Ital J Gender-Specific Med 2017; 3(2): 55-58

Dietary habits and gender differences

Rosaria Varì, Beatrice Scazzocchio, Sara Del Papa

Nutrition Unit, Centre for Gender-Specific Medicine, Istituto Superiore di Sanità, Rome, Italy. *Received 24 May 2017; accepted 11 July 2017.*

Summary. Gender and sex have been recognized as critical factors that significantly influence lifestyles. Gender differences have been reported also for dietary habits, as well as individual response to dietary intake. It is now established that nutrients contained in food can affect regulation of metabolic and epigenetic pathways. Obesity, in particular abdominal adiposity, is one of the major risk factors for non-communicable diseases: women have a greater risk of obesity, but a lower tendency to accumulate visceral fat, conversely in men, the amount of visceral fat constitutes a greater proportion of the total fat mass. A growing body of scientific evidence has been collected, demonstrating significant differences in lipid metabolism between males and females that may partially depend on sexual hormones. Therefore, in an era in which we are moving toward a more personalized medicine, we need to take into account individual gender-specific responses to environmental factors and nutrients.

Abitudini alimentari e differenze di genere

Riassunto. Sesso e genere sono fattori importanti che influenzano in modo significativo gli stili di vita. Differenze di genere sono evidenziabili nelle abitudini alimentari e nella risposta individuale all'assunzione degli alimenti. È ormai accertato che i nutrienti contenuti negli alimenti possono influenzare la regolazione dei pathway metabolici ed epigenetici. L'obesità, con particolare riguardo all'accumulo di grasso viscerale, rappresenta uno dei principali fattori di rischio per le malattie non trasmissibili: le donne hanno un maggiore rischio di obesità, ma una minore tendenza ad accumulare grasso viscerale, viceversa negli uomini il grasso addominale rappresenta una percentuale superiore della massa grassa totale. Dati recenti dimostrano una differenza significativa nel metabolismo dei lipidi tra maschi e femmine che può in parte dipendere dagli ormoni sessuali. Pertanto, in un'epoca in cui si tende a una medicina più personalizzata, è necessario tener conto delle risposte individuali genere-specifiche ai fattori ambientali e agli alimenti.

Introduction

The term 'sex' refers to those aspects that are biologically determined. However, we are born female or male but become girls and boys, and then women and men, after learning and adopting different behaviors. This means that we are strongly influenced by the social context, which ultimately leads to gender identity and gender roles. Hence, unlike sex, gender behaviors are defined by sociocultural expectations, and what may be considered neutral in one culture may be considered a masculine or feminine behavior in another one[1]. In short, 'gender' indicates socially determined characteristics of women and men that depend on psychosocial and cultural factors.

Non-communicable diseases (NCDs): sex- and gender-determinants

A number of epidemiological and clinical studies strongly suggested that chronic non-communicable diseases (NCDs), including cardiovascular diseases, type 2 diabetes, and cancer, are largely associated with four modifiable lifestyle risk factors: tobacco use, poor diet, physical inactivity, and excessive alcohol use. Due to the relevance of these individual behaviors in the prevention, development, and even in the response to treatment of these chronic diseases, they have been reported as "lifestyle-related" NCDs. An unbalanced lifestyle is associated with hypertension, increased blood sugar and cholesterol levels, and other risk factors that are precursors of chronic diseases, e.g. cardiovascular[2,3]. Importantly, the lifestyles at risk are acquired by a progressive process starting early in life and are largely influenced by familiar, economic, educational, and social environment as well as by sex. In fact, the risk of developing NCDs is also heavily influenced by sex/gender-specific environmental conditions that shape individual choices such as different roles played by women and men in modern society[4]. In addition, it should be pointed out that each individual has different nutritional habits and can respond to nutrients in a different way. This can be due to or associated with genetic background, hormonal features and levels, metabolic rates and personal metabolic pathways, and so on[5] (Figure 1).

This field of investigation is thus considered as paradigmatic of the strict intertwining between sex and gender, i.e. between biological and sociocultural factors influencing health and disease. Different social opportunities, economic disadvantage, and different opportunities to

exercise human rights, obviously inhomogeneous worldwide, can powerfully impact, in different ways, women's and men's health. From this point of view, it appears very clear that gender differences must be considered as one of the main determinants of lifestyle, and thus. of population health. For all these reasons, the European Commission pointed out the need to integrate our knowledge on sex-driven response to nutrients with that on gender-related dietary choices. The principal aim is the design of tailored preventive interventions aimed at effectively promoting healthy lifestyles in both genders[6]. For instance, recent published evidence demonstrates that one of the common Y haplotypes in Europe provides a roughly 50% higher risk of coronary artery disease regardless of the traditional cardiovascular disease (CVD) risk factors[7]. A further study suggests that the risk of death in patients with CVD can be lower in men with a high feminine behavioral score than in men with a high masculine behavioral score[8]. On the other hand, recent nutrigenomic studies suggest that females and males respond differently to specific diets at the genetic, molecular, and cellular levels. For example, it has been observed that polyunsaturated fatty acids can modulate the effects of the APOA1 G-A polymorphism on HDL-cholesterol concentrations in a sex-specific manner and that, more in general, gene-nutrient interactions may modulate the risk for some CVD such as metabolic syndrome[9,10]. Therefore, in an era in which we are moving away from generic dietary advice toward a more personalized approach to nutritional advice, there is a great need to establish individual gender-specific responses to environmental factors, nutrients and treatments.

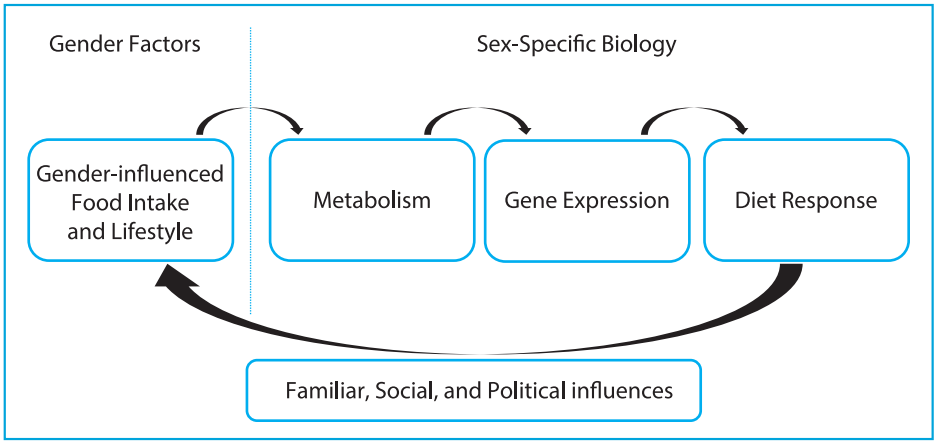

Figure 1. Gendered model for analyzing individual response to dietary intake in metabolic and epigenetic pathways influencing the response to therapeutic interventions .

Fat storage and obesity

One of the major risk factors for NCDs is obesity. This is thus one of the major public health concerns. People are generally considered obese when their body mass index (BMI), a measurement obtained by dividing a person's weight by the square of the person's height, is over 30 kg/m2, with the range 25–30 kg/m2 defined as overweight. Obesity is characterized by a pathologic expansion of adipose tissue, which is due to the storage of excess energy supply as fat. It is associated with chronic low-grade inflammatory status, a hallmark of NCDs[11]. Adipose tissue expansion is critical since it leads to endocrine and metabolic disturbances that are pathogenic for NCDs, e.g. CVD[12,13], as well as for immune dysfunction and chronic inflammation associated with several diseases such as autoimmune diseases[14].

However, the causes of obesity are quite complex. Obesity is most commonly caused by a combination of excessive food intake, lack of physical activity, and genetic susceptibility. A few cases are caused primarily by genes, endocrine disorders, medications, mental illness and a "viral hypothesis" has recently been proposed. The view that obese people eat little yet gain weight due to a slow metabolism is not generally supported. On average, obese people have a greater energy expenditure than their thin counterparts due to the energy required to maintain an increased body mass. The imbalance between energy intake and energy expenditure, as well as the type and the quality of foods consumed, are known to be causal factors for obesity. Consequently, poor quality of the diet and unhealthy dietary practices together with insufficient physical activity may be considered as useful predictive tools for obesity especially in childhood[15]. In this scenario, the role of gender disparity has to be taken into account. The real cause of gender disparity highlighted by WHO is far from being understood. It should be pointed out that relevant differences in the prevalence of obesity exist when age and geographical, social, and economic conditions are considered[16]. Some hypotheses have been formulated: a study carried out in an informal urban settlement in South Africa[17], suggested two factors that were associated with obesity in women, but not in men, to explain gender difference in obesity rates; the first one being nutritionally deprived as children, because it is quite common for boys, as babies and infants, to receive better care and nourishment than girls who can frequently experience hunger; and the second one having a higher

socio-economic status, as in some cultural environments wealth is associated with chubbiness. In Italy, the Italian Behavioral Risk Factor Surveillance System – PASSI (Progressi delle Aziende Sanitarie per la Salute in Italia) has reported that the consumption of vegetables and fruit as well as the level of physical activity, which are main determinants of obesity and overweight onset, show significant differences between males and females[18,19]. In addition they are greatly influenced by socio-economic factors, being inversely correlated with salaries and level of education[18,20].

Although the exact mechanisms regulating the different metabolic behavior are not completely understood, it is a fact that men and women are shaped differently, with men showing an upper body distribution of fat (apple shape), while in women it is mainly distributed in the lower body (pear shape). This difference in fat depot distribution is of particular interest from a clinical point of view, since obesity-linked metabolic diseases such as T2D, metabolic syndrome, CVD, and cancer as well, associate mainly with the visceral / android distribution of fat[21]. Women tolerate higher levels of body fat thanks to a lower amount of abdominal fat. However, they are at greater risk of obesity due to their increased propensity to gain fat. In fact, the global prevalence of obesity is higher in women than in men in all continents[16]. Conversely, in men, the amount of visceral fat constitutes a greater proportion of the total fat mass than in women, especially at elevated BMIs. Importantly, a growing body of evidence has been collected, clearly demonstrating significant differences in lipid metabolism between males and females that may partially depend on sexual hormones[22].

Dietary habits and gender

Most of the studies aimed at evaluating dietary habits have been carried out in US and Europe, and the collected data cannot be extended to other countries that are geographically and culturally very different from the Western ones. It is a matter of great concern that unhealthy behaviors such as not consuming the recommended daily five or more servings of fruit and vegetables, consuming little milk and dairy products, skipping meals and frequently eating energy- dense, nutrient-poor fast foods and ready-to-eat foods, have been found to be common especially among young adults[23,24]. However, gender differences have been reported for dietary intakes and eating behaviors[25]. Women consume more fruit and vegetables, legumes, and whole foods, but they also consume more sweets and cakes. Men tend to have more fat and protein rich foods and to drink more wine, beer, spirits, and sweet carbonated drinks. In general, they show dietary behaviors potentially favoring overweight and obesity. A recent study carried out among college students in US evidenced a significant gender difference in weight status (with the percentage of overweight/obese males being more than double that of females), mirroring significant differences in the diet consumed[26]. Furthermore, these data also provide interesting evidence on the influence of high socio-economic and cultural levels, such as that of US universities, on food choices that might be influenced by cultural and advertising pressures promoting, for example, thinness as a criterion for beauty. Data collected in Italy among adult subjects show that a higher percentage of women than men consume daily the recommended five portions of fruit and vegetables. Motivation to adopt healthy eating is also recognized as an important factor in the regulation of dietary intakes and eating behaviors[27]. In this regard, an Italian study reported that among type 2 diabetes patients, females seemed to be more willing to follow dietary advice than men. Actually, women appear to be especially aware of the role played by nutrition on human health and thus more ready to adopt a healthier diet; moreover, women are particularly worried about their body image, with which they are generally unsatisfied[28]. Nevertheless, women have been demonstrated to give up and abandon the new dietary plan more frequently than men. A possible explanation is that the good results obtained by moving towards more healthy dietary habits are much more pronounced in men than in women who might therefore be easily discouraged. Finally, it should be considered that a number of gender-based stereotypes about food exist in every human culture. In extreme synthesis, meat rich in fat and protein is food for men, whereas a little mixed salad is food for women. Although the causes for this are far from being fully elucidated, the consequence on food choice and dietary habits might be considerable, because both men and women tend to adhere to those expectations most likely for reinforcing their gender identity[29,30].

Conclusions

Gender and sex have been recognized as critical factors that significantly influence lifestyles and habits, and vice-versa. This complex interplay can have a strong impact on the onset and course of chronic diseases. For instance, dietary habits as well as individual response of women and men to dietary intake are key regulators of metabolic and epigenetic pathways, also influencing response to therapeutic interventions. Thus, an integrated approach that puts together all the existing variables identifiable in the two sexes appears to be mandatory in order to improve medical intervention and practice.

References

1. Mahalik JR, Locke BD, Ludlow LH, et al. Development of the conformity to masculine norms inventory. Psychol Men Masc 2003; 3: 25.
2. Mastrangelo A, Barbas C. Chronic diseases and lifestyle biomarkers identification by metabolomics. Adv Exp Med Biol 2017; 965: 235-63. doi: 10.1007/978-3-319-47656-8_10.
3. Passi SJ. Prevention of non-communicable diseases by balanced nutrition: population-specific effective public health approaches in developing countries. Curr Diabetes Rev 2016 Sep 5. [Epub ahead of print].
4. Mayén AL, de Mestral C, Zamora G, et al. Interventions promoting healthy eating as a tool for reducing social inequalities in diet in low- and middle-income countries: a systematic review. Int J Equity Health 2016; 15(1): 205. doi: 10.1186/s12939-016-0489-3.
5. Caslake MJ, Miles EA, Kofler BM, et al. Effect of sex and genotype on cardiovascular biomarker response to fish oils: the FINGEN Study. Am J Clin Nutr 2008; 88(3): 618-29.
6. Integrating Gender Perspectives in the work of WHO-WHO Gender Policy. World Health Organization, 2002.
7. Charchar FJ, Bloomer LD, Barnes TA, et al. Inheritance of coronary artery disease in men: an analysis of the role of the Y chromosome. Lancet 2012; 379(9819): 915-22. doi: 10.1016/S0140-6736(11)61453-0.
8. Hunt K, Lewars H, Emslie C, Batty GD. Decreased risk of death from coronary heart disease amongst men with higher 'femininity' scores: a general population cohort study. Int J Epidemiol 2007; 36(3): 612-20. doi: 10.1093/ije/dym022
9. Ordovas JM, Corella D, Cupples LA, et al. Polyunsaturated fatty acids modulate the effects of the APOA1 G-A polymorphism on HDL-cholesterol concentrations in a sex-specific manner: the Framingham Study. Am J Clin Nutr 2002; 75(1): 38-46.
10. Phillips CM, Goumidi L, Bertrais S, et al. Gene-nutrient interactions and gender may modulate the association between ApoA1 and ApoB gene polymorphisms and metabolic syndrome risk. Atherosclerosis 2011; 214(2): 408-14. doi: 10.1016/j.atherosclerosis.2010.10.029.
11. Hotamisligil GS. Inflammation and metabolic disorders. Nature 2006; 444(7121): 860-7. doi: 10.1038/nature05485.
12. Khandekar MJ, Cohen P, Spiegelman BM. Molecular mechanisms of cancer development in obesity. Nat Rev Cancer 2011; 11(12): 886-95. doi: 10.1038/nrc3174.
13. Rask-Madsen C, Kahn CR. Tissue-specific insulin signaling, metabolic syndrome, and cardiovascular disease. Arterioscler Thromb Vasc Biol 2012; 32(9): 2052-9. doi: 10.1161/ATVBAHA.111.241919.
14. Vandanmagsar B, Youm YH, Ravussin A, et al. The NLRP3 inflammasome instigates obesity-induced inflammation and insulin resistance. Nat Med 2011; 17(2): 179-88. doi: 10.1038/nm.2279.
15. Perry CP, Keane E, Layte R, Fitzgerald AP, Perry IJ, Harrington JM. The use of a dietary quality score as a predictor of childhood overweight and obesity. BMC Public Health 2015; 15: 581. doi: 10.1186/s12889-015-1907-y.
16. Obesity and Overweight, WHO Global InfoBase: available online at http://www.who.int/topics/obesity/en/
17. Case A, Menendez A. Sex differences in obesity rates in poor countries: evidence from South Africa. Economics and Human Biology 2009; 7(3): 271-82. doi: 10.1016/j.ehb.2009.07.002.
18. La sorveglianza Passi: Attività fisica. Available at http://www.epicentro.iss.it/passi/dati/attivita.asp
19. La sorveglianza Passi: Sovrappeso e obesità Available at http://www.epicentro.iss.it/passi/dati/sovrappeso.asp
20. Teleman AA, Iodice L, Poscia A, de Waure C, Ricciardi W, Di Pietro ML. Female-male differences in health-related behaviours in the Italian university student population: Perspectives from the "Sportello Salute Giovani" Project. Ital J Gender-Specific Med 2016;2(1): 15-21. doi 10.1723/2288.24606.
21. Britton KA, Massaro JM, Murabito JM, Kreger BE, Hoffmann U, Fox CS. Body fat distribution, incident cardiovascular disease, cancer, and all-cause mortality. J Am Coll Cardiol 2013; 62(10): 921-5. doi: 10.1016/j.jacc.2013.06.027.
22. Santosa S, Jensen MD. The Sexual dimorphism of lipid kinetics in humans. Front Endocrinol 2015; 6: 103. doi: 10.3389/fendo.2015.00103.
23. Lowry R, Galuska DA, Fulton JE, Wechsler H, Kann L, Collins JL. Physical activity, food choice, and weight management goals and practices among US college students. Am J Prev Med 2000; 18(1): 18-27.
24. Malinauskas BM, Raedeke TD, Aeby VG, Smith JL, Dallas MB. Dieting practices, weight perceptions, and body composition: a comparison of normal weight, overweight, and obese college females. Nutr J 2006; 5: 11. doi: 10.1186/1475-2891-5-11.
25. Li KK, Concepcion RY, Lee H, et al. An examination of sex differences in relation to the eating habits and nutrient intakes of university students. J Nutr Educ Behav 2012; 44(3): 246-50. doi: 10.1016/j.jneb.2010.10.002.
26. Yahia N, Wang D, Rapley M, Dey R. Assessment of weight status, dietary habits and beliefs, physical activity, and nutritional knowledge among university students. Perspect Public Health 2016; 136(4): 231-44.
27. Leblanc V, Begin C, Corneau L, Dodin S, Lemieux S. Gender differences in dietary intakes: what is the contribution of motivational variables? J Hum Nutr Diet 2015; 28(1): 37-46. doi: 10.1111/jhn.12213.
28. Ferguson CJ, Winegard B, Winegard BM. Who is the fairest one of all? How evolution guides peer and media influences on female body dissatisfaction. Rev Gen Psychol 2011; 15(1): 11-28.
29. Cavazza N, Guidetti M, Butera F. Ingredients of gender-based stereotypes about food. Indirect influence of food type, portion size and presentation on gendered intentions to eat. Appetite 2015; 91: 266-72.
30. Cavazza N, Guidetti M, Butera F. Portion size tells who I am, food type tells who you are: Specific functions of amount and type of food in same- and opposite-sex dyadic eating contexts. Appetite 2017; 112: 96-101.

Conflict of interest statement: the Authors declare that the research discussed in this manuscript was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest

Correspondence to:
Beatrice Scazzocchio
Nutrition Unit, Centre for Gender-Specific Medicine
Istituto Superiore di Sanità
Viale Regina Elena 299
00161 Rome, Italy
email beatrice.scazzocchio@iss.it