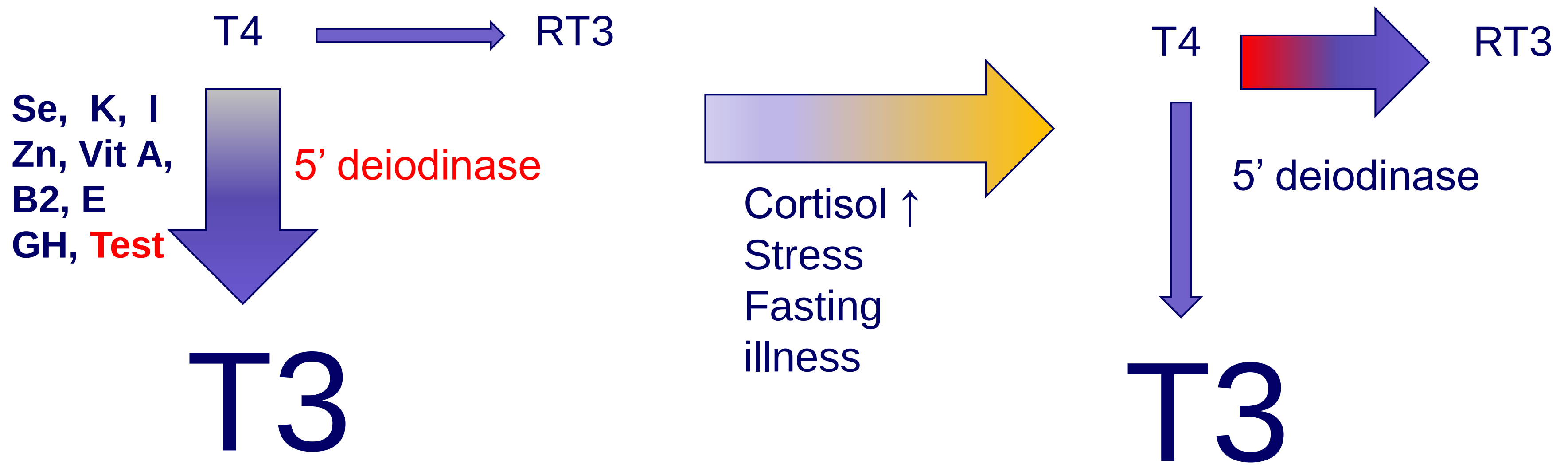
Stress and low Testosterone





Physiology & Behavior 142 (2015) 48–51

Thyroid Hormone



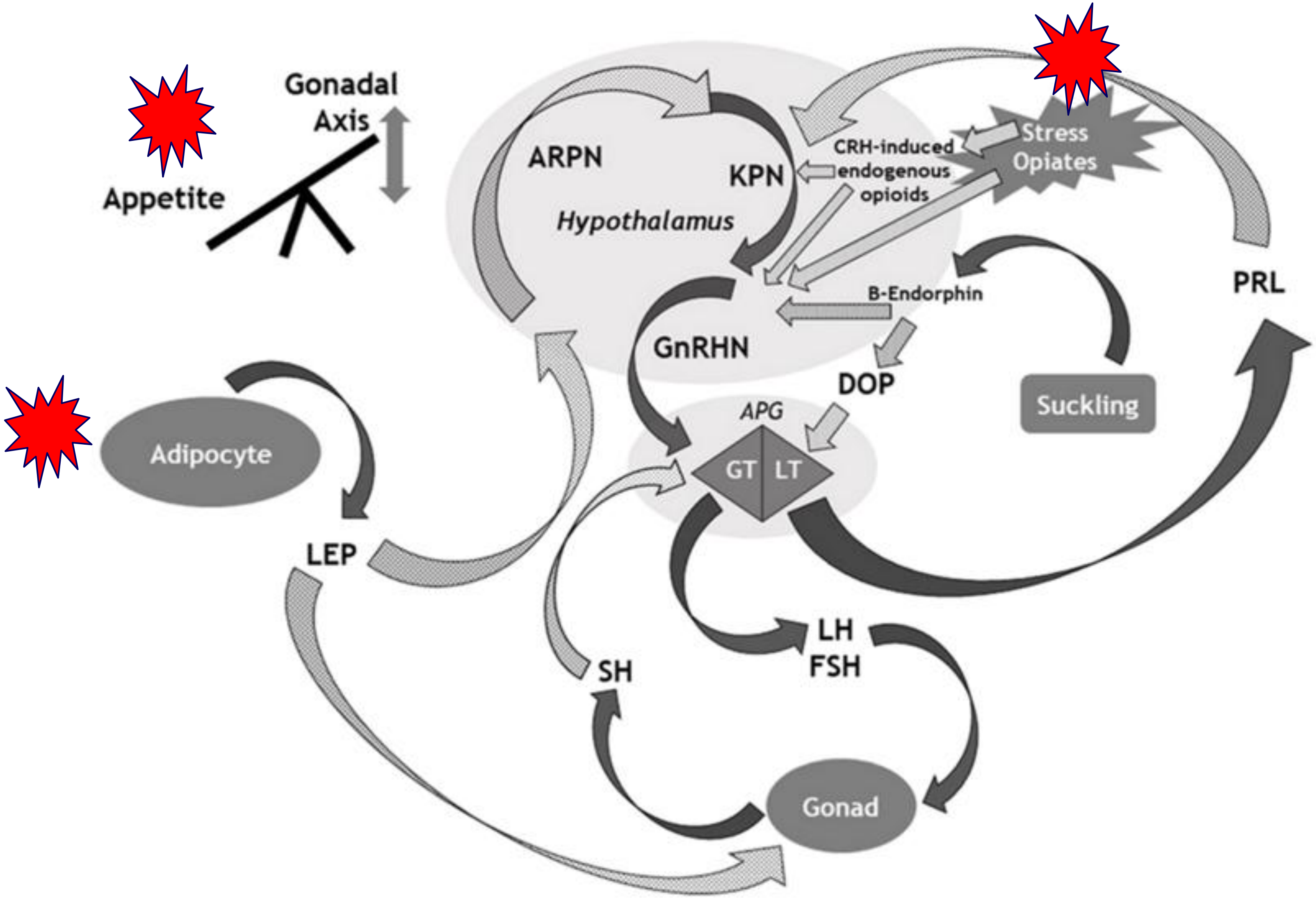
✓ **Decreased production of T4**

- deficiency of Zn, Cu, vit A, B2, B6, C

✓ **Interference of 5' deiodinase**

- Se def, stress, Cd, Hg, Pb, starvation,
- cortisol ↑, DM, inflammation, aging

Main mechanism that influence the gonadal axis



Int. J. Mol. Sci. **2021**, *22*, 8217

Therapeutic benefits of ART in MOSH

World J Exp Med 2024;14:93689

Weight loss on Male Hormones

Table 3. Mediation of effect of intensive lifestyle intervention by mean waist circumference[a] at year 1 on hormones at year 4 of the Look AHEAD study

	Females	Males
	Percent change in hormone level	
E2	−2.6 (−4.3,−1.1)	−1.2 (−2.4,−0.1)
Total T	−0.6 (−2.0,0.7)	0.7 (−0.4,1.9)
BioT	−0.1 (−1.4,1.4)	0.5 (−1.0,1.9)
SHBG	−1.2 (−2.4,−0.1)	−0.8 (−2.1,0.5)

Abbreviations: bioT, bioavailable testosterone; E2, estradiol; T, testosterone.
[a]Mean change in waist circumference at year 1 due to intensive lifestyle intervention in females was −6.4 cm (95% confidence interval: −10.7 to −2.5) and in males was −8.0 cm (95% confidence interval: −12.6, −3.8).

J Clin Endocrinol Metab. 2024 Sep 2:dgae584. doi: 10.1210/clinem/dgae584. Online ahead of print.

Testosterone response to long-term weight loss

Table 2. Median (IQR) values for sex hormones at each time point. after Op

Parameter IQR (Q1, Q3)	Baseline	6 months	12 months	24 months	36 months
Females					
Testosterone, nmol/L, (0.0–1.8)	0.9 (0.6, 1.4)	**0.6 (0.2, 0.9)**	**0.6 (0.5, 0.9)**	**0.6 (0.2, 0.85)**	0.7 (0.2, 0.95)
SHBG, nmol/L (20–110)	29.1 (21.3, 49)	**47.8 (29.5, 70.1)**	**47.0 (33.6, 64.6)**	**56 (31.6, 75.5)**	**46.5 (39.5, 75.2)**
LH (IU/L), Postmenopausal Females: (7.7–60)	17.3 (5.7, 30.0)	15.8 (4.75, 34.6)	22.5 (6.6, 37.6)	**28.4 (7, 41.9)**	25.6 (13.6, 36.0)
FSH (IU/L), Postmenopausal Females: (25–140)	27.4 (5.7, 53.6)	**33.1 (4.4, 65.4)**	**48.0 (9.85, 66.1)**	**52.1 (12.9, 71.4)**	**55.2 (37.0, 68.0)**
Oestradiol pmol/L, Postmenopausal Females: <100	87 (54.2, 218)	67 (49, 244)	53 (49, 172)	54.5 (49, 109)	49 (49, 56.8)
Males					
Testosterone, nmol/L, (12–36)	11.8 (10.1, 16.4)	15.7 (12.5, 20.0)	**17 (13.7, 19.8)**	**17.7 (14.3, 22.5)**	**17.8 (14.4, 19.4)**
SHBG nmol/L, Males (20–90)	20.1 (17, 31.6)	36.8 (32.1, 41.0)	**35.2 (28.3, 43)**	**41 (30, 50)**	37.5 (30.5, 43.5)
LH (IU/L), (1.7–8.6)	4.0 (2.7, 5.3)	4.9 (4.15, 5.65)	4.25 (3.08, 4.25)	**5.15 (4.3, 6.1)**	4.85(3.97, 5.6)
FSH (IU/L), Males (1.5–13)	4.2 (3.7, 6.3)	4.9 (4.0, 6.8)	4.45 (3.4, 5.2)	4.65 (3.8, 5.6)	5.1 (4.2, 9.3)
Oestradiol pmol/L, (0–160)	113 (80.5, 131)	103 (87.8, 112)	104 (72.2, 130)	106 (88, 120)	102 (69.8, 130)

Bolded values indicate statistical significance for changes in parameters at each timepoint in comparison with the baseline values.
FSH Follicle-stimulating hormone, *LH* Luteinizing hormone, *SHBG* sex hormone-binding globulin.

Int J Obes 2024;48:1481-88

Weight Loss as Therapeutic Option to Restore Fertility in Obese Men: A Meta-Analytic Study

Daniele Santi [1, 2], Carla Greco [1, 3], Arcangelo Barbonetti [4], Manuela Simoni [1, 3], Mario Maggi [5], Giovanni Corona [6]

Affiliations + expand

PMID: 39344112 DOI: 10.5534/wjmh.240091

Abstract

Purpose: Weight loss has been shown to significantly elevate testosterone serum levels, though the impact on semen analysis parameters and fertility remains incompletely understood. The objective of this study was to examine the influence of body weight loss on semen parameters in obese men.

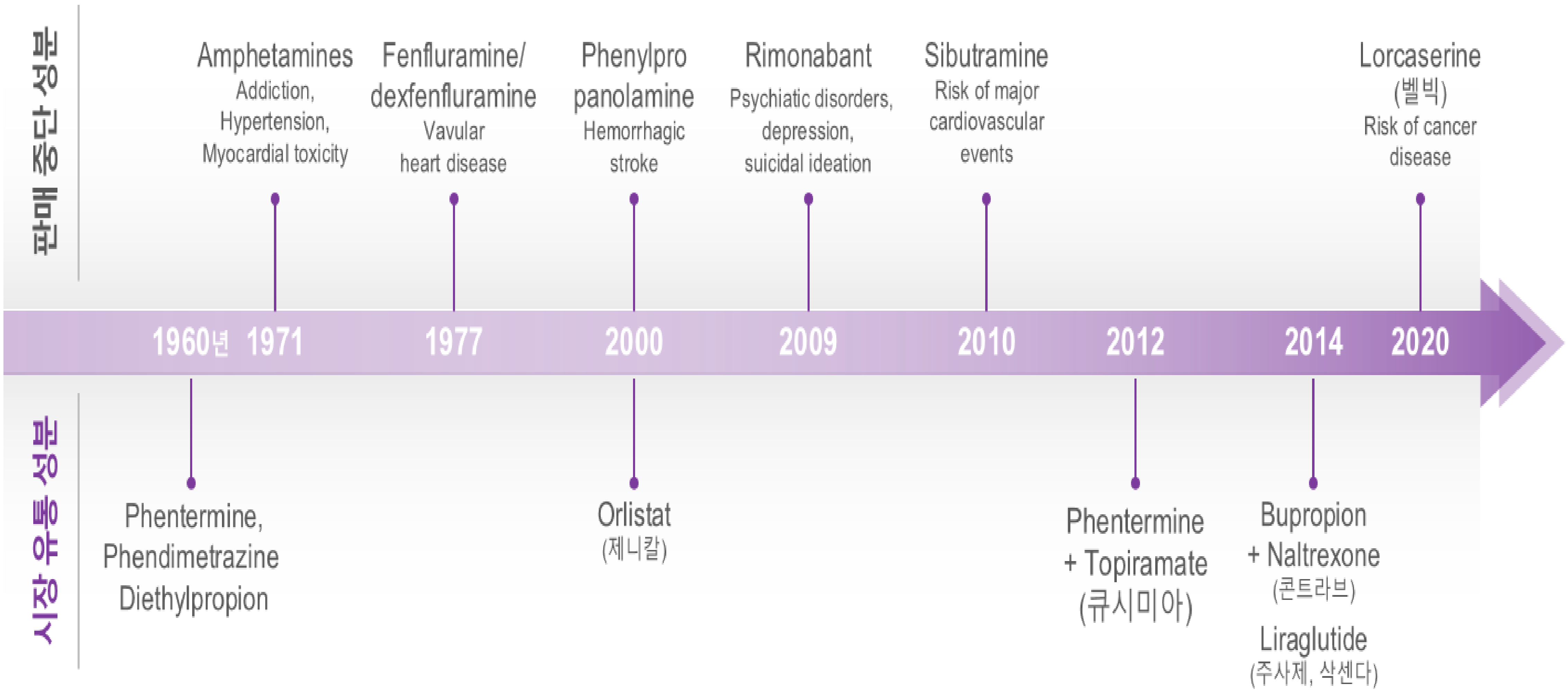
Materials and methods: A meta-analysis was performed that included clinical trials in which a semen analysis before and after weight loss was evaluated. All strategies potentially available for weight loss were considered eligible. The primary outcome was the comparison of conventional semen analysis parameters before and after weight loss.

Results: Twelve studies were considered including 345 subjects (mean age 37.6±7.9 years; mean baseline body mass index 45.4±6.0 kg/m^2). Weight loss resulted in a significant increase of sperm concentration (effect size 0.495, standard error 0.251 [0.003, 0.986], p=0.049) and progressive motility (effect size 0.567, standard error 0.372 [0.370, 0.764], p<0.001). Moreover, a significant decrease of sperm DNA fragmentation index after weight loss (effect size -0.689, standard error 0.278 [-1.123, -0.255], p=0.002) was observed.

Conclusions: This meta-analytic analysis confirmed that body weight loss may improve qualitative and quantitative sperm characteristics providing evidence for suggesting weight loss to male partners with obesity and semen analysis alteration in couples attempting conception.

World J Mens Health. 2024 Aug 21. doi: 10.5534/wjmh.240091. Online ahead of print.

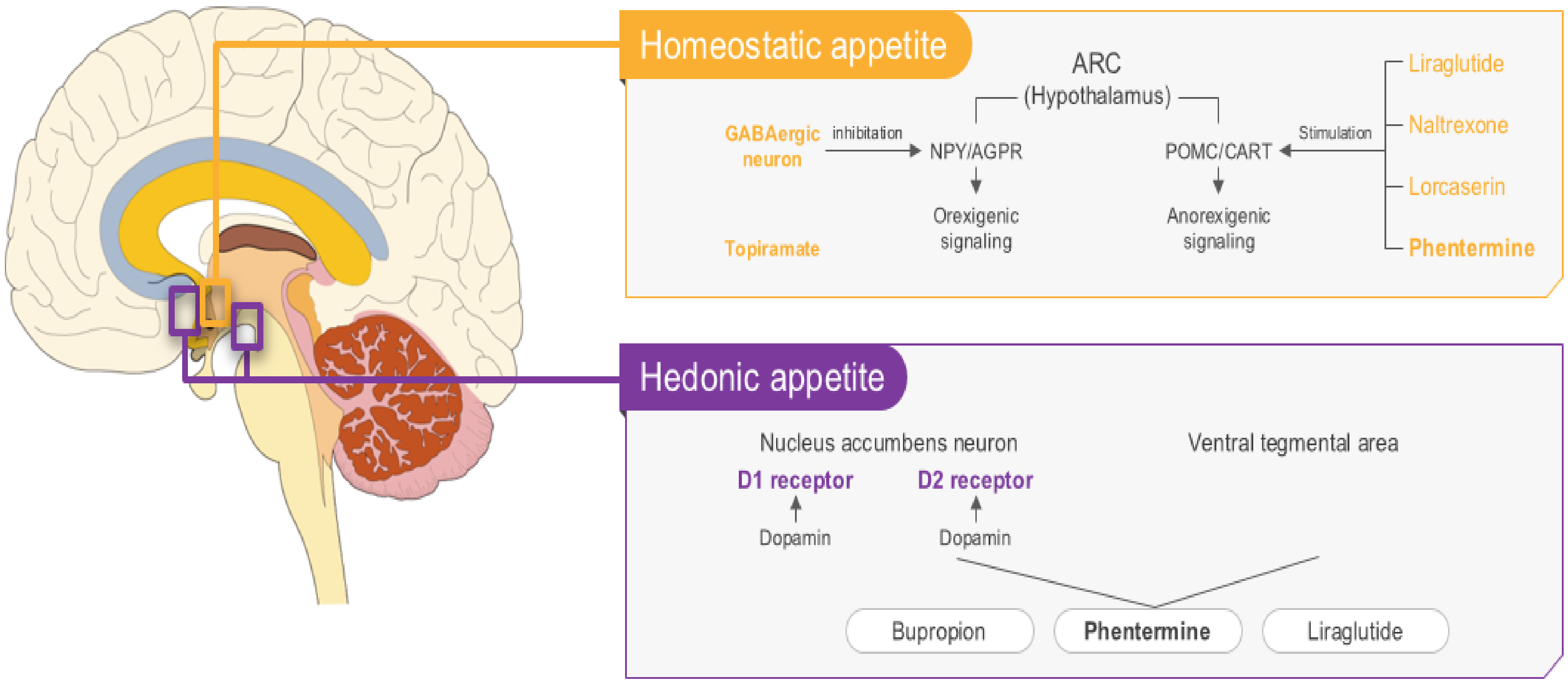
비만 치료 약제들



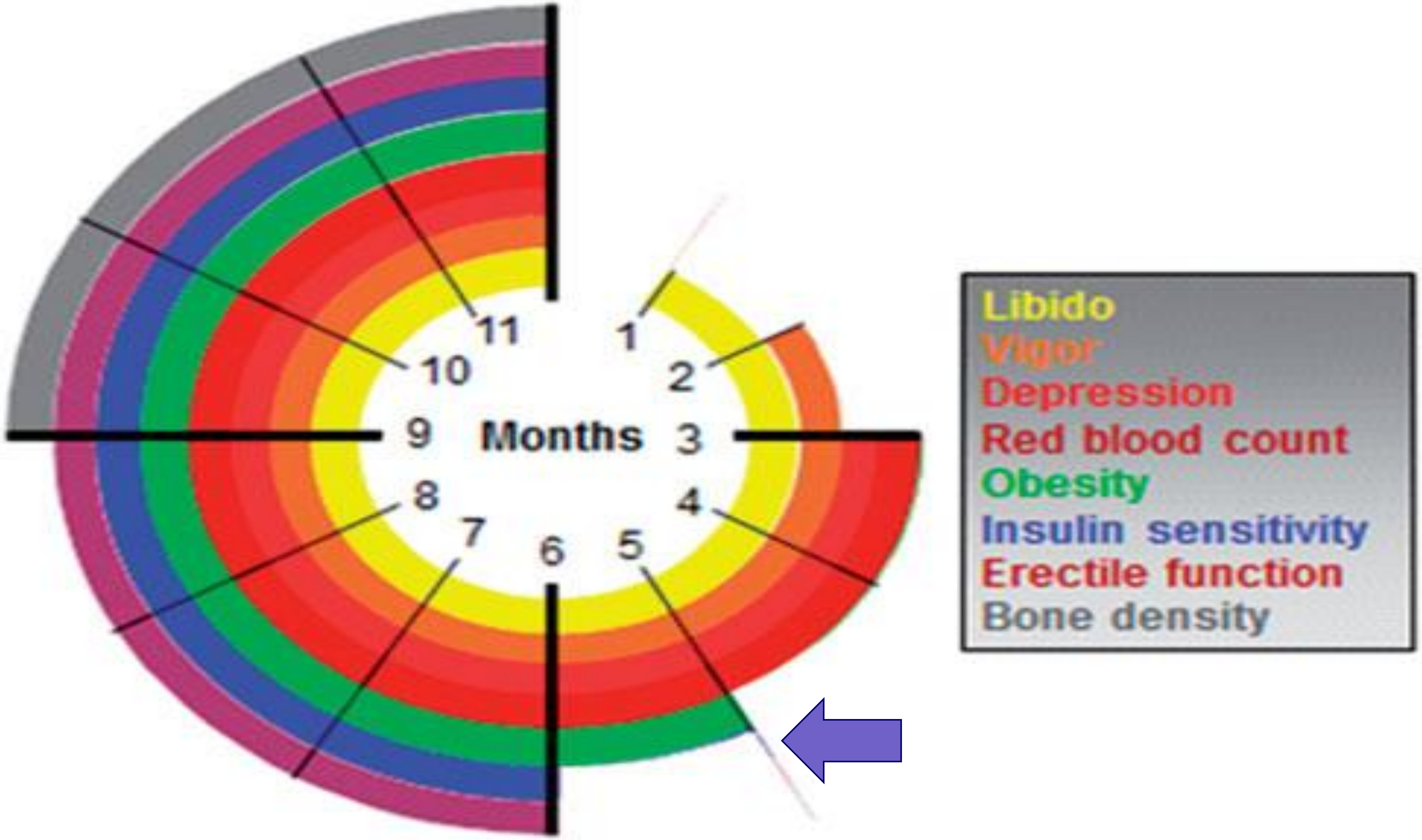
판매 중단 성분
Amphetamines
Addiction, Hypertension, Myocardial toxicity
Fenfluramine/ dexfenfluramine
Vavular heart disease
Phenylpro panolamine
Hemorrhagic stroke
Rimonabant
Psychiatic disorders, depression, suicidal ideation
Sibutramine
Risk of major cardiovascular events
Lorcaserine (벨빅)
Risk of cancer disease
1960년
1971
1977
2000
2009
2010
2012
2014
2020
시장 유통 성분
Phentermine, Phendimetrazine Diethylpropion
Orlistat (제니칼)
Phentermine + Topiramate (큐시미아)
Bupropion + Naltrexone (콘트라브)
Liraglutide (주사제, 삭센다)

식욕 조절의 기전

Mechanism of anti-obesity medication about homeostatic appetite and hedonic appetite.[81)]
ARC.arcuate nucleus; GABA, gamma-aminobutyric acid.



Time-dependent onset of effects after TRT

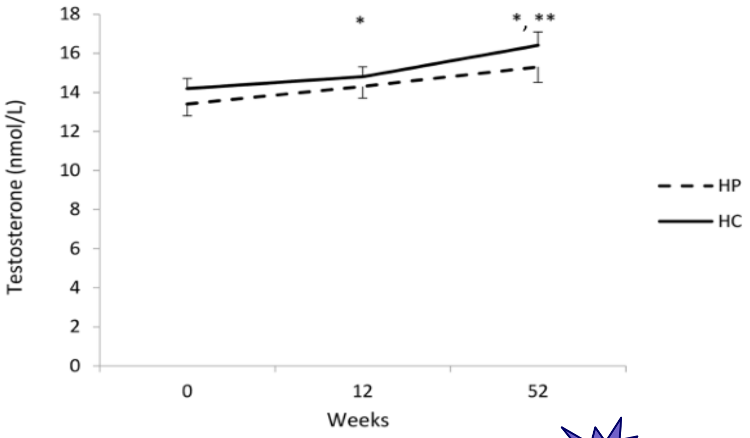


Aging Male. 2015;18(1):5-15.

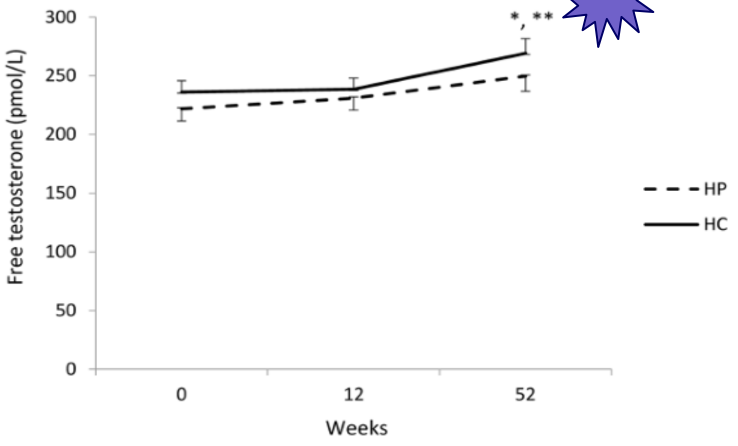
Diet on testosterone

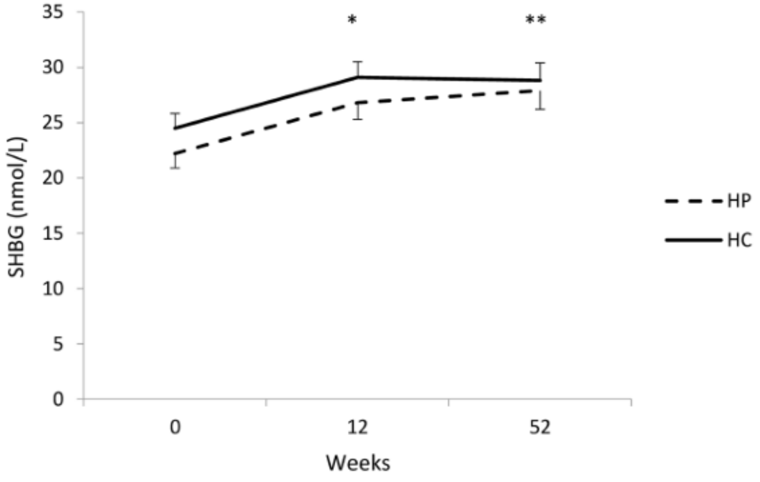
Table 2. Change in outcomes with weight loss intervention for all participants combined.

Outcome measures	0–12 weeks	12–52 weeks	0–52 weeks
Weight (kg)	-8.9±0.4, P<0.001	-1.6±0.6, P = 0.034	-10.5±0.8, P<0.001
BMI (kg/m²)	-2.8±0.1, P<0.001	-0.6±0.2, P = 0.018	-3.4±0.3, P<0.001
Waist circumference (cm)	-10.4±0.4, P<0.001	-0.7±0.5, P = 0.700	-11.0±0.7, P<0.001



HP; **35% P**, 40% C, 25% F (n=57)
HC; 17% P, **58% C**, 25% F (n=61)





고탄 ▶ 인슐린 분비 ▶ T합성 자극

PLOS ONE | DOI:10.1371/journal.pone.0161297 September 1, 2016

Low Carbohydrate?

Table 4 End points before and after the intervention

	Control gourp (*n* = 6)			Low Carbohydrate group (*n* = 12)		
	Before	After	*P*-value	Before	After	*P*-value
Weight (Kg)	98.3	97.3	**0.04**	96.5	91.9	**0.002**
Body Mass Index	30.2	29.7	**0.07**	31.7	30.0	**0.01**
Abdominal circumference (cm) *	113.3	110.5	**0.06**	112.2	106.3	**0.002**
Hip circumference (cm)	105.7	105.2	**0.41**	104.3	102.3	**0.21**
Waist circumference (cm) **	108	107.3	**0.39**	106.4	102.8	**0.10**
Total testosterone (ng/dL)	217.7	227.2	**0.76**	229.1	310.7	**0.002**
Calculated free testosterone (ng/dL)	4.3	4.8	**0.58**	4.7	6.7	**0.001**

* Tape measure around person's umbilical scar

** Tape measure around person's middle (between the bottom of the ribs and the top of the hipbones)

Table 3 Hypogonadism and symptoms of hypogonadism prevalence using serum total testosterone level and ADAM score before and after the intervention

	Control gourp (*n* = 6)		Low Carbohydrate group (*n* = 12)		
	Before	After	Before	After	*P*-value
Total testosterone < 300 ng/dL (%)	100	83.3	100	50	**0.05**
Symptoms of hypogonadism by ADAM score (%)	100	85.7	78.6	21.4	**< 0.01**

ADAM Androgen Deficiency in the Aging Male scale

The control group was instructed to continue eating normally but received guidance about healthy eating patterns. The low-carbohydrate group was instructed by a nutritionist, member of the study team, to reduce carbohydrate intake and increase protein and fat intake [18]. Their diet could not contain more than 25–30% carbohydrates per day, aiming for 20–30 g carbohydrate per day. The two diets have the same amount of calories.

BMC Endocrine Disorders (2023) 23:30

medicina MDPI

Review

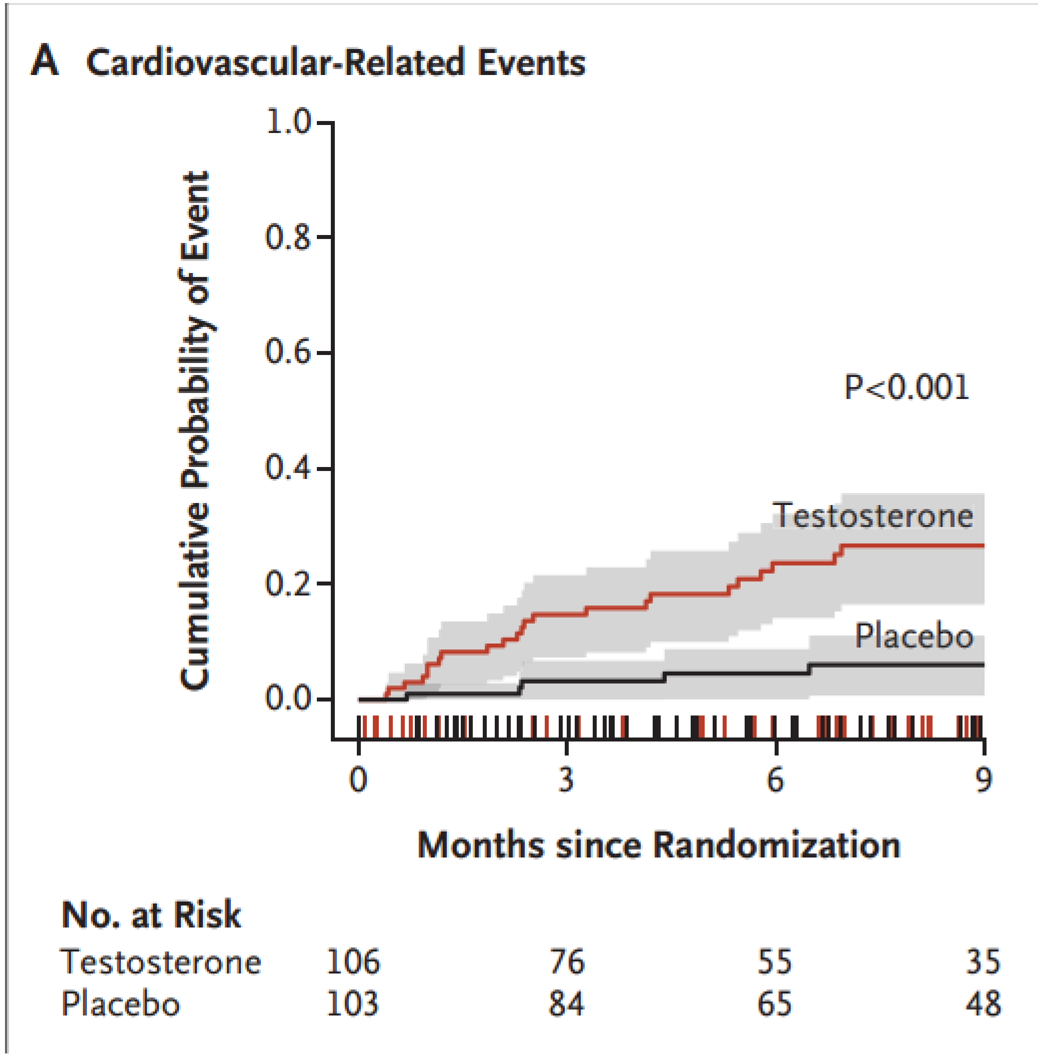
Impact of GLP-1 Agonists on Male Reproductive Health—A Narrative Review

Alexandra Aponte Varnum [1], Edoardo Pozzi [1,2,3], Nicholas Allen Deebel [4], Aymara Evans [1], Nathalie Eid [5], Hossein Sadeghi-Nejad [5] and Ranjith Ramasamy [1,*]

and sperm parameters. *Results*—GLP-1 receptors have been identified within the male reproductive system according to the existing literature. While the exact mechanisms are not well understood, they appear to be involved in glucose homeostasis and energy metabolism, both vital processes in spermatogenesis. Multiple clinical trials have demonstrated the efficacy of GLP-1 RAs for promoting weight loss. Recent studies show that the use of GLP-1 RAs in obese males may enhance sperm metabolism, motility, and insulin secretion in vitro, along with positive effects on the human Sertoli cells. Recent clinical trials discussed in this review demonstrate weight loss associated with GLP-1 RAs is correlated with improvements in sperm count, concentration, and motility. However, the direct impact of GLP-1 RAs on male reproductive hormones remains unclear, necessitating further research to confirm their potential role in treating male infertility. *Conclusions*—This narrative review summarizes the existing literature discussing the potential impact of GLP-1 RA on the male reproductive system, emphasizing their potential therapeutic role in addressing idiopathic infertility in obese men. Despite numerous studies exploring the influence of GLP-1 and GLP-1 RAs on reproductive hormones, testicular function, and spermatogenesis, further clinical trials are crucial to validate initial evidence. Longer follow-up periods are essential to address uncertainties regarding the long-term repercussions and outcomes of GLP-1 RA use. While this holds true, the current literature suggests that GLP-1RAs show promise as a potential therapeutic approach for improving sperm parameters in obese men.

Medicina **2024**, *60*, 50.

Testosterone Treatment (TRT) Adverse effect?



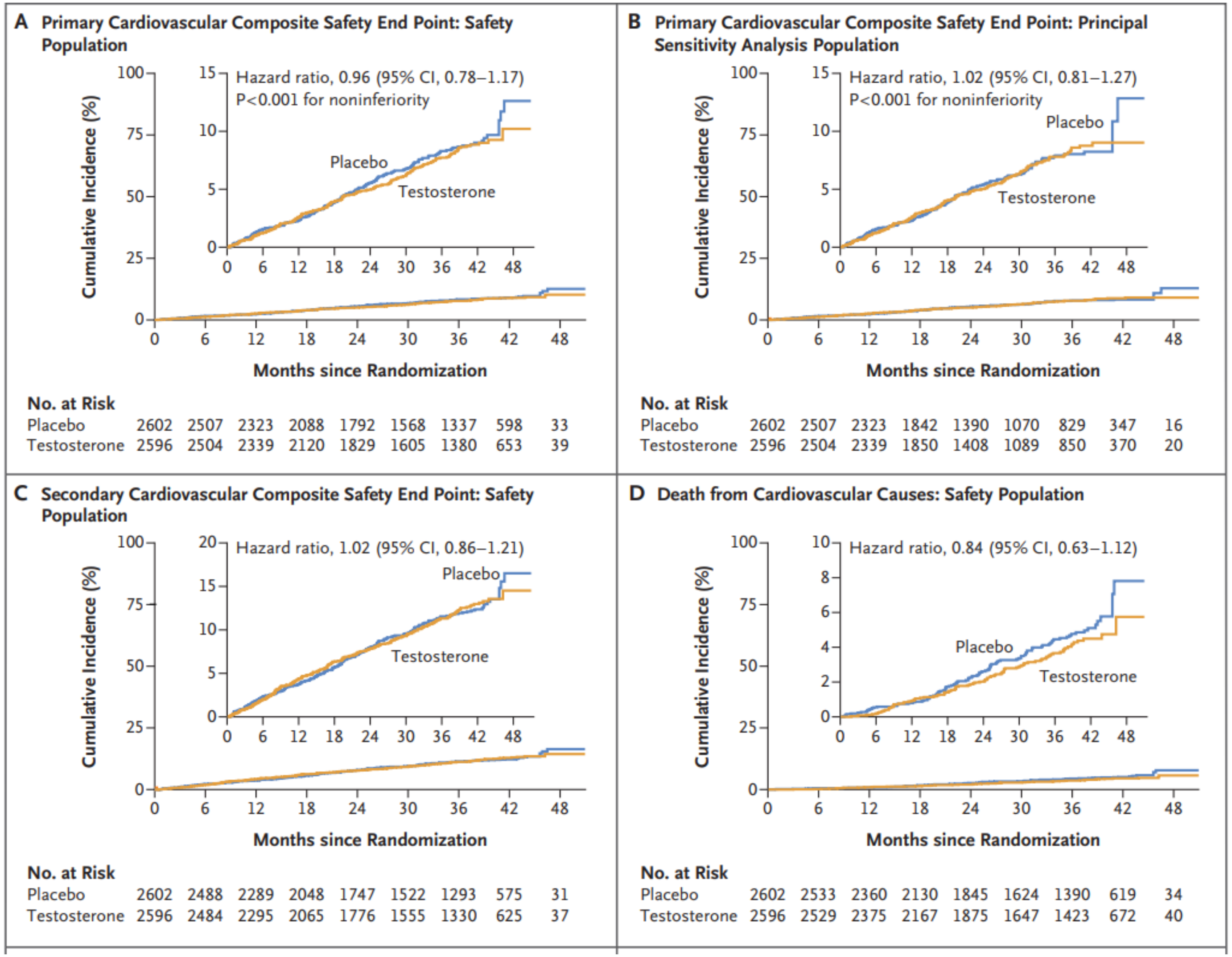
-RCT, 209 men of mean 74 YO(>65YO)

-High prevalence of HTN, DM, hyperlipidemia, obesity.

- 100mg Testosterone gel(Testim 1%) for 6 m
- dose adjusted, if less than 5.0ng/ml
- Stopped prematurely at 6 m

N Engl J Med 2010;363:109-22.

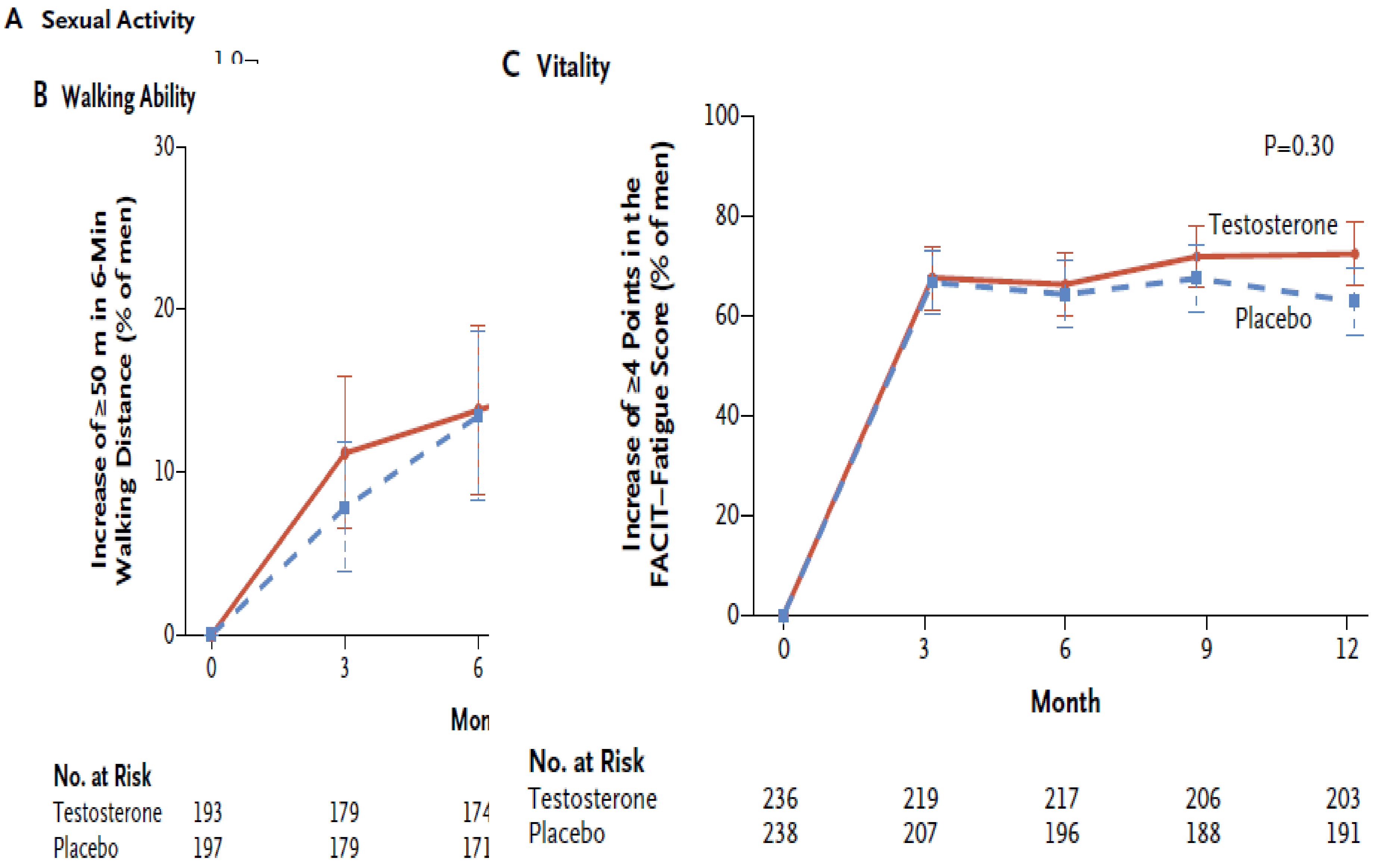
CVD Safety of TRT



-5,246 men,
45~80 YO
-High risk of CVD
-<3.0ng/dl 등록
-1.62% T gel
-3.5~7.5ng/ml로 dose adjust

N Engl J Med. 2023;389:107-117

Effects of TRT



N Engl J Med 2016;374:611-24.

TRT on Weight loss

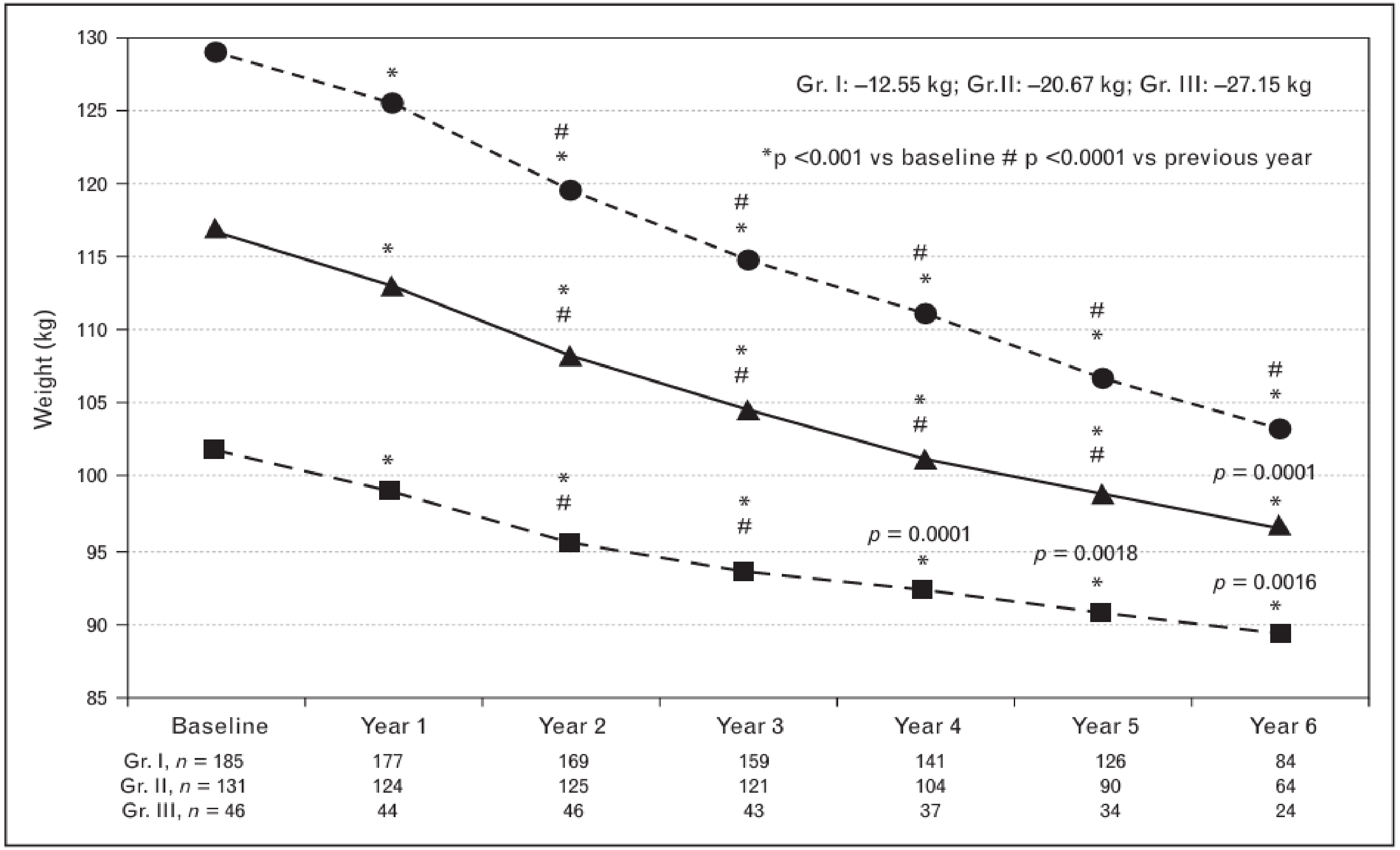
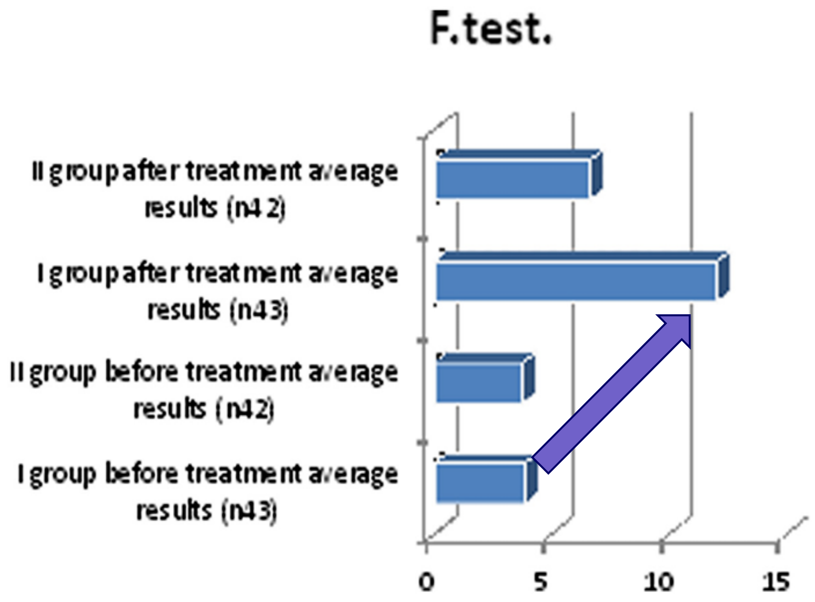


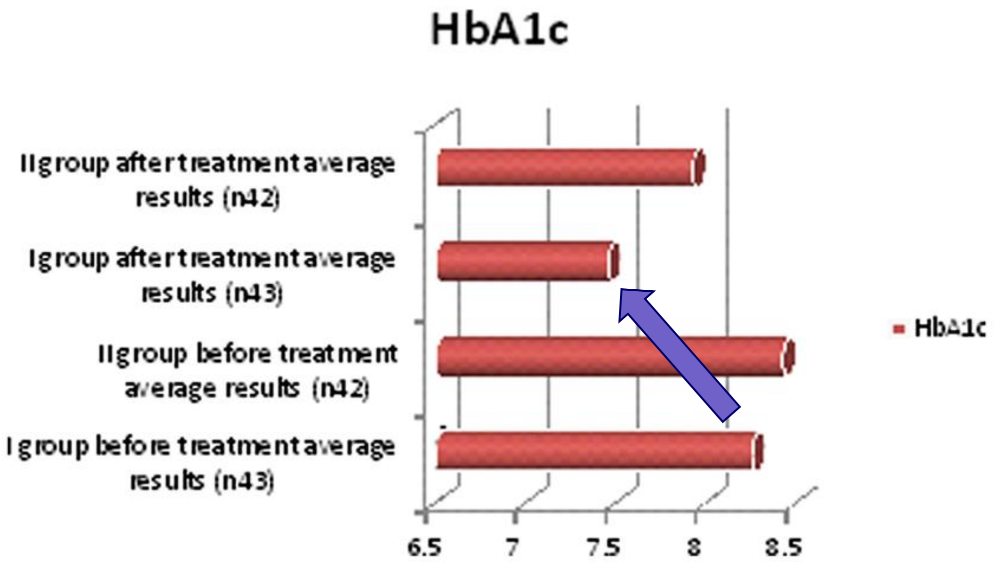
FIGURE 1. Testosterone therapy in men with testosterone deficiency and differing grade of obesity produces significant and sustained weight loss. Hypogonadal men ($n=362$) with obesity grade I (Gr. I, $n=185$, mean age: 58.39 ± 8.04 years), grade II (Gr. II, $n=131$, mean age: 60.62 ± 5.56 years) and grade III (Gr. III, $n=46$, mean age: 60.28 ± 5.39 years) treated with testosterone undecanoate injections for up to 6 years. Weight expressed in kilogram. Adapted with permission from [60••].

Curr Opin Endocrinol Diabetes Obes 2014, 21:313–322

TRT on DM with obesity



Eighty-five subjects, with age range 41 to 65 years and BMI from 27.0 to 48.0 kg/m^2, were randomized in a placebo-controlled study. According to the laboratory and clinical conditions, we divided patients into two groups: 1) a treatment group; 2) a placebo group. In the first group we used diet, physical activity (lifestyle intervention implies reduced calorie diet - the reduction of daily calorie intake to 1800 to 2000 calories – and this was selected individually), patient's antidiabetic therapy and TRT (testosterone undecanoate 250 mg/ml intramuscularly once every 3 months). In the second group we used diet, physical activity (lifestyle intervention



European Journal of Medical Research 2014, **19**:56

TRT on metabolic parameters

Table 1—Effect of TRT on nonsexual parameters in men with diabesity

Parameter	Change	References
Fat mass	↓	(44,49–51,53,54,56,61)
Lean mass	↑	(44,53,56)
BMI	↔	(44,45,55,56)
Insulin sensitivity	↑	(44,49,50,54)
Glycemic control	↔	(44–46,55,56,61)
Hemoglobin	↑	(44,62)
Bone density	Not studied	
Lipids	↓ in total cholesterol, LDL, and lipoprotein (a), minor decrease in HDL, ↔ in triglycerides	(44,45,56)
Cardiovascular disease	Not studied	
PSA	↔	(44,45,51,54)

We focused on randomized controlled trials in men with obesity, type 2 diabetes, or metabolic syndrome. If there was disagreement among studies on a parameter, we chose to depict it as increased (↑), decreased (↓), or no change/variable results (↔) based on the totality of evidence.

Diabetes Care 2018;41:1516–1525

TRT on metabolic parameters

Table 1 Metabolic effects of testosterone treatment in clinical trials

Parameter	Effect
Body weight	No change[a]
Fat mass	Decrease
Lean mass	Increase
Hepatic fat	No change
Visceral fat	Decrease or no change
Insulin resistance (HOMA-IR)	Decrease or no change
Insulin resistance (hyperglycemic-euglycemic clamps)	Decrease or no change
HbA1c	No change[a]
Total cholesterol	Decrease
LDL cholesterol	Decrease
HDL cholesterol	Decrease
Triglycerides	Decrease or no change

[a]A decrease has been reported in non-randomized, non-blinded studies.

Andrology, 2020, 8, 1519–1529

T4DM Study

Eligible participants
- Men aged 50–74 years
- Prediabetic or newly diagnosed diabetic
- Serum T ≤ 14 nmol/L
- Waist circumference ≥ 95 cm.

Stratification:
- Centre
- Age group 50–59 years, 60–74 years
- Waist circumference (cm)
  - 95–100;
  - 101–115;
  - > 115.
- 2-h glucose on OGTT (mmol/L)
  - 7.8–9.5;
  - 9.6–11.0;
  - 11.1–15.0.
- Currently smoking-yes, no.
- First-degree family history of T2D-yes, no.

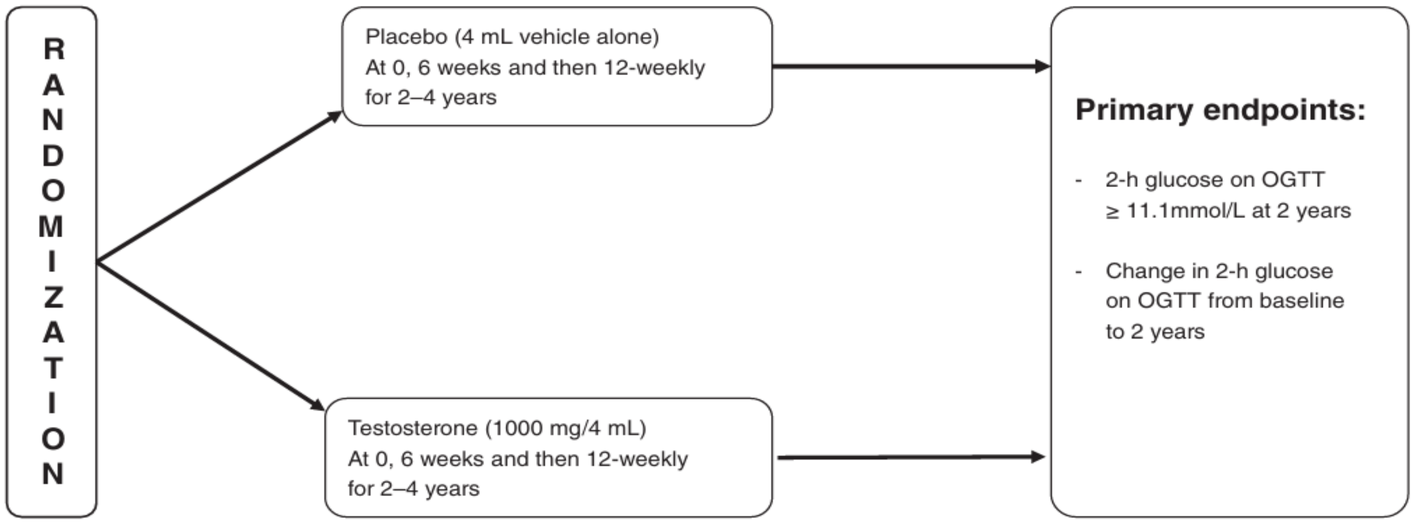


FIGURE 1 T4DM study design

당뇨가 진단된 사람들이었고, 3개월 간격으로 1 g의 testosterone undecanoate 혹은 위약을 주사하였다. 위약 대비 테스토스테론 치료를 받은 군에서 2년째 제2형당뇨의 유병률이 40% 감소함을 보였다. 그렇지만, 당화혈색소에 미치는 영향은 없었다. 정확한 이유는 모르지만, 남성호르몬의 혈구세포 합성능력이 아마도 혼란 변수로 작용했을 가능성이 있다는 것이다. 또한, 중재 전의 테스토스테론의 농도와 연구 결과와도 유의한 상관성이 없었다. 그렇지만, 테스토스테론 치료를 받은 군에서는 체성분의 변화(총지방량 및 내장지방량의 감소, 근육량 증가)에는 좋은 결과를 미쳤으며, 근력 증가, 성기능 개선 등을 보였으나, 위약군에서는 지방량 감소와 더불어 제지방량 및 근력도 함께 감소하였다. 2년간의 치료 동안에 부작용은 두 군에서 차이가 없었고, 전립선암 발생도 차이가 없었고 치료군에서 고등급의 암 발생이 적었다. 또, 다른 연구에서는 테스토스테론 저하가 있

Diabetes Obes Metab. 2019;21(4):772–80

Obesity, Male Reproductive Function and Bariatric Surgery

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CONCLUSION

Bariatric surgery seems to be effective to improve free and total testosterone plasma levels in obese men, even if more evidence is needed about changes of other hormones such as gonadotropins and adrenal sex steroids. In addition, while testosterone plasma levels improvement is maintained for a long-term, restored erectile function seems not to be a durable effect, even if increased semen quality is not guaranteed after metabolic surgery. These conditions may be explained by the complex pathophysiology of reproductive function abnormalities occurring in men with obesity. In particular, adipose tissue expansion and consequent biochemical activity impairment (cytokines and adipokines production, increase peripheral androgens aromatization) may be responsible for reduced levels of testosterone while different and even more complex mechanisms, involving not only sex hormones levels but also neuro-vascular abnormalities and gonadal specific alterations, could be responsible for erectile dysfunction and infertility. To this regard, metabolic surgery may present some limitations; however, with respect to non-surgical weight loss, bariatric surgery remains the most effective treatment for a rapid improvement of global sexual activity and hypogonadism, so it could be considered as a relevant option for severely obese hypogonadal males.

Front. Endocrinol. 9:769.

Bariatric surgery

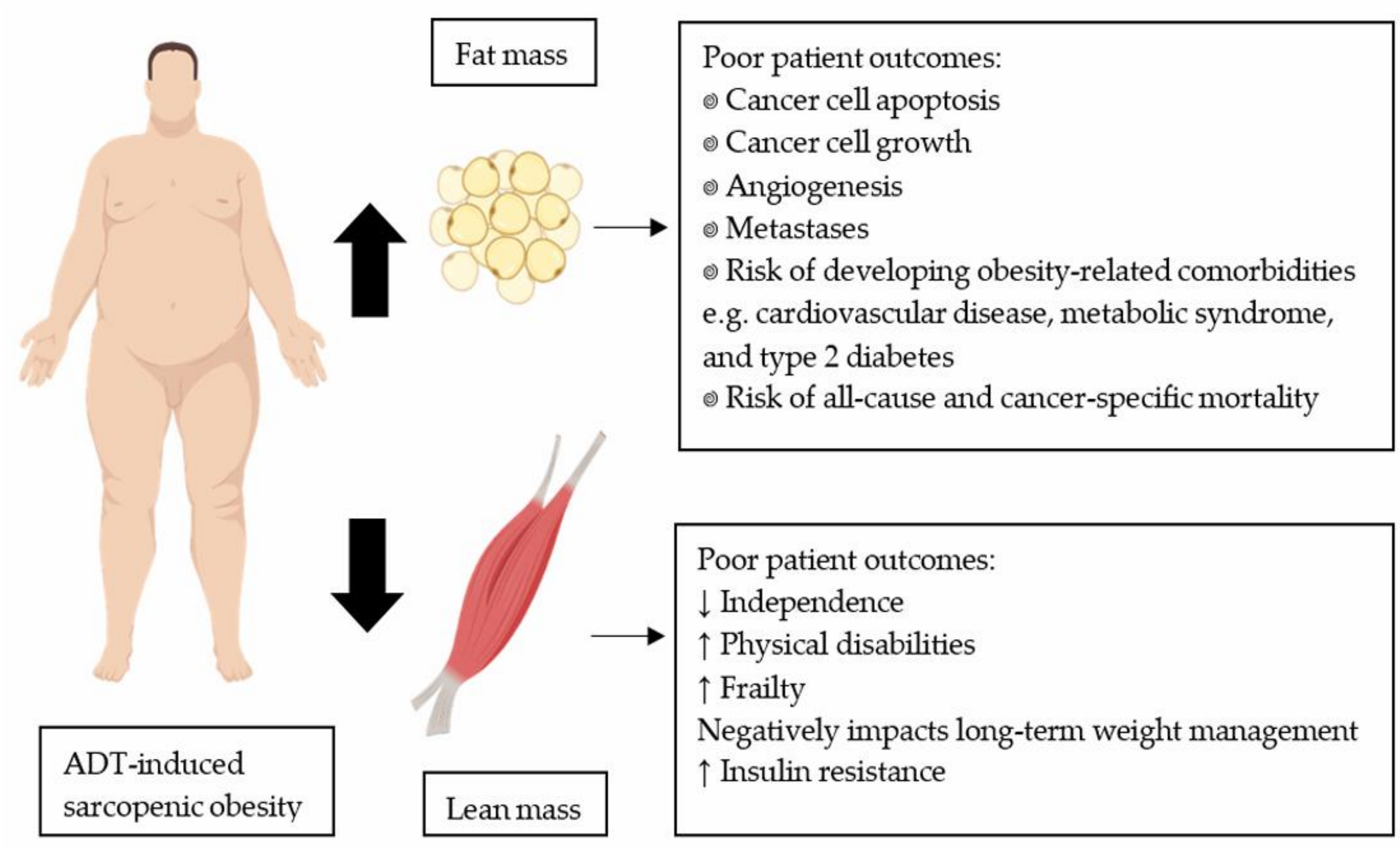
TABLE 1 | Effects of bariatric surgery on hormonal and metabolic profile, erectile dysfunction, semen and sperm parameters.

Level of evidence	References	Sample Size	Intervention	Outcome
Level Ib	Samavat et al. (58)	103	Gastric bypass	Post operative time point review: 9 months Weight loss achieved: Mean −36.2 ± 20.24 kg Outcome: significant increase in free and total testosterone, OCN and SHBG; decrease in Oestradiol
Level Ib	Arolfo et al. (59)	44	Roux-en-y gastric bypass; Sleeve gastrectomy	Post operative time point review: 9 months Weight loss achieved: Mean-39.75 ± 24 kg Outcome: Significant increase in total testosterone, SHBG and IIEF score; decrease in HbA1c, insulin, triglycerides, HDL cholesterol, and CRP
Level Ib	Legro et al. (60)	6	Roux-en-y gastric bypass	Post operative time point review: 1, 3, 6 months Weight loss achieved: Mean −55 ± 30 kg Outcome: improvement in testosterone level
Level Ib	Reis et al. (61)	20	Lifestyle modifications, Gastric bypass	Post operative time point review: 4 and 24 months Weight loss achieved: inaccessible Outcome: improvement in total and free testosterone and FSH and reduced prolactin levels

and metabolic hormonal profile. Significant weight loss also alleviates the pro-inflammatory state that is associated with obesity and other co-morbid conditions and helps restore endothelial integrity thereby reducing erectile dysfunction and other cardiovascular risk burden. Bariatric surgery produces successful and encouraging outcomes in terms of the patient's overall health and well-being but more specifically seems to ameliorate hypogonadism and sexual dysfunction.

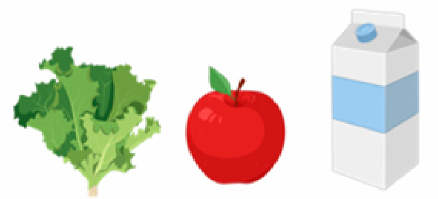
Front. Endocrinol. 11:408.

Androgen Deprivation Treatments



Nutrients **2021**, *13*, 1664.

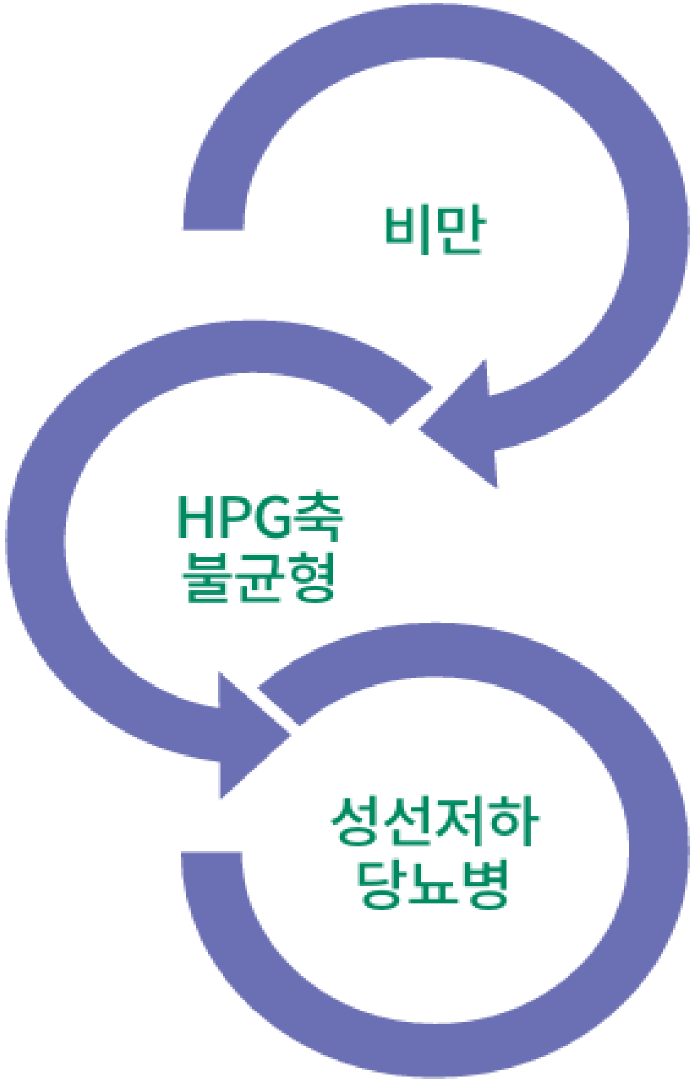
Prostate cancer-specific guidelines

	Current Exercise and Nutrition Guidelines	Current Weight Loss Guidelines
 Aerobic training	150 min/week of moderate intensity exercise or 75 min/week of vigorous intensity exercise	300 min/week of moderate intensity exercise or 150 min/week of vigorous intensity exercise
 Resistance training	Minimum two strength training sessions/week	
 Nutritional intake	Healthy balanced diet with high fruit and vegetables, low saturated fats, and adequate calcium (<1200 mg/d) and vitamin D (>600 IU)	2100–4200 kJ daily energy deficit

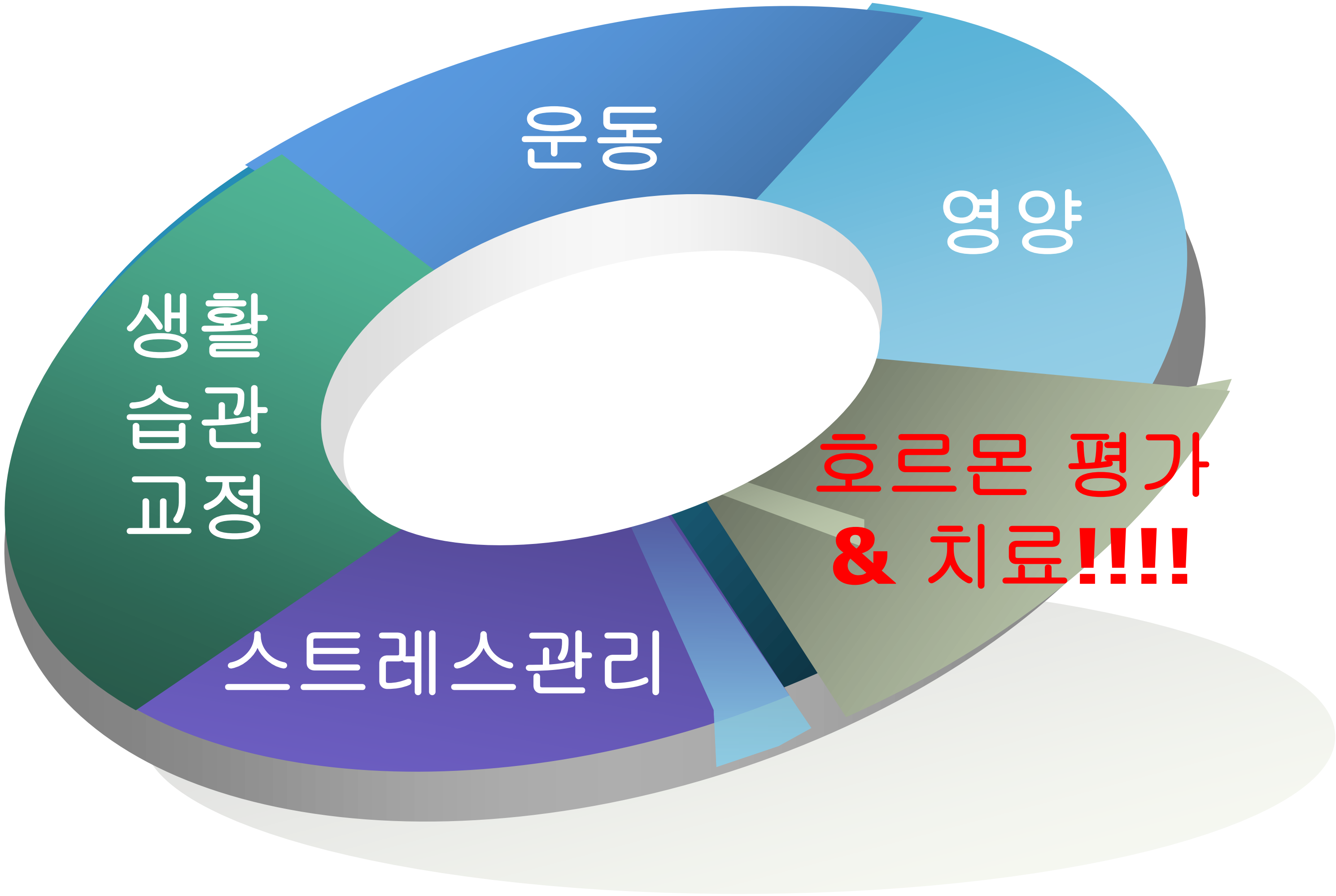
Images created with BioRender.com (accessed on 5 April 2021).

Nutrients **2021**, *13*, 1664.

Obesity ► HPG Axis ► Hypogonadism/DM



Treating Obese Male with Hormonal Dysfunction



Thank You !

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