“NUTRITION, LIFESTYLE & METABOLIC SYNDROME (MetS): BRIDGING KNOWLEDGE & PRACTICE”

A COMPREHENSIVE APPROACH

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Who are we?

CARDIOMETABOLIC RESEARCH LAB
CRL

ThriveWell
@ ELON UNIVERSITY

HEALTH EYOU

HEALTHEU
FOR YOU · FOR US · FOR OUR COMMUNITY

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Definition of MetS

Metabolic Syndrome is a cluster of conditions that increase the risk of cardiovascular disease, stroke, and type 2 diabetes.

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MetS Diagnostic Criteria

TABLE 1. Previous Criteria Proposed for Clinical Diagnosis of Metabolic Syndrome

Clinical Measure	WHO (1998)	EGIR	ATP III (2001)	AACE (2003)	IDF (2005)
Insulin resistance	IGT, IFG, T2DM, or lowered insulin sensitivity* **plus any 2 of the following**	Plasma insulin >75th percentile **plus any 2 of the following**	None, **but any 3 of the following 5 features**	IGT or IFG **plus any of the following based on clinical judgment**	None
Body weight	Men: waist-to-hip ratio >0.90; women: waist-to-hip ratio >0.85 and/or BMI >30 kg/m^2	WC ≥94 cm in men or ≥80 cm in women	WC ≥102 cm in men or ≥88 cm in women†	BMI ≥25 kg/m^2	Increased WC (population specific) **plus any 2 of the following**
Lipid	TG ≥150 mg/dL and/or HDL-C <35 mg/dL in men or <39 mg/dL in women	TG ≥150 mg/dL and/or HDL-C <39 mg/dL in men or women	TG ≥150 mg/dL HDL-C <40 mg/dL in men or <50 mg/dL in women	TG ≥150 mg/dL and HDL-C <40 mg/dL in men or <50 mg/dL in women	TG ≥150 mg/dL or on TG Rx HDL-C <40 mg/dL in men or <50 mg/dL in women or on HDL-C Rx
Blood pressure	≥140/90 mm Hg	≥140/90 mm Hg or on hypertension Rx	≥130/85 mm Hg	≥130/85 mm Hg	≥130 mm Hg systolic or ≥85 mm Hg diastolic or on hypertension Rx
Glucose	IGT, IFG, or T2DM	IGT or IFG (but not diabetes)	>110 mg/dL (includes diabetes)‡	IGT or IFG (but not diabetes)	≥100 mg/dL (includes diabetes)
Other	Microalbuminuria			Other features of insulin resistance§	

Reference: Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, Gordon DJ, Krauss RM, Savage PJ, Smith SC Jr, Spertus JA, Costa F; American Heart Association; National Heart, Lung, and Blood Institute. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Circulation. 2005 Oct 25;112(17):2735-52. doi: 10.1161/CIRCULATIONAHA.105.169404. Epub 2005 Sep 12. Erratum in: Circulation. 2005 Oct 25;112(17):e297. Erratum in: Circulation. 2005 Oct 25;112(17):e298. PMID: 16157765.

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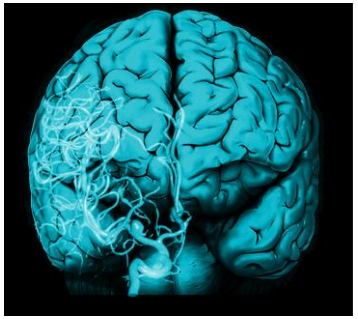
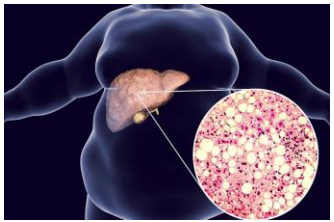
Metabolic Syndrome (MetS) Criteria - AHA/NHLBI

TABLE 2. Criteria for Clinical Diagnosis of Metabolic Syndrome

Measure (any 3 of 5 constitute diagnosis of metabolic syndrome)	Categorical Cutpoints
Elevated waist circumference*†	≥102 cm (≥40 inches) in men ≥88 cm (≥35 inches) in women
Elevated triglycerides	≥150 mg/dL (1.7 mmol/L) or On drug treatment for elevated triglycerides‡
Reduced HDL-C	<40 mg/dL (1.03 mmol/L) in men <50 mg/dL (1.3 mmol/L) in women or On drug treatment for reduced HDL-C‡
Elevated blood pressure	≥130 mm Hg systolic blood pressure or ≥85 mm Hg diastolic blood pressure or On antihypertensive drug treatment in a patient with a history of hypertension
Elevated fasting glucose	≥100 mg/dL or On drug treatment for elevated glucose

↑ **Risk**





Reference: Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, Gordon DJ, Krauss RM, Savage PJ, Smith SC Jr, Spertus JA, Costa F; American Heart Association; National Heart, Lung, and Blood Institute. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Circulation. 2005 Oct 25;112(17):2735-52. doi: 10.1161/CIRCULATIONAHA.105.169404. Epub 2005 Sep 12. Erratum in: Circulation. 2005 Oct 25;112(17):e297. Erratum in: Circulation. 2005 Oct 25;112(17):e298. PMID: 16157765.

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Prevalence of MetS

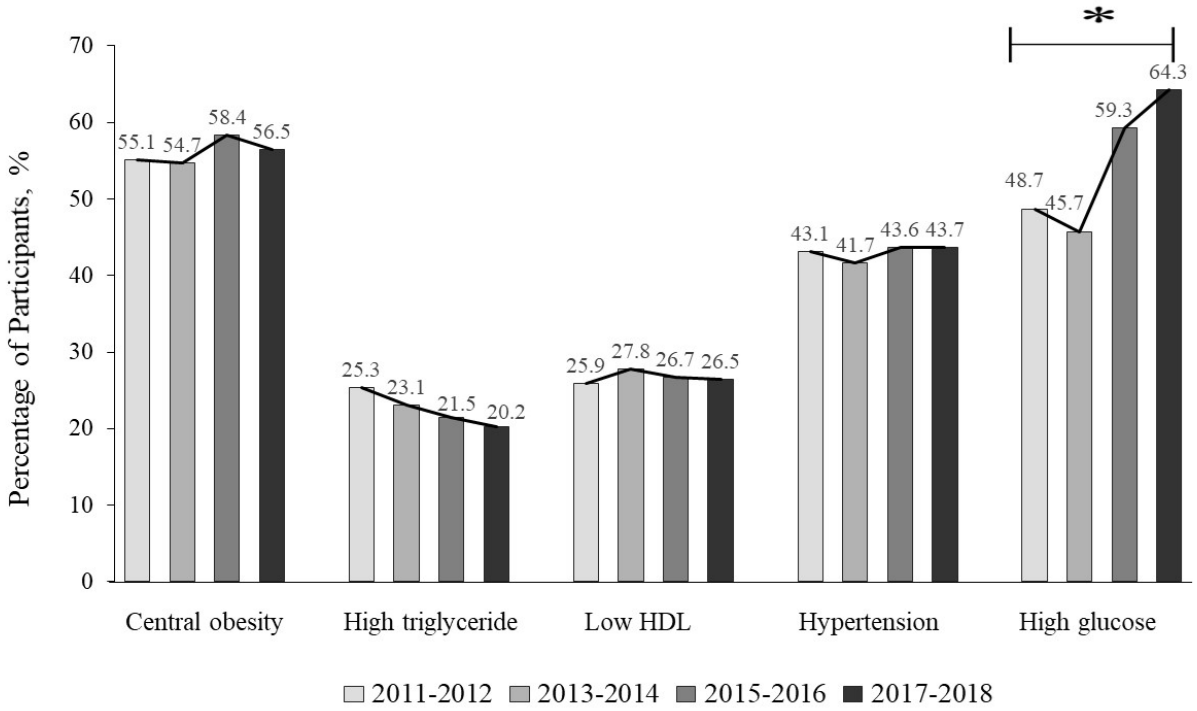
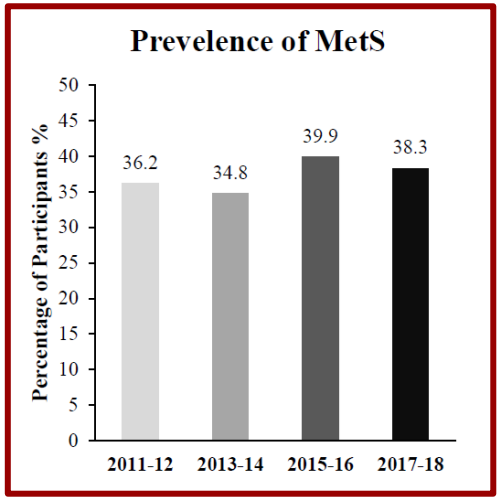


Figure 1. The Percentage of Participants with Each Component of MetS. Adapted from Prevalence of Metabolic Syndrome in the United States National Health and Nutrition Examination Survey (NHANES) 2011-2018 by Xiaopeng Liang et al., 2021. Retrieved from Prevalence of Metabolic Syndrome in the United States National Health and Nutrition Examination Survey (NHANES) 2011-2018 (medrxiv.org)



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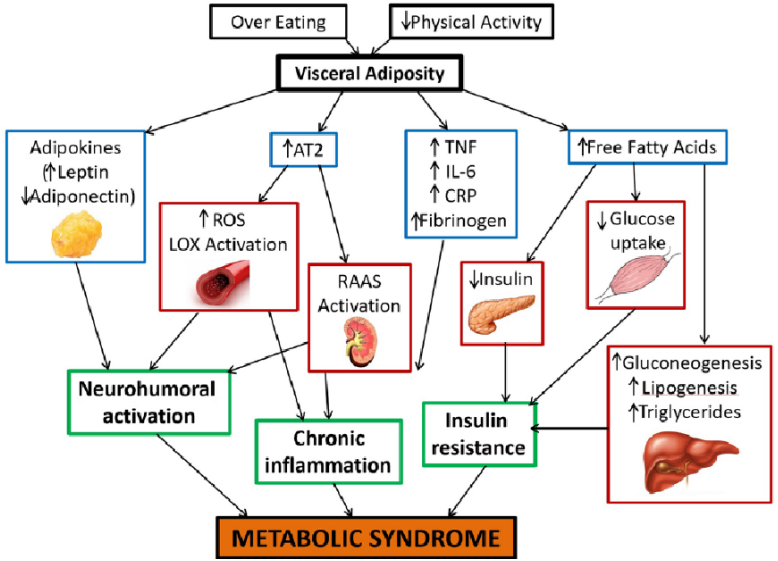
Pathophysiology of MetS

- **Core Mechanism: Insulin resistance???**
- **Key Players:**
  - **Visceral fat**
  - Inflammatory cytokines
  - Dysregulated lipid metabolism
  - Oxidative stress
- **Result:**
  - Chronic inflammation
  - Endothelial dysfunction
  - Metabolic disturbances



Reference: Rochlani, Y.M., Pothineni, N.V., Kovelamudi, S., & Mehta, J.L. (2017). Metabolic syndrome: pathophysiology, management, and modulation by natural compounds. *Therapeutic Advances in Cardiovascular Disease, 11*, 215 - 225.

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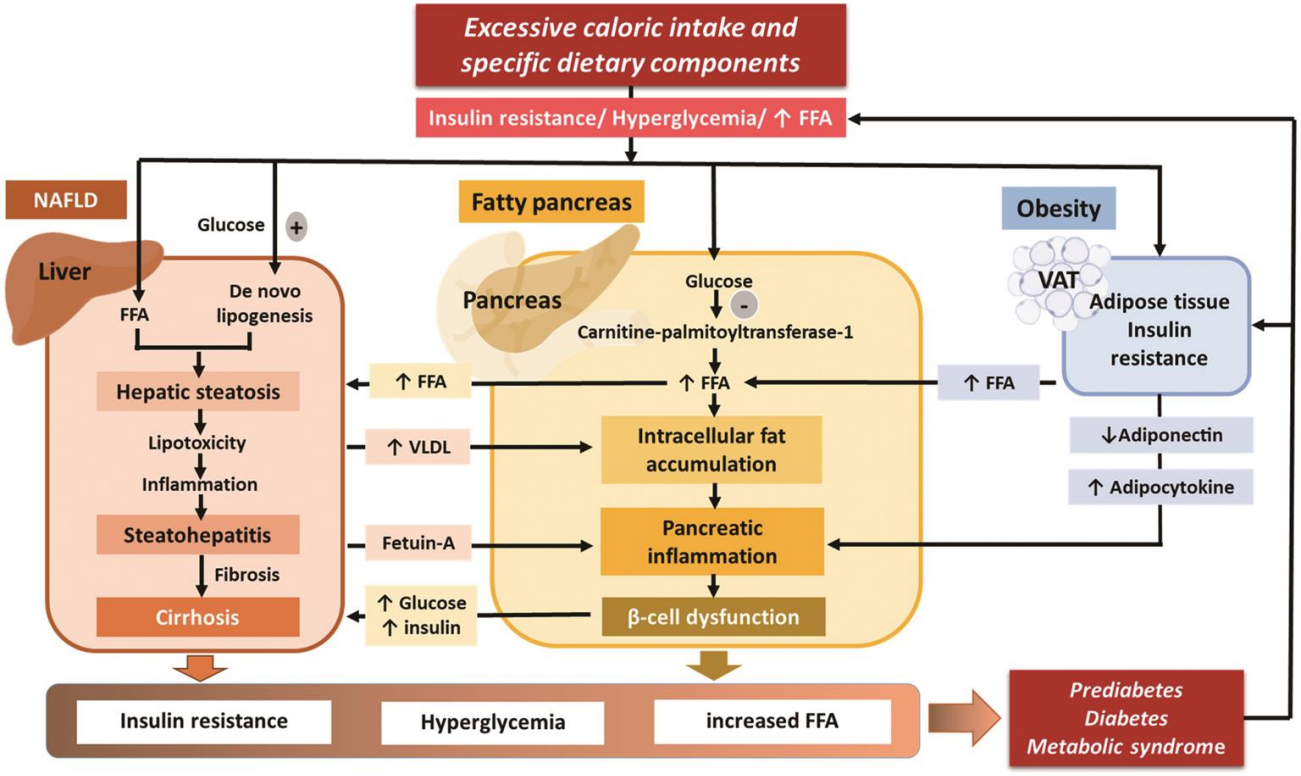
Pathophysiology of MetS



Reference: Rugivarodom M, Geeratragool T, Pausawasdi N, Charatcharoenwitthaya P. Fatty Pancreas: Linking Pancreas Pathophysiology to Nonalcoholic Fatty Liver Disease. *J Clin Transl Hepatol*. 2022;10(6):1229-1239. doi: 10.14218/JCTH.2022.00085.

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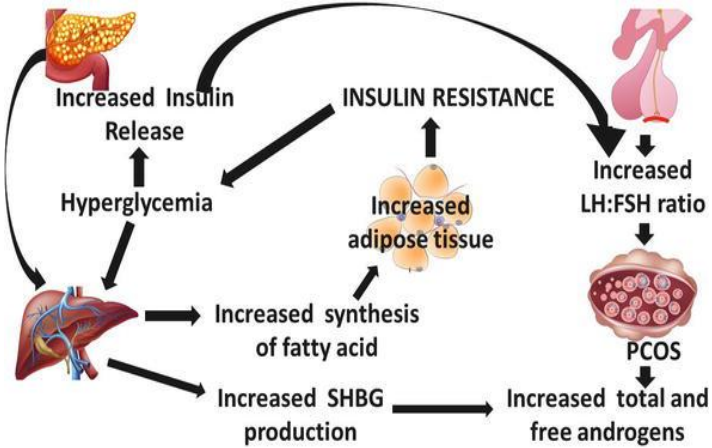
Identifying Patients at Risk for MetS

- MetS criteria (AHA/NHLBI or IDF)
- H/o symptoms of OSA
- H/o PCOS in premenopausal women
- Family H/o CVD and DM
- Blood pressure and waist circumference
- Laboratory investigations:
  - Fasting lipid profile and fasting glucose
  - hs-CRP, fibrinogen, uric acid, urinary microalbumin
  - LFT for NAFLD
  - Sleep study for OSA
  - Testosterone, FSH, LH for PCOS



Reference: Manu, Thomson Soni, Victoria and Pranav Kumar Prabhakar. *Pathophysiology of Polycystic Ovarian Syndrome.* Published: 07 January 2022. DOI: 10.5772/intechopen.101921

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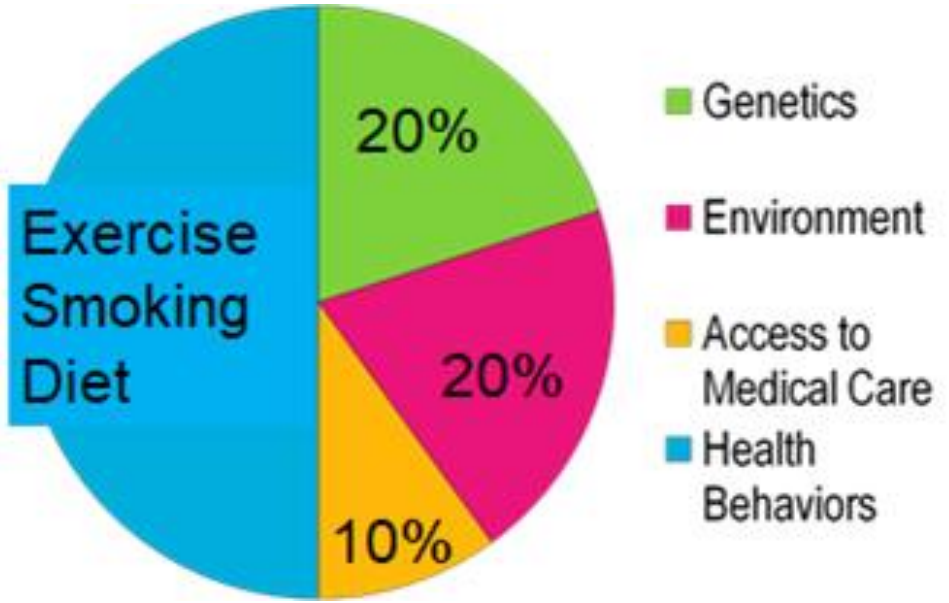
Contributors to Overall Health



Kaiser Family Foundation, 2015 (CDC)

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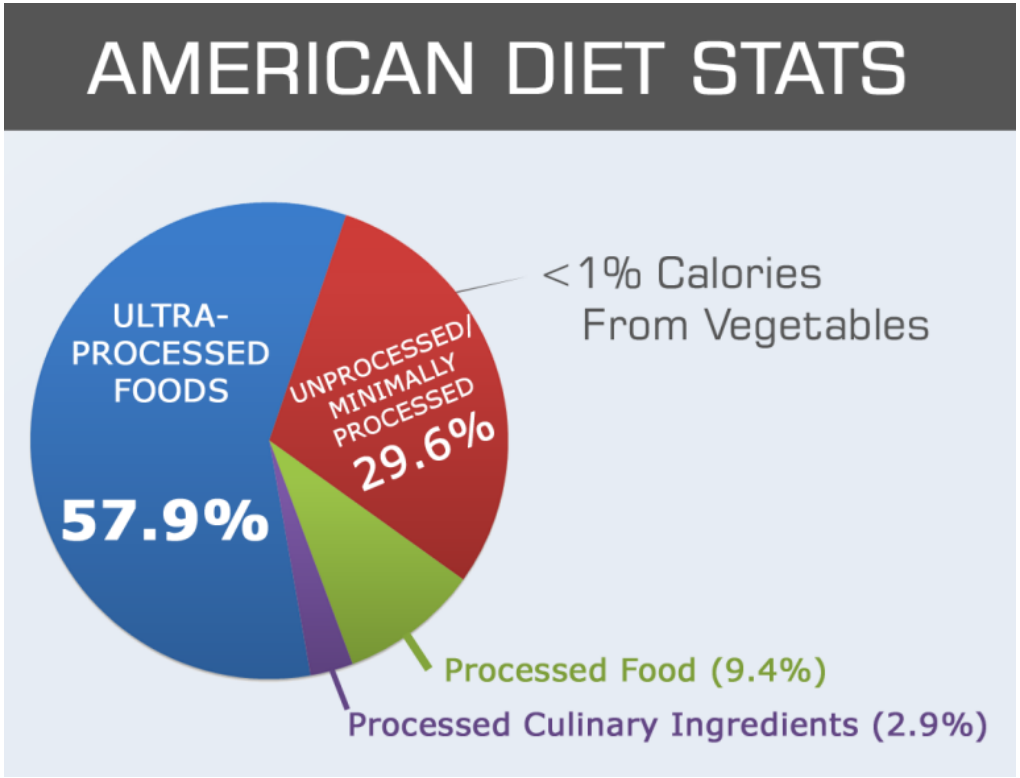
Role of Dietary Habits on MetS



Reference: Martínez Steele E, Baraldi LG, Louzada MLDC, *et al*Ultra-processed foods and added sugars in the US diet: evidence from a nationally representative cross-sectional study. *BMJ Open* 2016;**6:**e009892. doi: 10.1136/bmjopen-2015-009892

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Role of Dietary Habits on MetS - NOVA

NOVA Food classification

Unprocessed or minimally processed foods	Processed culinary ingredients	Processed foods	Ultra-processed foods
Foods which did not undergo processing or underwent minimal processing technics, such as fractioning, grinding, pasteurization and others.	These are obtained from minimally processed foods and used to season, cook and create culinary dishes.	These are unprocessed or minimally processed foods or culinary dishes which have been added processed culinary ingredients. They are necessarily industrialized.	These are food products derived from foods or parts of foods, being added cosmetic food additives not used in culinary.
			
Legumes, vegetables, fruits, starchy roots and tubers, grains, nuts, beef, eggs, chicken, milk	Salt, sugar, vegetable oils, butter and other fats.	Bottled vegetables or meat in salt solution, fruits in syrup or candied, bread, cheeses, purees or pastes.	Breast milk substitutes, infant formulas, cookies, ice cream, shakes, ready-to-eat meals, soft drinks and other sugary drinks, hamburgers, nuggets.

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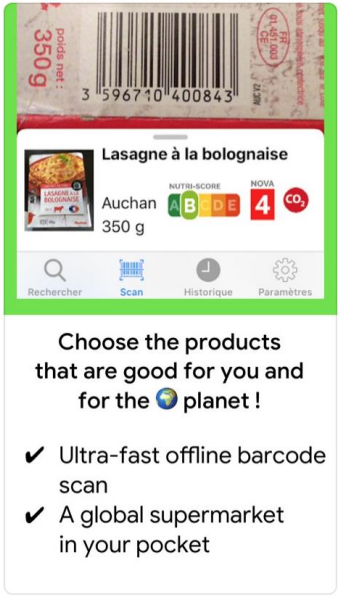
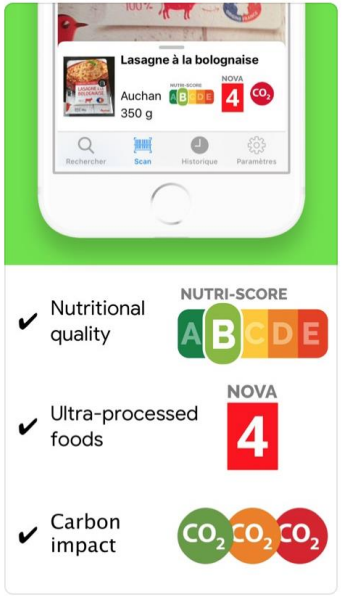
Practical Applications of Open Food Facts App





Scan this QR code from your mobile to download the app!

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Role of Dietary Habits on MetS

Ultraprocessed Foods Consumption and Increased Risk of Metabolic Syndrome in Adults – the ELSA-Brasil

Ultraprocessed foods (UPFs) are formulations of ingredients that result from a series of industrial processes.

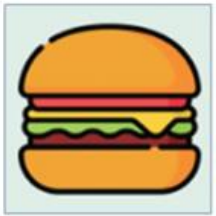
In a prospective **cohort study** of 8,065 participants from ELSA-Brasil, we aimed to investigate the association between UPFs consumption and the incidence of MetS.

The **increased risk** of MetS associated with UPFs may impact the development of many chronic diseases.

Findings contribute to the planning of nutritional counseling when preventive measures are possible and desirable.

- UPFs increases the risk of chronic diseases such as cancer, CVD, and diabetes.
- **Metabolic syndrome** (MetS) precedes and contributes to such chronic diseases.

We found that:
For every **150 g/day increments**
→ Mets risk increased by **7%**
Comparing **> 552 vs. < 234 g/day**
→ Risk increased by **33%**



Reference: Scheine Leite Canhada, Álvaro Vigo, Vivian Cristine Luft, Renata Bertazzi Levy, Sheila Maria Alvim Matos, Maria del Carmen Molina, Luana Giatti, Sandhi Barreto, Bruce Bartholow Duncan, Maria Inês Schmidt; Ultra-Processed Food Consumption and Increased Risk of Metabolic Syndrome in Adults: The ELSA-Brasil. *Diabetes Care* 1 February 2023; 46 (2): 369–376. https://doi.org/10.2337/dc22-1505

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Dietary Approaches to Managing MetS

Table 1. Dietary strategies and potential health benefits for Metabolic Syndrome (MetS).

Dietary Pattern	Nutritional Distribution	Improvements in MetS Criteria
Mediterranean diet	▪ 35–45% kcal/d from total fat (mainly MUFA [1], EVOO and nuts being the principal source) ▪ 35–45% kcal/d from CH ▪ 15–18% kcal/d from protein	Reduction of CVD incidence and outcomes Decreased BP (systolic and diastolic) Inverse association with mortality Improvements in dyslipemia Decreased incidence of T2DM
DASH diet	▪ Total fats 27% kcal/d ▪ Saturated fats 6% kcal/d ▪ Dietary cholesterol ▪ CH 55% kcal/d ▪ Proteins 18% kcal/d	Reduction of BP (systolic and diastolic) Reduction in BMI and waist circumference Improvement in cardiometabolic profile Reduction in T2DM incidence
Plant-based diets	▪ Reduction or restriction of animal-derived foods ▪ High intake of plant-source foods ▪ Fat profile rich in UFAs	Reduction of BP (systolic and diastolic) Decreased body weight and risk of obesity Reduction of the risk of CVD Decreased all-cause mortality Decreased risk of T2DM
Low CH diets and very low CH diets (ketogenic diets)	▪ <50% kcal/d from carbohydrates and <10% kcal/d from CH in ketogenic diets ▪ High protein (20–30% kcal/d) ▪ High fat intake (30–70% kcal/d)	Weight-loss and weight-loss maintenance Reduction of DBP Reduction of LDL-c and triglycerides levels Increase of HDL-c levels Improvements in insulin resistance Reduction of HbA1c levels

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Dietary Approaches to Managing MetS

Table 1. Dietary strategies and potential health benefits for Metabolic Syndrome (MetS).

Dietary Pattern		Nutritional Distribution	Improvements in MetS Criteria
	Nordic diet	▪ High content of whole-grain high-fibre products ▪ Low in meat and processed foods	Reduction of BP (systolic and diastolic) Increase of HDL-c levels
Other dietary patterns and strategies	Intermittent fasting	▪ Fasting for a long period of time	Weight loss Improvements in insulin resistance Improvements in dyslipidaemia Reduction of BP (systolic and diastolic) Decreased risk of T2DM Decreased risk of CVD
	Low-fat diet	▪ <30% kcal/d from total fat (<10% of saturated fat) ▪ 15–17% kcal/d from protein ▪ 50–60% kcal/d from CH	Reduction of BP (systolic and diastolic) Short-term improvement of cholesterol profile Short-term weight loss Reduced risk of all-cause mortality
	High protein diet	▪ High protein (20–30% kcal/d) or 1.34–1.50 g/Kg body weight/d from protein ▪ Low CH (40–50% kcal/d)	Reduction of triglycerides levels

Reference: Castro-Barquero S, Ruiz-León AM, Sierra-Pérez M, Estruch R, Casas R. Dietary Strategies for Metabolic Syndrome: A Comprehensive Review. Nutrients. 2020 Sep 29;12(10):2983. doi: 10.3390/nu12102983. PMID: 33003472; PMCID: PMC7600579.

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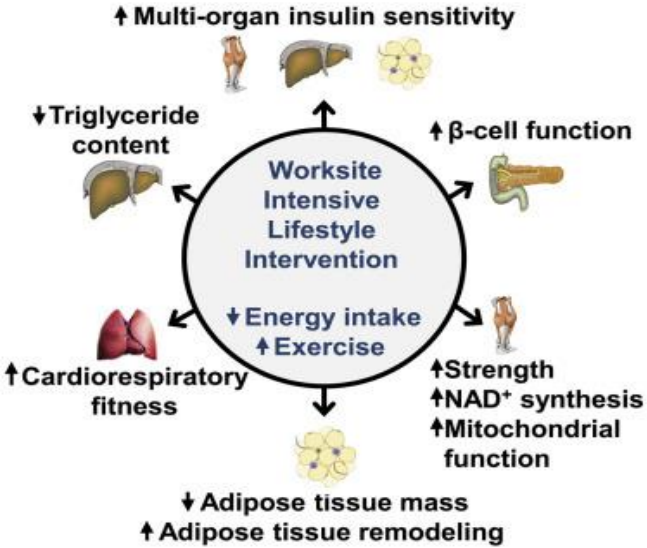
Role of Lifestyle interventions on MetS

- **Multifaceted lifestyle intervention programs:**
  - ↓ MetS
  - ↓WC, SPB, DBP, TRY & FBG
  - ↑ Physical activity & fitness
  - ↑ Dietary behaviors&
  - ↑ Quality of Life

- **Workplace intervention programs:**
  - ↓ MetS, WC, BMI, Lipids & FBG
  - ↑ Physical activity & fitness
  - ↑Quality of Life & mood
  - ↑Job attendance & satisfaction
  - ↓Job stress & employee absenteeism



References: Van Namen et al., 2019, Tojansen et al., 2017, Saboya et al. 2016, Orchard et al., 2005, Tan et al., 2017, Namen et al., 2019, (Ryu et al., 2017, Myers et al., 2019, Conn et al., 2007, & Conn et al., 2009

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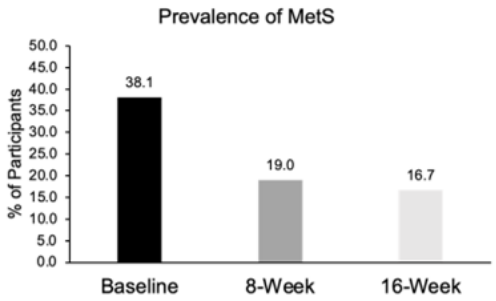
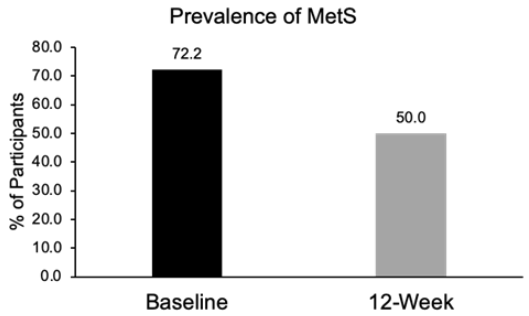
Workplace Intervention Programs at Elon

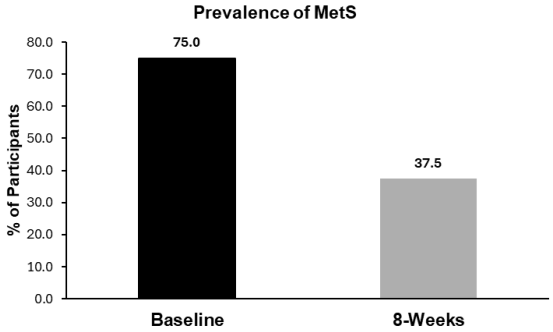
HEY I - 16 wk program



HEY II - 12 wk program



ThriveWell - 8 wk program



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Role of Physical Activity on MetS - Theoretical Framework

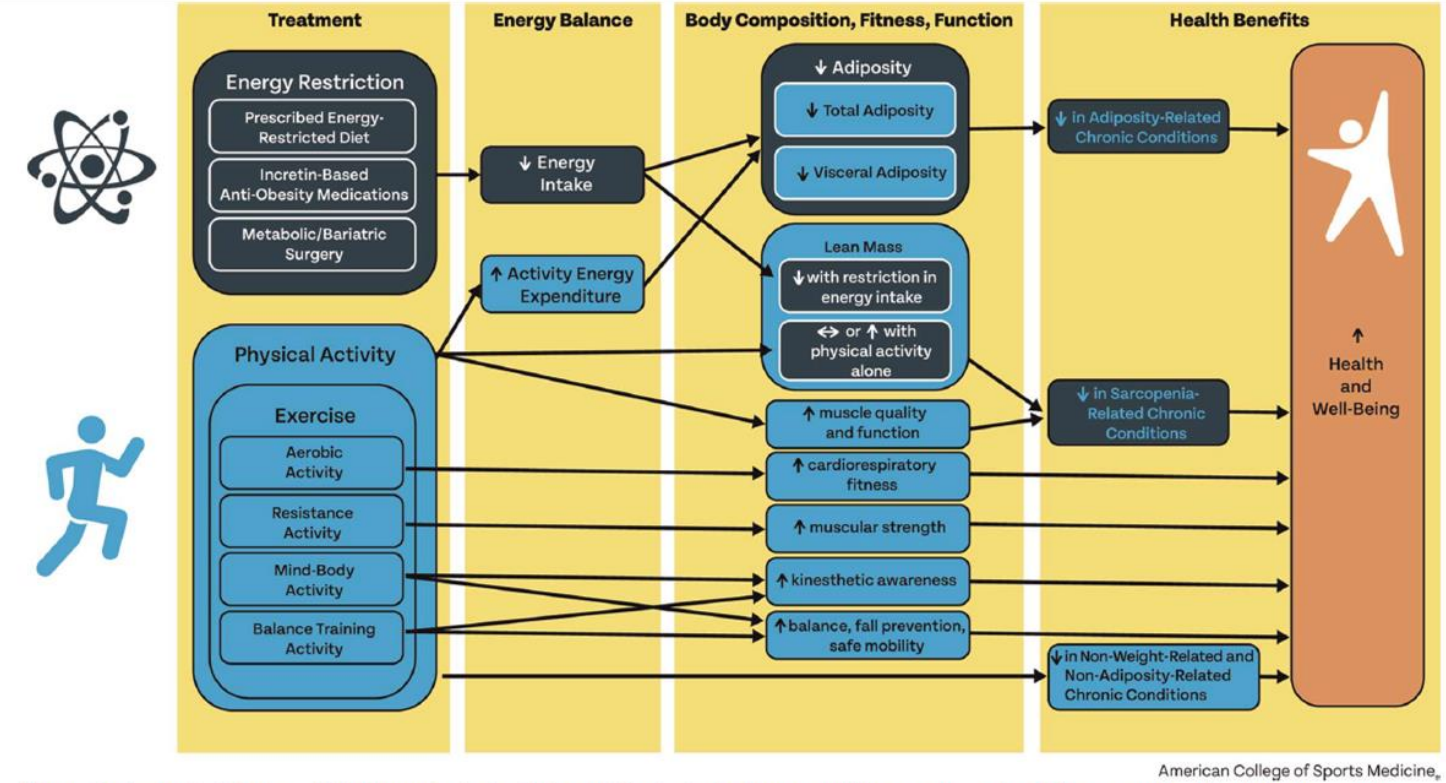

Figure 1: Theoretical framework for how physical activity contributes to body composition, components of fitness, and health within approaches targeting body weight regulation.

Reference: Jakicic JM, Apovian CM, Barr-Anderson DJ, Courcoulas AP, Donnelly JE, Ekkekakis P, Hopkins M, Lambert EV, Napolitano MA, Volpe SL. Physical Activity and Excess Body Weight and Adiposity for Adults. American College of Sports Medicine Consensus Statement. Med Sci Sports Exerc. 2024 Oct 1;56(10):2076-2091. doi: 10.1249/MSS.0000000000003520.

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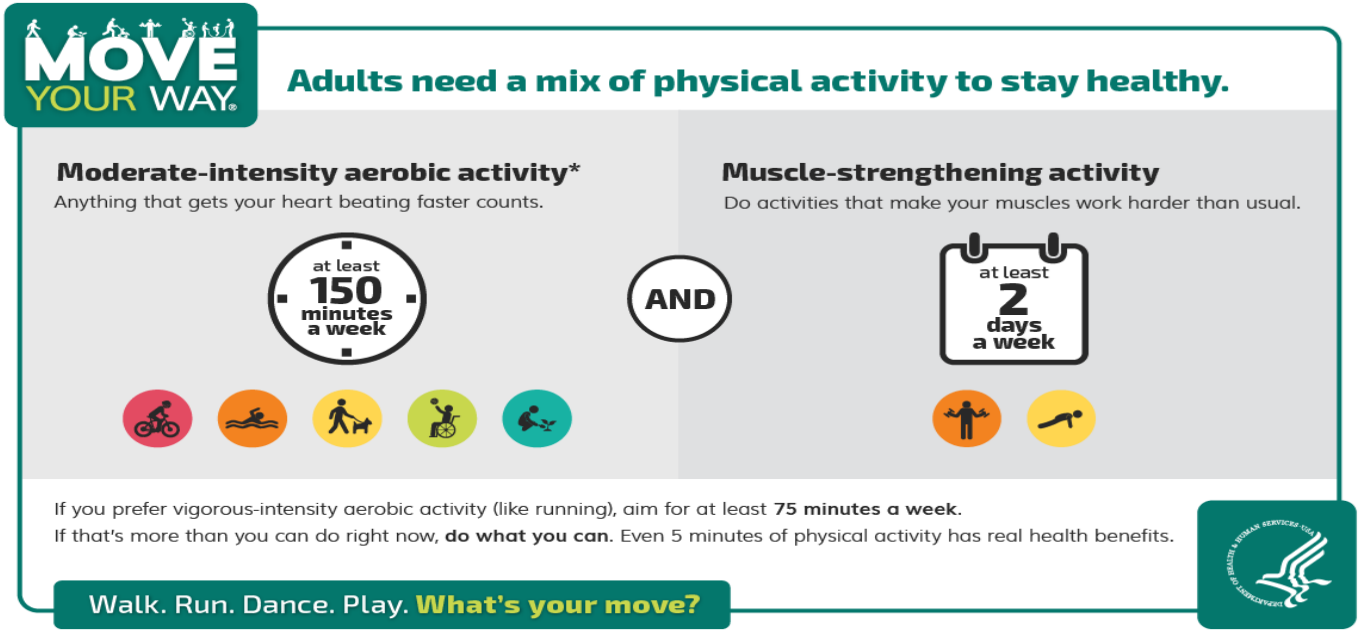
Role of Physical Activity on MetS - The National PA Guidelines



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Role of Physical Activity on MetS

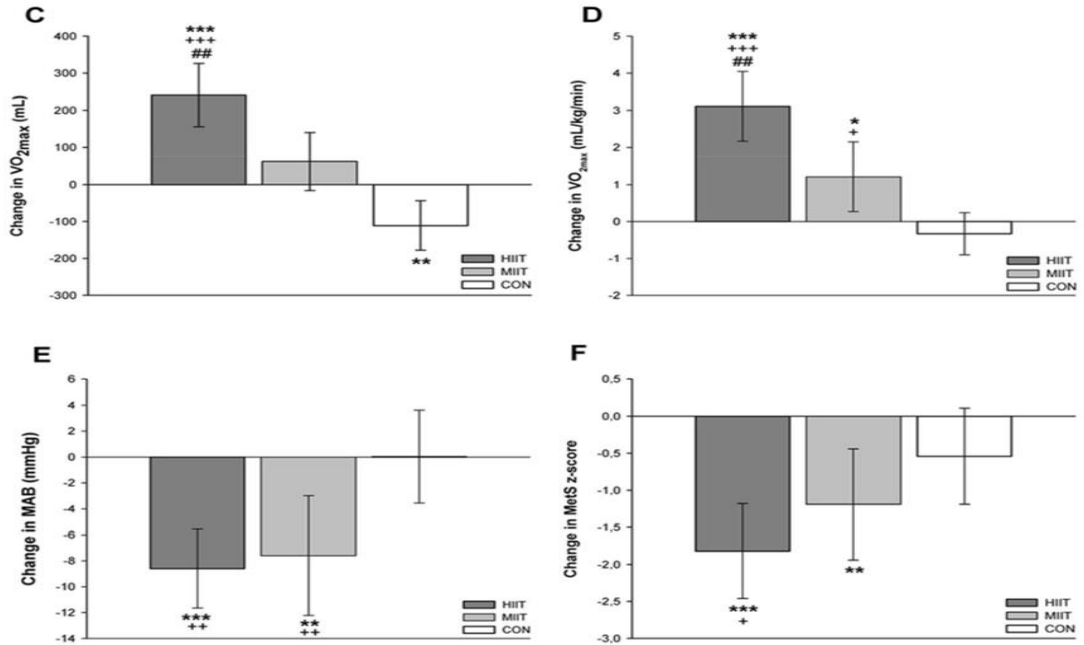

Figure 2. Changes in body weight **(A)**, waist circumference **(B)**, absolute maximal oxygen uptake **(C)**, relative maximal oxygen uptake **(D)**, mean arterial blood pressure **(E)**, and metabolic syndrome z-score **(F)**. HIIT, high-intensity interval training group; MIIT, moderate-intensity interval training group; CON, control group; VO_{2max}, maximal oxygen uptake; MAB, mean arterial blood pressure; MetS, metabolic syndrome. $^{*}(p<0.05)$, $^{**}(p<0.01)$, $^{***}(p<0.001)$, significantly different from pre-intervention. $^{+}(p<0.05)$, $^{++}(p<0.01)$, $^{+++}(p<0.001)$, significant difference vs. CON; $^{\#\#}(p<0.01)$, significant difference vs. MIIT.

Effects of very low volume high intensity versus moderate intensity interval training in obese metabolic syndrome patients: a randomized controlled study

Reference: Reljic, D., Frenk, F., Herrmann, H.J. *et al.* *Sci Rep* 11, 2836 (2021). https://doi.org/10.1038/s41598-021-82372-4

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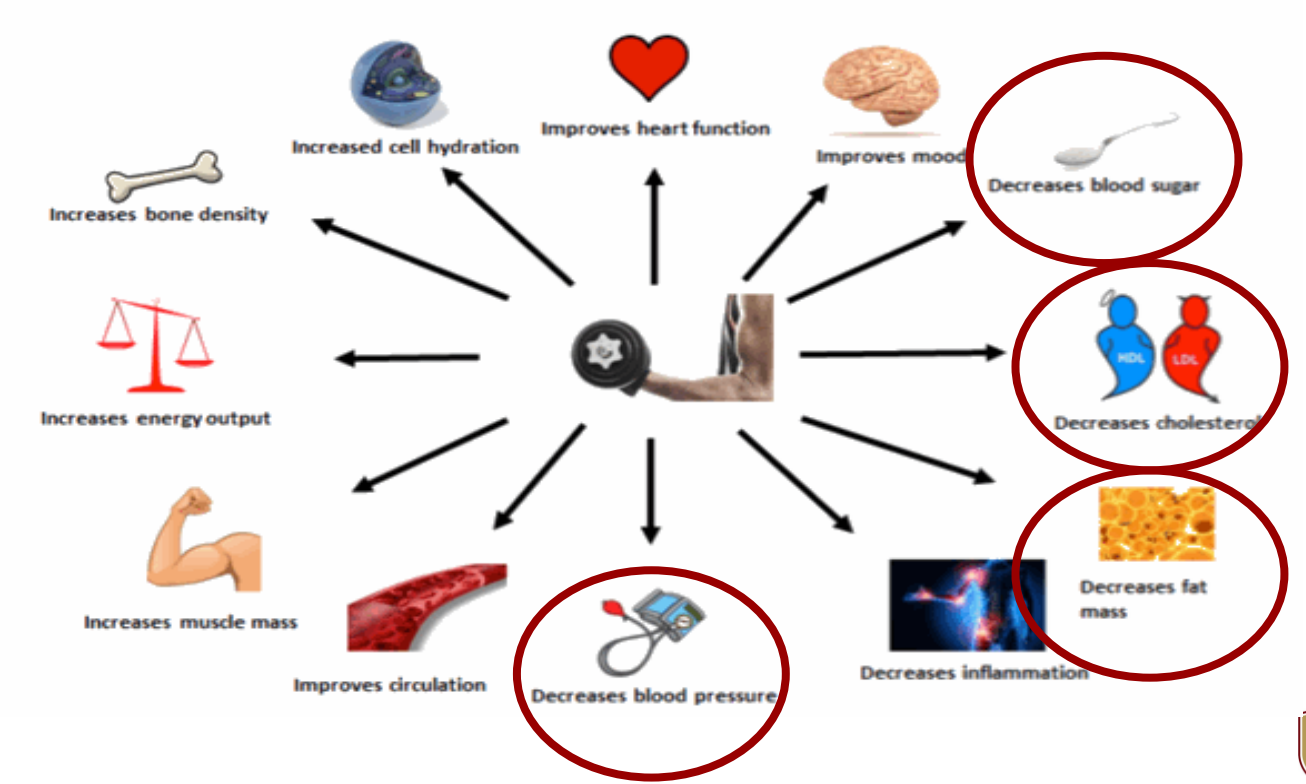
Role of Physical Activity on MetS



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Role of Physical Activity on MetS

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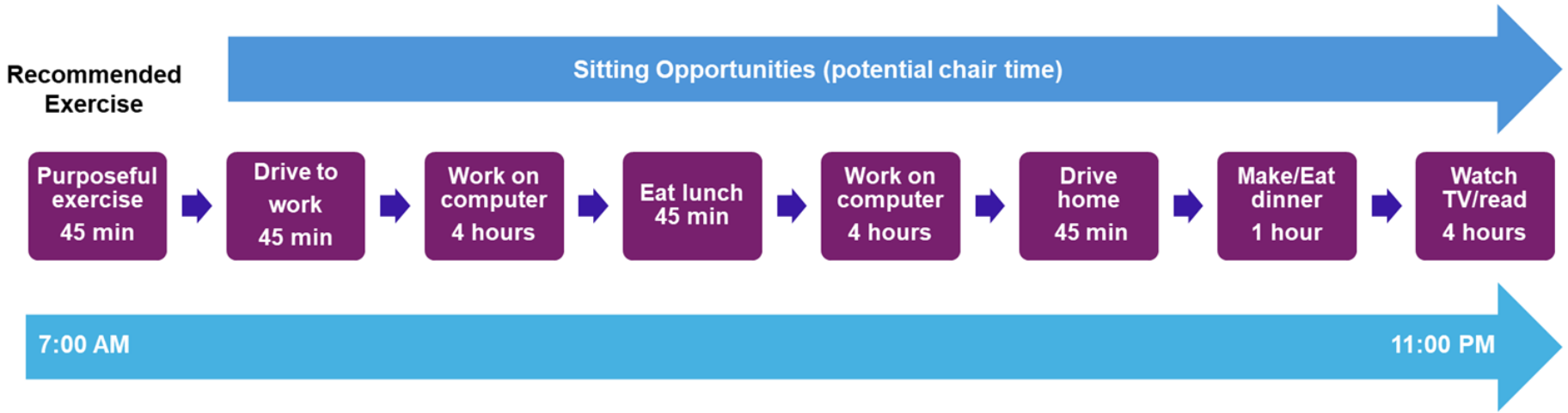
Are you an Exercising Couch Potato?



Reference: Hamilton MT, Healy GN, Dunstan DW, Zderic TW, Owen N. Too Little Exercise and Too Much Sitting: Inactivity Physiology and the Need for New Recommendations on Sedentary Behavior. Curr Cardiovasc Risk Rep. 2008 Jul;2(4):292-298. doi: 10.1007/s12170-008-0054-8. PMID: 22905272; PMCID: PMC3419586.

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24-Hour Activity Cycle (24-HAC)

Reference: Keeping Seniors Active - A 24 Hour Approach - Stanford Center on Longevity

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Practical Applications of 24-HAC Tracking

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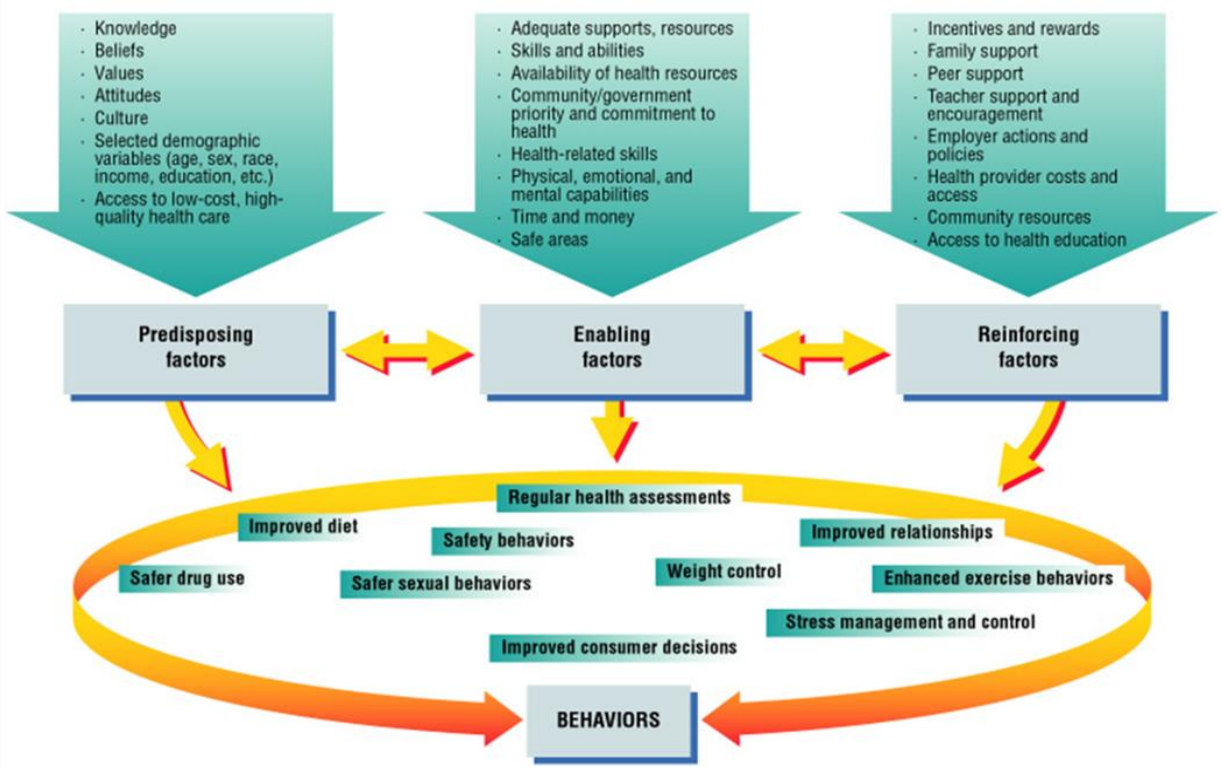
Factors Impacting Behavior Change



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Collaborative Care Approach

- **Interdisciplinary communication**
- **Tailored interventions**
- **Patient education**
- **Exercise**
- **Lifestyle modification**
- **Mental health support**

Each **healthcare provider brings expertise** that, when combined, maximizes the patient's potential for **long-term success in managing MetS**

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Motivational Interviewing (MI)

- **Motivational Interviewing (MI)** is a collaborative form of communication, designed to empower people to change by helping them to focus on their values and individual capacity for change.
    - **Reference:** Bischof G, Bischof A, Rumpf HJ (2021): Motivational interviewing—an evidence-based approach for use in medical practice. *Dtsch Arztebl Int*; 118: 109–15. DOI: 10.3238/arztebl.m2021.00

- In a recent review, **MI was found to be effective** for **increasing motivation** for behavioral change in patients with various behaviorally influenced health issues and for **promoting adherence to treatment.**
    - **Reference:** Bischof G, Bischof A, Rumpf HJ (2021): Motivational interviewing—an evidence-based approach for use in medical practice. *Dtsch Arztebl Int*; 118: 109–15. DOI: 10.3238/arztebl.m2021.0014

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Practical Applications of MI

Open-Ended Questions	Reflective Listening	Affirmations	Eliciting Change Talk
• "What are your thoughts on how your eating habits are affecting your health?"	• "It sounds like you're worried about how hard it might be to change your diet."	• "It sounds like you've already prioritized cutting back on sugary drinks."	• "What would be some of the benefits of losing weight or improving your blood sugar levels?"

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Goal-Setting Strategies (SMART)

Goals should align with patients lifestyle, preferences, and readiness for change

"I will walk for 30 minutes at an intensity where I can talk but not sing after dinner on Monday, Wednesday, Friday for the next three months"

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Now it’s Your Turn to Practice

Scenario: You are a healthcare professional meeting with a patient, Alex, who has been recently diagnosed with metabolic syndrome. Alex is overweight, has high blood pressure, and high blood sugar levels. They have expressed concern about their health but feel overwhelmed by the thought of making significant lifestyle changes. Alex enjoys eating fast food and has a sedentary lifestyle but has started to notice fatigue and discomfort in daily activities.

Objective is to use motivational interviewing techniques to:

1. Understand Alex’s ambivalence or resistance to change
2. Help explore motivations for improving their health
3. Help explore challenges and strengths
4. Collaboratively set **SMART goals** related to diet and physical activity

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Group Discussion & Debrief

- What strategies helped **build rapport** and trust with the patient?
- How did you assess and address the patient's **readiness for change**?
- What was effective in eliciting **change talk and motivating** the patient?
- How did you integrate **challenges, past successes or strengths** into the conversation?
- In what way did you organize **SMART goals?**

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THANK YOU!