

The Science of Gendered Nutrition: Differences in Metabolism and Hormones

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ABSTRACT

It is yet unclear how gender affects how the body reacts to lifestyle changes. The purpose of this research was to assess how a six-month Mediterranean diet (MD) intervention coupled with consistent exercise affected the metabolic parameters of persons who were overweight. An significant socioeconomic burden has resulted from the ageing population and the rise of age-related chronic illness. Because it shortens life expectancy and increases the risk of chronic disease, the slow and steady age-related decline in the production of hormones and action has a negative effect on human health. Here, we go over how the production of hormones decreases with age, as well as how changes in body composition and biochemistry with ageing cause some hormones to become less accessible and effective. For females to maintain hormonal balance, diet plays a crucial role in ovulation, menstrual periods, and fertility. Additionally, nutritional consumption has a major role in promoting healthy male reproductive function and maintaining hormonal balance. The active role of nutrients and their metabolites in controlling gene expression and cellular function has been shown by recent developments in high volumes analysis, which have also helped to improve our understanding of metabolism. In addition to being sources of energy and the building blocks of cells, nutrients and their metabolites also act as powerful signalling molecules, direct facilitators of protein function, and triggers and regulators of gene expression. By directly impacting the actions of transcription factors and by regulating modifications in epigenetic markers within the genome, a large number of them participate to the control of gene expression.

Keywords: Hormones; Chronic Illness; Mediterranean Diet; Ovulation; Fertility

Introduction

Addressing sex and gender differences has been a major concern in recent years in several medical fields, including metabolic illnesses [1]. While sex dimorphism is based on fundamental genetic differences that impact male and female physiological or pathological processes differently, gender is primarily related to people's socially constructed identities. The fundamental mechanisms, which are not fully understood, include sex chromosomes, sex steroid hormones, epigenetic modifications, and sex specificities in fetal/neonatal programming. Recent guidelines, which steer clear of the typical male when using these techniques, call for preclinical (cellular and animal models) to clinical research efforts to take these sex differences into

consideration [2]. It is widely acknowledged that the Mediterranean diet (MD) enhances metabolic health and weight control. In addition to a small amount of fish and poultry, it promotes eating more plant-based foods such as fruits, vegetables, whole grains, and legumes. Numerous studies [1,2] have demonstrated the benefits of exercise and MD on lipid profiles, glycaemic control, and body composition. Despite the latest advancements, there are still many unanswered questions about how these drugs impact different genders. Previous studies occasionally neglect to stratify data by gender, leaving out physiological and hormonal factors that may influence metabolic outcomes. Additionally, little is known about the interactions and effects of dietary modifications and different types of physical activity on these behaviours [3].

Hormonal factors are the main reason why nutritional research is beginning to recognize that men and women's metabolic responses to dietary interventions differ. For instance, oestrogen is important for women's lipid regulation, frequently leading to higher HDL-C levels and a favourable fat distribution pattern after dietary changes [4], but men tend to respond with greater reductions in LDL-C levels due to variations in genes, such as hormone-sensitive lipase polymorphisms which demonstrate sex-specific associations with lipid and levels of glucose [5]. These genetic variations give to varying weaknesses to metabolic disorders, which highlights the need for gender-specific dietary regimens [6]. The overall lipid-lowering effects may not be as strong for women as for men, despite the fact that they may gain more from better control of their glucose and HDL-C levels [7]. Furthermore, lifestyle modifications frequently have a gender-specific impact on liver enzyme levels, indicating that liver health is also impacted by these metabolic differences (Niemi, et al. 2016). After dietary changes, men frequently show larger decreases in liver enzymes like aspartate aminotransferase (AST) and alanine aminotransferase (ALT).

Nutritional Impact on Hormonal Regulation

Males and females who are overweight or obese are at increased risk for both increased ROS generation and disrupted hormonal regulation. Low-grade systemic inflammation resulting from imbalanced eating patterns can have a substantial effect on endocrine homeostasis. Nutrition plays an important role in the hormonal balance of both sexes, with dietary practices significantly affecting reproductive and endocrine health. Ovulation, menstrual cycles, and fertility are all impacted by nutrition, which is essential for preserving hormonal balance in females [8-10]. Maintaining hormonal balance and encouraging healthy male reproductive function also depend heavily on dietary intake. Cutting calories and losing weight. Calorie restriction (CR) is widely regarded as an effective weight loss method. The extent of this restriction varies, ranging from a 25% reduction in caloric intake to a very-low-calorie diet (VLCD) with an absolute consumption of 400–800 kcal/day. Numerous *in vivo* and human studies suggest that CR may improve hormonal balance in overweight and obese people. According to a meta-analysis, fat loss in overweight and obese individuals undergoing CR was found to be sex- and age-specific: older individuals (over 45) showed less of a difference in fat loss in comparison to their male counterparts, while younger females (less than 45) showed resistance to fat loss [11].

Relationship between Nutrition, Hormonal Equilibrium and Reproductive Health

Diets high in energy, fat, and protein, as well as those with a high glycaemic index, have been linked to unbalanced micronutrient materials involved in hormonal stimulation, leading to premature adolescence [12]. Several pathogenic mechanisms have been suggested to

explain this early activation, including the activation of GnRH through hypothalamic inflammation and microglial cell activation, dietary signals influencing the hypothalamus, changes in gut microbiota affecting hormone secretion, and over expression of transcription factors. Dietary habits and nutritional imbalances may cause problems with the reproductive system's normal growth and functioning, affecting the regularity of ovulation and the quality of oocytes released throughout the menstrual cycle. A diet high in vegetables and fruit, fish and shellfish, cereals, and low-fat dairy items is positively linked to ovulation quality [2].

Conversely, it appears that diets high in processed meats, soy, potatoes, full-fat dairy goods, sugary drinks, and sweets have a negative impact on reproductive and endocrine health [2,13]. The reproductive system is particularly affected by obesity, as obese women and adolescents are more likely to experience infertility, anovulation, PCOS, menstrual disorder, and subfecundity [14,15]. Hormonal imbalances resulting from female obesity impair reproductive control by upsetting the HPG axis [14]. Overnutrition-related oxidative stress and chronic inflammation can also have a detrimental effect on fertility [16,8]. Also, metabolic diseases linked to obesity, like obesity-related insulin resistance and hyperandrogenism, could impact fertility by disturbing hormonal balance and triggering syndromes like PCOS [14].

Nutrients and their Metabolism: Their Significance for Human Health

Treatment of the related nutrient deficiencies was effective with single nutrient interventions, such as including vitamin D to milk, iron to cereal, and iodine to table salt [17]. However, the same technique has led to different results when used to study got metabolic syndromes that are common in modern societies [18,11]. For example, it does not seem to be possible to lower the risk of cardiovascular diseases by increasing dietary intake of omega-3 polyunsaturated fatty acids and decreasing dietary intakes of saturated fatty acids or cholesterol [14,19,20]. It has long been thought nutrients are food, the source of the fundamental elements required for cell development and division, and the energy source for cellular metabolism. It is clear, therefore, that nutrients and their byproducts also play a part in the instruction, control, and balance of the many cellular functions that keep the body in a state of homeostasis. Additionally to the optimal availability of essential nutrients, context—such as age and sex—determines how well cells perform. Processed foods, which are common in Western diets, may be an important contributor to the rise in acquired metabolic disorders seen in advanced countries [21-28].

References

1. Rich Edwards JW, Kaiser UB, Chen GL, Manson JE, Goldstein JM (2018) Sex and gender differences research design for basic, clinical, and population studies: essentials for investigators. *Endocr Rev* 39(4): 424-439.

2. Lombardo M, Feraco A, Camajani E, Gorini S, Strollo R, et al. (2024) Effects of Different Nutritional Patterns and Physical Activity on Body Composition: A Gender and Age Group Comparative Study. *Foods* 13(4): 529.
3. Mauvais Jarvis F, Arnold AP, Reue K (2017) A guide for the design of pre-clinical studies on sex differences in metabolism. *Cell Metab* 25(6): 1216-1230.
4. Varlamov O, Bethea C, Roberts C (2014) Sex-Specific Differences in Lipid and Glucose Metabolism. *Front Endocrinol* 5: 241.
5. Qi L, Shen H, Larson I, Barnard J R, Schaefer E J, et al. (2004) Genetic Variation at the Hormone-Sensitive Lipase: Gender-Specific Association with Plasma Lipid and Glucose Concentrations. *Clin Genet* 65: 196.
6. Niemelä O, Bloigu A, Bloigu R, Halkola A S, Niemelä M, et al. (2023) Associations Between Liver Enzymes, Lifestyle Risk Factors and Pre-Existing Medical Conditions in a Population-Based Cross-Sectional Sample. *J Clin Med* 12(13): 4276.
7. Pradas F, García Giménez A, Toro Román V, Sánchez Alcaraz B, Ochiană N, et al. (2020) Effect of a Padel Match on Biochemical and Haematological Parameters in Professional Players with Regard to Gender-Related Differences. *Sustainability* 12: 8633.
8. Agarwal A, Aponte Mellado A, Premkumar BJ, Shaman A, Gupta S (2012) The effects of oxidative stress on female reproduction: a review. *Reprod Biol Endocrinol* 10: 49.
9. Zavatta A, Parisi F, Mandò C, Scaccabarozzi C, Savasi VM, et al. (2023) Role of inflammaging on the reproductive function and pregnancy. *Clin Rev Allergy Immunol* 64(2): 145-160.
10. Siri Tarino PW, Sun Q, Hu FB, Krauss RM (2010) Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. *Am J Clin Nutr* 91(3): 535-546.
11. Walford R L, Mock D, Verdery R, MacCallum T (2002) Calorie Restriction in Biosphere 2: Alterations in Physiologic, Hematologic, Hormonal, and Biochemical Parameters in Humans Restricted for a 2-Year Period. *J Gerontol A Biol Sci Med Sci* 57: 211.
12. Turcato E, Zamboni M, De Pergola G, Armellini F, Zivelonghi A, et al. (1997) Interrelationships between Weight Loss, Body Fat Distribution and Sex Hormones in Pre- and Postmenopausal Obese Women. *J Intern Med* 241(5): 363-372.
13. Silvestris E, Lovero D, Palmirotta R (2019) Nutrition and female fertility: an interdependent correlation. *Front Endocrinol* 10: 346.
14. Woo C Y, Jang J E, Lee S E, Koh E H, Lee K U (2019) Mitochondrial Dysfunction in Adipocytes as a Primary Cause of Adipose Tissue Inflammation. *Diabetes Metab J* 43(3): 247-256.
15. Aoun A, Khoury VE, Malakieh R (2021) Can nutrition help in the treatment of infertility? *Prev Nutr Food Sci* 26(2): 109-120.
16. Zain MM, Norman RJ (2008) Impact of obesity on female fertility and fertility treatment. *Women's Health* 4(2): 183-194.
17. Shi H, Clegg D J (2009) Sex Differences in the Regulation of Body Weight. *Physiol Behav* 97(2): 199-204.
18. Taylor R W, Grant A M, Williams S M, Goulding A (2010) Sex Differences in Regional Body Fat Distribution from Pre- to Postpuberty. *Obesity* 18(7): 1410-1416.
19. Westerterp K R, Goran M I (1997) Relationship between Physical Activity Related Energy Expenditure and Body Composition: A Gender Difference. *Int J Obes Relat Metab Disord* 21(3): 184-188.
20. Saris W H (2001) Very-Low-Calorie Diets and Sustained Weight Loss. *Obes Res* 9(Suppl. S4): 295S-301S.
21. Agarwal A, Parekh N, Panner Selvam M K, Henkel R, Shah R, et al. (2019) Male Oxidative Stress Infertility (MOSI): Proposed Terminology and Clinical Practice Guidelines for Management of Idiopathic Male Infertility. *World J Mens Health* 37(3): 296-312.
22. Calcaterra V, Magenes VC, Hruba C, Siccario F, Mari A, et al. (2023) Links between childhood obesity, high-fat diet, and central precocious puberty. *Children* 10(2): 241.
23. Bauman D (2023) Impact of obesity on female puberty and pubertal disorders. *Best Pract Res Clin Obstet Gynaecol* 91: 102400.
24. Miller DD, Welch RM (2013) Food system strategies for preventing micronutrient malnutrition. *Food Policy* 42: 115-128.
25. Desai CK, Huang J, Lokhandwala A, Fernandez A, Riaz IB, et al. (2014) The role of vitamin supplementation in the prevention of cardiovascular disease events. *Clin Cardiol* 37(9): 576-581.
26. Martini LA, Catania AS, Ferreira SR (2010) Role of vitamins and minerals in prevention and management of type 2 diabetes mellitus. *Nutr Rev* 68(6): 341-354.
27. Berger S, Raman G, Vishwanathan R, Jacques PF, Johnson EJ (2015) Dietary cholesterol and cardiovascular disease: a systematic review and meta-analysis. *Am J Clin Nutr* 102(2): 276-294.
28. Siscovick DS, Barringer TA, Fretts AM, Wu JH, Lichtenstein AH, et al. (2017) Omega-3 Polyunsaturated Fatty Acid (Fish Oil) Supplementation and the Prevention of Clinical Cardiovascular Disease: A Science Advisory From the American Heart Association. *Circulation* 135(15): 867-884.

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