BELLY FAT: ARE GENES INVOLVED?

Biên Soạn: ĐV SHPT, BVĐK FAMILY, ĐÀ NẴNG.

These are genes that determine subcutaneous fat in the belly, visceral fat, and the genes that do both.

These are **not the only genes**, but they are the **best-established,** linked to **fat distribution**, specifically **subcutaneous & visceral abdominal fat**.

GENES AFFECTING ABDOMINAL FAT DISTRIBUTION

Grouped by: Subcutaneous fat (SC), Visceral fat (VAT), or Both

1 ☐ Genes that primarily influence SUBCUTANEOUS fat (belly-skin fat)

These genes mainly affect *fat stored under the skin* around the waist and hips.

Subcutaneous (SC)–dominant genes

Gene	Main Function
PPARG	Master regulator of adipocyte differentiation; strong effect on SC fat expansion.
KLF14	Adipocyte transcription factor; maternal-imprinted regulation of SC fat storage.
IRS1	SC fat insulin signaling; low SC fat can paradoxically increase metabolic risk.
LYPLAL1	SC abdominal fat accumulation and waist circumference regulation.
VEGFA	SC adipose tissue vascularization & growth.
CPEB4	Controls adipocyte development, especially SC depots.
TBX15	Body shape gene influencing subcutaneous fat distribution (especially flanks, waist).
SPATA20	SC fat accumulation in women.

Interpretation:
These genes help your SC fat pads expand *smoothly* and "safely."
People with weak SC-fat genes tend to **push fat internally → visceral fat**.

2 ☐ Genes that primarily influence VISCERAL fat (around organs)

These genes are associated with *central obesity, visceral adiposity, insulin resistance*, and **metabolic syndrome**.

Visceral (VAT)–dominant genes

Gene	Main Function
FTO	Appetite, energy balance; increases visceral and deep abdominal fat.
MC4R	Hunger/satiety; strong effect on visceral obesity.
ADIPOQ	Adiponectin levels → low adiponectin = more VAT.
GIPR	Incretin signaling; VAT accumulation, insulin resistance.
PNPLA3	Fat storage in liver & visceral region (strong link to fatty liver).
TM6SF2	Liver lipid metabolism → visceral fat–phenotype.
IRS2	Insulin resistance → more VAT deposition.
CETP	Visceral fat, HDL metabolism, cardiometabolic risk.
LPL	Lipid breakdown; variants increase VAT.
GCKR	Glucose/lipid regulation → visceral adiposity tendency.

Interpretation:
These genes push the body to store extra calories **deep inside the abdomen**, not under the skin.

3 ☐ Genes that influence BOTH visceral AND subcutaneous abdominal fat

These affect overall **fat distribution patterns**, waist circumference, WHR (waist-hip ratio), and adipocyte biology.

Dual-effect genes (SC + VAT)

Gene	Main Function
LEP	Leptin production; regulates total and regional fat mass.
LEPR	Leptin receptor; affects both SC & visceral stores.

Gene	Main Function
TMEM18	Body mass and total fat distribution.
UCP1	Brown fat activation; both SC and visceral metabolism.
ADRB3	β3-adrenergic receptor controlling fat breakdown in both depots.
SH2B1	Energy homeostasis; affects global fat distribution.
TFAP2B	Adipocyte differentiation across all fat depots.
ZNRF3	Global fat distribution including waist circumference.
RSPO3	WNT signaling, affects both SC & visceral fat development.
GDF5	General adipose tissue patterning.

Interpretation:
These genes shape the *overall architecture* of body-fat distribution.

4 ☐ Simplified clinical interpretation (for patients)

- **Subcutaneous fat genes** → "body shape genes"
- **Visceral fat genes** → "metabolism & insulin resistance genes"
- **Both** → "master regulators of fat distribution"

SAT vs VAT GENETICS REFERENCE SHEET

(Song ngữ Việt – Anh)
Family Hospital / Family Hospital Network – Đà Nẵng

1. Định nghĩa | Definitions

SAT — Mỡ Dưới Da | Subcutaneous Adipose Tissue

- Lớp mỡ nằm ngay dưới da bụng, hông, đùi.
- Chủ yếu mang tính thẩm mỹ, ít nguy cơ chuyển hoá.
- Khả năng "chứa mỡ an toàn" → bảo vệ cơ thể khỏi mỡ nội tạng.
  Subcutaneous fat stored beneath the skin of the abdomen, hips, and thighs.
  Metabolically safer; protects against visceral/ectopic fat.

VAT — Mỡ Nội Tạng | Visceral Adipose Tissue

- Mỡ nằm sâu trong ổ bụng, quanh gan – ruột – tụy.
- Liên quan mạnh với kháng insulin, NAFLD, T2D, bệnh tim mạch.
  Deep abdominal fat stored around organs.
  Strongly associated with insulin resistance, NAFLD, T2D, and cardiovascular risk.

2. Các Gene ảnh hưởng SAT | Genes influencing SAT (Subcutaneous Fat)

GENE	VN – Vai trò	EN – Function
PPARG	Điều hoà tạo mỡ, giúp mô mỡ dưới da giãn nở an toàn	Master regulator of adipogenesis; SC expansion
KLF14	Điều hoà SC mỡ ở nữ (gene in dấu mẹ)	Maternal-imprinted regulator of SC fat distribution (female-specific)
IRS1 (SC variant)	SC-insulin signaling; SC yếu → đẩy mỡ vào nội tạng	SC insulin signaling; low SC capacity → visceral "spillover"
LYPLAL1	Điều hoà vòng eo & tích mỡ bụng dưới da	WHR/SC abdominal fat locus
VEGFA	Tân mạch mô mỡ → SC giãn nở tốt hơn	Vascularization of SC adipose tissue
CPEB4	Phát triển SC adipocyte; liên quan béo phì	Controls SC adipocyte development
TBX15	Gene "body-shape"; kiểm soát mỡ vùng eo – hông	Regional SC fat identity
SPATA20	Tích mỡ dưới da (đặc biệt ở nữ)	SC fat accumulation (female-predominant)

Ý nghĩa lâm sàng / Clinical meaning:
SC tốt = bảo vệ. SC kém = mỡ chuyển vào VAT hoặc gan.
High SC expandability protects against VAT and liver fat.

3. Các Gene ảnh hưởng VAT | Genes influencing VAT (Visceral Fat)

GENE	VN – Vai trò	EN – Function
FTO	Tăng cảm giác đói → mỡ nội tạng	Appetite → visceral adiposity

GENE	VN – Vai trò	EN – Function
MC4R	Tín hiệu no; đột biến → béo bụng	Satiety defects → visceral obesity
ADIPOQ	Adiponectin ↓ → tăng VAT	Low adiponectin → VAT accumulation
GIPR	Incretin; tăng kháng insulin + VAT	Incretin & insulin resistance → VAT
PNPLA3	Mỡ gan + mỡ nội tạng	Liver fat + visceral fat axis
TM6SF2	Rối loạn lipid gan → kiểu hình VAT	Hepatic lipid metabolism → VAT phenotype
IRS2	Tín hiệu insulin gan → tích VAT	Hepatic insulin signaling
CETP	Điều hoà HDL; mỡ nội tạng tăng	Lipid trafficking → VAT
LPL	Phân giải lipid; biến thể ↑ VAT	Lipid partitioning → visceral storage
GCKR	Glucose/lipid; tăng VAT + TG	Central adiposity via glucose–lipid axis

Ý nghĩa lâm sàng / Clinical meaning:
VAT là "mỡ nguy hiểm" — liên quan trực tiếp đến NAFLD, T2D, bệnh tim.
VAT genes drive central obesity and cardiometabolic risk.

4. Gene ảnh hưởng cả SAT & VAT | Genes influencing BOTH depots

GENE	VN – Vai trò	EN – Function
LEP	Tín hiệu leptin; kiểm soát tổng lượng mỡ	Leptin production; total fat regulation
LEPR	Kháng leptin → tăng SC & VAT	Leptin receptor; SC + VAT accumulation
TMEM18	Điều hoà khối lượng mỡ toàn thân	Global adiposity
UCP1	Mỡ nâu; đốt mỡ SC + VAT	Brown-fat thermogenesis
ADRB3	Lipolysis ở cả SC & VAT	β3-adrenergic lipolysis
SH2B1	Homeostasis năng lượng toàn thân	Energy homeostasis
TFAP2B	Biệt hoá adipocyte ở mọi depot	Adipocyte differentiation across depots
ZNRF3	Điều hoà WNT; WHR & body shape	WNT signalling; WHR

GENE	VN – Vai trò	EN – Function
RSPO3	Gene “master” tái phân bố mỡ	Central body-fat distribution regulator
GDF5	Phát triển mỡ toàn cục	General adipose patterning

Ý nghĩa / Meaning:
Những gene này định hình tổng thể cơ thể (SC + VAT).
These genes shape the overall “architecture” of body fat.

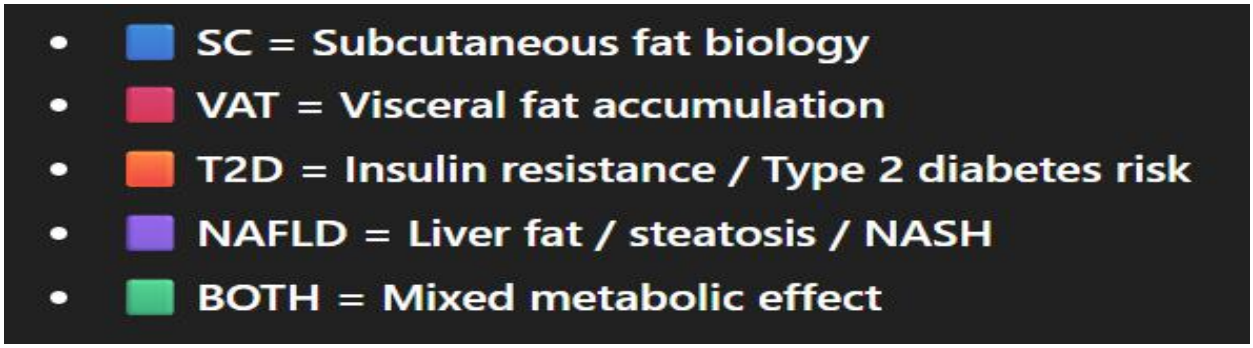
5. Tương tác Hormone–Gene | Hormone–Gene Interaction

Hormone	VN	EN
Cortisol	Tăng VAT, đặc biệt khi stress	↑ VAT under stress
Estrogen	Hỗ trợ SC; mãn kinh → VAT ↑	SC-favoring; menopause → VAT increase
Testosterone	Thấp → VAT ↑ ở nam	Low → VAT gain in men
Insulin	Kháng insulin → VAT ↑	Resistance → visceral adiposity
Adiponectin (ADIPOQ)	Bảo vệ chống VAT	Protects against VAT
Thyroid / GH	Thấp → VAT tăng	Low → central fat gain

6. Ảnh hưởng lối sống | Lifestyle Influence

Behavior	VN	EN
Đường, rượu	VAT tăng	Sugar/alcohol → VAT gain
Thể dục	Giảm VAT	Aerobic + strength → VAT ↓
Ngủ	Thiếu ngủ → cortisol ↑ → VAT ↑	Poor sleep → VAT ↑
Stress	VAT ↑	Chronic stress → VAT
Ăn Địa Trung Hải	Giảm VAT	Mediterranean diet → VAT ↓

LEGEND: Color-code genes by metabolic phenotype (T2D, NAFLD, VAT, SC)



🎨 Color-Coded Gene Map by Metabolic Phenotype

🟦 1. Subcutaneous Fat (SC) Biology Genes

(Reduced SC capacity → visceral spillover → metabolic risk)

Gene	Color	Interpretation
PPARG	🟦	SC adipogenesis; loss leads to ectopic fat/T2D.
KLF14	🟦🟧	SC fat patterning; female-specific T2D risk.
IRS1	🟦🟧	SC insulin signaling; low SC → IR & T2D.
LYPLAL1	🟦🟧	SC abdominal fat; modest T2D association.
TBX15	🟦	Regional SC fat identity.
VEGFA	🟦🟧	Adipose vascularization; hypoxia → IR.
SPATA20	🟦	SC depot development.
CPEB4	🟦	Adipocyte differentiation (general).

2. Visceral Fat (VAT) Accumulation Genes

(Direct contributors to cardiometabolic risk)

Gene	Color	Interpretation
FTO		Appetite → visceral obesity → T2D.
MC4R		Hyperphagia → central obesity + T2D.
ADIPOQ		Low adiponectin → visceral fat + IR.
GIPR		Post-prandial insulin effects → VAT gain.
PNPLA3		VAT + very strong NAFLD/NASH genotype.
TM6SF2		Liver fat storage; NAFLD > VAT phenotype.
IRS2		Hepatic insulin resistance → VAT.
CETP		Lipid transport favoring visceral deposition.
LPL		Lipolysis defects → VAT accumulation.
GCKR		Triglycerides, NAFLD, T2D mix.

🟪 3. Predominant NAFLD / Liver-Fat Genes

Gene	Color	Interpretation
PNPLA3	🟪🟥	Strongest common NAFLD gene + VAT.
TM6SF2	🟪🟥	Liver steatosis, fibrosis risk, mild VAT.
GCKR	🟪🟥🟧	Liver fat, high TGs, T2D tendencies.

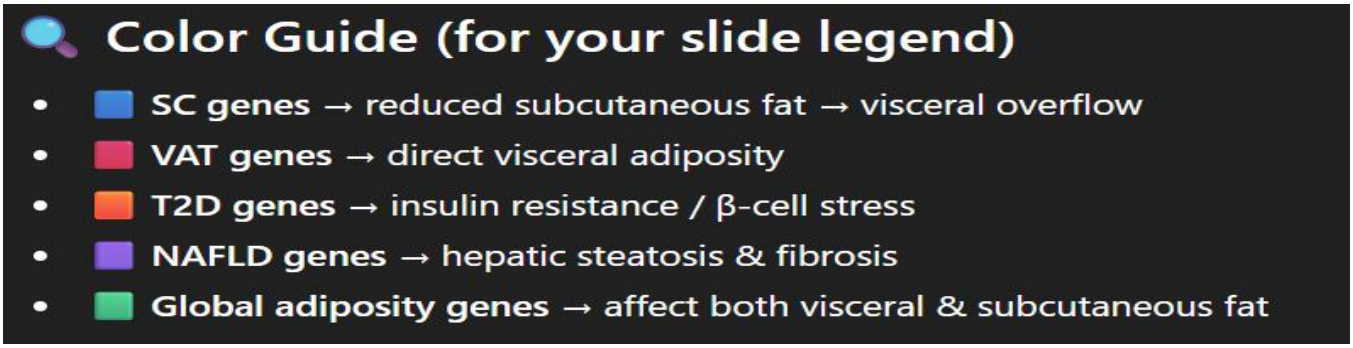
🟧 4. Predominant T2D / Insulin Resistance Genes

Gene	Color	Interpretation
IRS1	🟦🟧	SC insulin signaling → IR/T2D when defective.
IRS2	🟥🟧	Hepatic IR → VAT gain + T2D.
ADIPOQ	🟥🟧	Low adiponectin → T2D risk.
FTO	🟥🟧	Appetite → obesity → T2D.
MC4R	🟥🟧	Appetite → obesity → T2D.
GCKR	🟪🟥🟧	Mixed liver + VAT + T2D.
SH2B1	🟧🟥	Leptin/insulin signaling → central obesity + IR.

🟩 5. Mixed (Both SC & VAT) — Whole-Body Regulation Genes

These genes affect **global adiposity**, energy balance, and both fat depots.

Gene	Color	Interpretation
LEP		Leptin deficiency/resistance → global obesity.
LEPR		Leptin receptor → hyperphagia, IR, VAT.
UCP1		Brown fat thermogenesis; low BAT → both vats.
ADRB3		Lipolysis impairment affects SC + VAT.
TMEM18		Total adiposity + mixed distribution.
SH2B1		Leptin/insulin pathway → strong central obesity.
RSPO3		WNT pathway → waist circumference + VAT.
ZNRF3		Similar WNT effect → body shape + VAT.
TFAP2B		Broad adipogenesis gene.
GDF5		Shapes SC/VAT distribution + metabolic risk.



KẾT LUẬN:

Mặc dù mỡ nội tạng chịu ảnh hưởng bởi gene và hormone, đây vẫn là loại mỡ dễ cải thiện nhất. Chỉ cần thay đổi lối sống nhỏ nhưng đều đặn—ăn uống lành mạnh, vận động thường xuyên, ngủ đủ, và giảm căng thẳng—cũng có thể giảm đáng kể mỡ nội tạng và ngăn ngừa tiểu đường, gan nhiễm mỡ, hay bệnh tim mạch.

Gene chỉ tạo xu hướng, nhưng chính thói quen hằng ngày quyết định kết quả.
Chủ động sớm và duy trì đều đặn sẽ giúp bạn phòng ngừa bệnh tật và bảo vệ sức khỏe lâu dài.

Conclusion: (English Version)

Visceral fat may have genetic and hormonal influences, but it is still one of the easiest types of fat to improve. Even small, consistent lifestyle changes—better diet, regular exercise, good sleep, and lower stress—can significantly reduce visceral fat and lower the risks of diabetes, fatty liver, and heart disease.

Your genes set the tendency, but your daily choices shape the outcome.
By acting early and steadily, you can prevent serious illnesses and protect long-term metabolic health.

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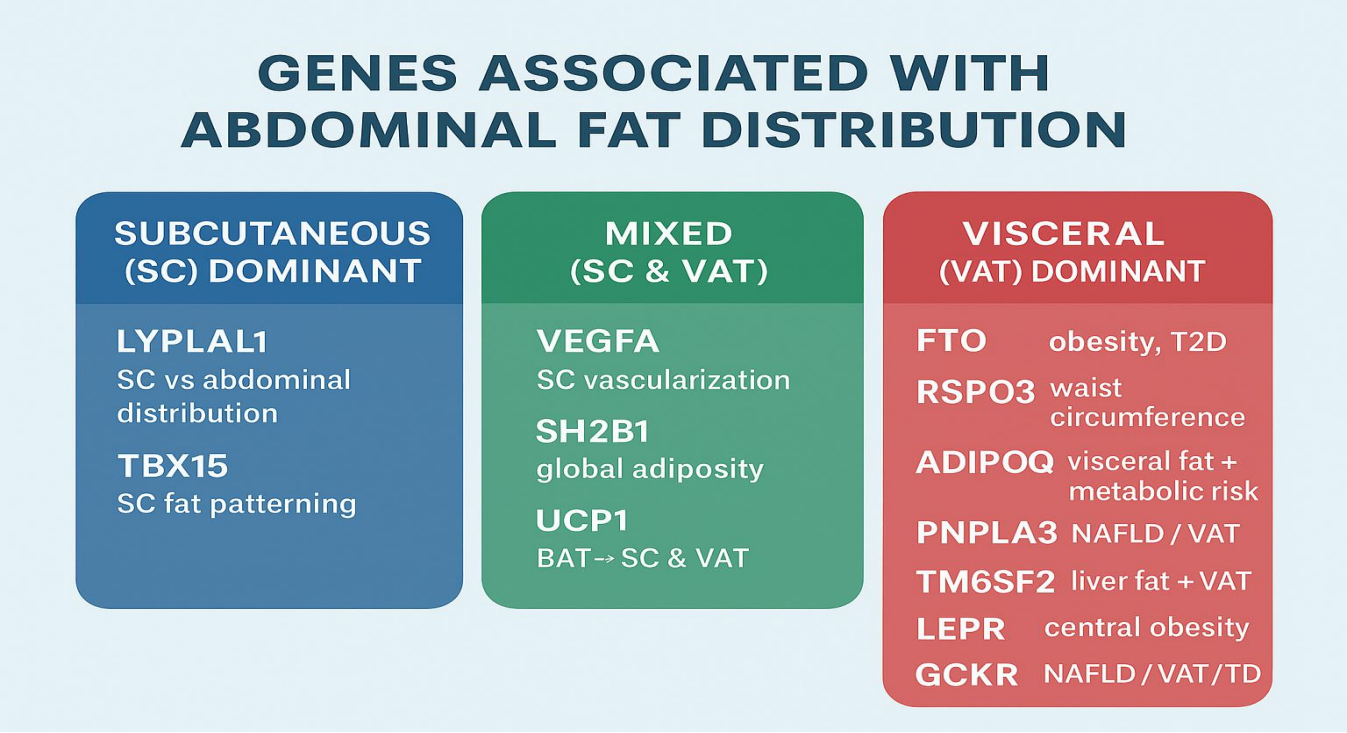
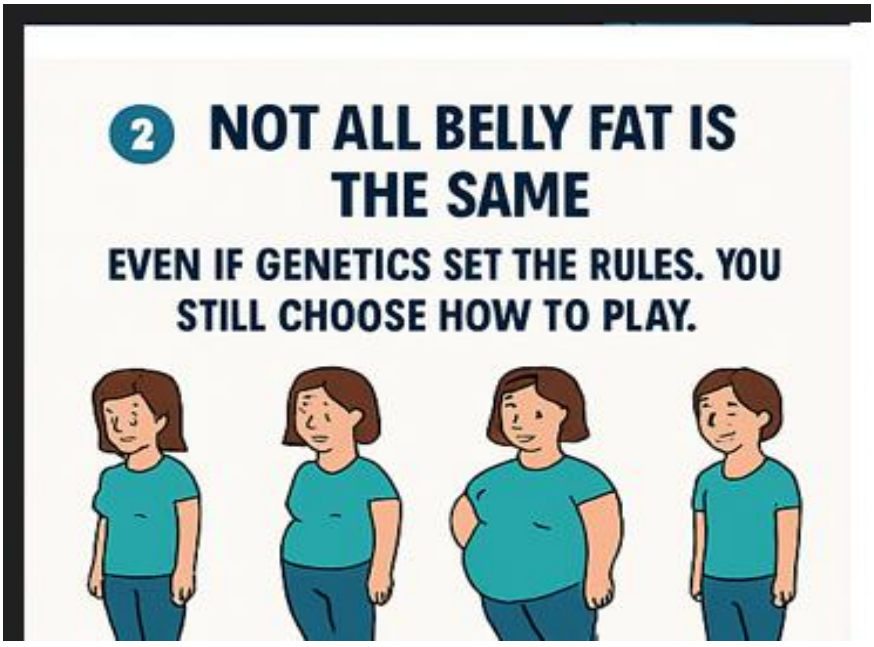



1 YOUR
BELLY FAT
..YOUR
FAULT?
OR YOUR
DNA?


2 NOT ALL BELLY FAT IS
THE SAME
EVEN IF GENETICS SET THE RULES. YOU
STILL CHOOSE HOW TO PLAY.


3 HORMONES JOIN THE PARTY
CORTISOL
"STRESSED? LETS STORE . FAT. IN THE BELLY.
INSULIN RESISTANGE
PARTLY GENETIC, FULLY ANNOYING
ESTROGEN DROPS
MORE BELLY FAT IN WOMEN


BASICALLY:
GENES LOAD THE GUN.
LIFESTYLE DECIDES IF IT FIRES.