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ORIGINAL ARTICLE

Association of meat and dairy consumption with normal weight metabolic obesity in men: the Qazvin Metabolic Diseases Study

Sima Hashemipour[1] · Neda Esmailzadehha[1] · Mahdieh Mohammadzadeh[1] · Amir Ziaee[1]

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Abstract

Background Insulin resistance (IR) is not limited to obese individuals. Normal weight individuals may also be insulin resistant. The aim of this study was to determine the association of lifestyle and diet patterns with IR in normal weight Iranian men.

Methods This cross-sectional study was conducted in 232 men with a body mass index lower than 25 kg/m^2 (aged 20–72 years old) between September 2010 and April 2011 in Qazvin, Iran. Metabolically obese normal weight (MONW) was defined as IR using the homeostatic model assessment (HOMA). The optimal cut point to diagnose IR was the 80th percentile of HOMA-IR values in normal subjects. The HOMA-IR cut point was 2.48. Dietary pattern was assessed by a semi-quantitative food frequency questionnaire. Data were analyzed using backward logistic regression and ANCOVA.

Results Fat and meat consumption and energy intake in subjects with MONW were more than subjects without MONW. Each serving of meat consumption was associated with three times increased risk of MONW (OR: 3.06), while each serving of dairy consumption was associated with 56 % lower risk of MONW with borderline significance (OR: 0.64). Adjusted mean of HOMA-IR in the first tertile of dairy consumption was significantly higher than other tertiles. Adjusted HOMA-IR value in the third tertile of meat consumption was significantly higher than the second tertile.

Conclusion Higher meat consumption was associated with MONW in men. Higher meat consumption and lower dairy consumption were associated with higher means of HOMA-IR.

Keywords Meat · Milk · Body mass index · Insulin resistance · Diet

Introduction

Insulin resistance (IR) plays a key role in the pathophysiology of type 2 diabetes and cardiovascular disease. Both genetic and lifestyle factors contribute to complex etiology of IR [1]. Obesity is the most important and the most common cause of IR. Body mass index (BMI), waist circumference (WC), hip circumference, and/or skinfold caliper are of non-invasive anthropometric measures of obesity. The most widely used classification of obesity is expressed in terms of BMI.

IR is not limited to obese individuals. Normal weight individuals may also be insulin resistant [2], while an individual may exhibit an obese phenotype in the absence of any metabolic abnormalities [3]. In the 1980s, Ruderman et al. introduced the term "metabolically obese but normal weight" (MONW) for individuals who are not obese or even overweight by standard weight tables, but who have metabolic abnormalities that are associated with obesity [4]. In addition to metabolic derangement, various complications including increased cardiovascular events and shortened 10 years survival have been reported in these subjects [5, 6].

BMI is not sufficient as anthropometric evaluation to define body composition and may be inaccurate, because BMI does not measure body fat directly and poorly

✉ Amir Ziaee
aziaee1963@yahoo.com

[1] Metabolic Diseases Research Center, Qazvin University of Medical Sciences, Qazvin, Iran

that red meat consumption, especially processed red meat, is associated with an increased risk of type 2 diabetes [22].

Several mechanisms may explain the association of meat consumption and insulin resistance. Meat consumption is associated with a significant higher plasma concentration of free iron that may lead to increased oxidative stress and subsequent increase in inflammatory mediators [23]. Meat contains a high level of advanced glycation end products that form during the cooking process of foods. Advanced glycation end products have significant pro-inflammatory actions [24, 25]. Increased inflammatory mediators can increase IR [26].

In the present study, higher consumption of dairy products was associated with improved insulin sensitivity. In most studies, the inverse association between dairy consumption and IR has been reported [27–29]. Fumeron et al. reported that a higher consumption of dairy products was associated with a lower 9-year incidence of metabolic syndrome and type 2 diabetes [27]. In Lutsey et al. study, the last quintile of dairy consumption was associated with lower incidence of metabolic syndrome compared to the first quintile [28]. Elwood et al. in a meta-analysis of four prospective cohort studies reported that the relative risk of diabetes in the subjects with the highest consumption of milk or dairy products was 0.92 [29]. In the same study, the meta-analysis of 15 prospective cohort studies revealed that the relative risk of cardiovascular disease and cerebrovascular accident in subjects with high milk consumption was 0.79 and 0.84, respectively [29]. However, the results of different studies are not consistent. In Lawlor et al. study, avoiding milk was associated with lower HOMA-IR values and a reduced risk of IR and the metabolic syndrome in women [30]. These differences may be attributable to gender, age or ethnicity.

Several pathophysiologic reasons may explain the increased insulin sensitivity with higher dairy consumption. Dairy products contain high levels of calcium and magnesium. Reduced adiposity and increased thermogenesis due to high calcium diets have been reported previously [31]. In Melanson et al. study, higher calcium intake was associated with higher rates of fat oxidation [32]. High magnesium diets were also associated with a lower risk of type 2 diabetes among US black women [33]. Dairy products contain medium-chain triglycerides. Although medium-chain fatty acids induce steatosis and IR in the liver, but reduce adipose accumulation and preserve insulin action in the tissues [34]. This is another reason for IR in lower dairy consumption.

There was linear association between dairy consumption and HOMA-IR in the present study, but there was not such association between meat consumption and HOMA-IR. In ANCOVA, only the third tertile of meat consumption was associated with IR. These findings indicate that only higher consumption of meat can cause IR.

In the present study, univariate analysis showed that fat consumption was associated with MONW. However, this association was not confirmed in multivariate analysis. In Shab-Bidar et al. study, fatty acid consumption was significantly associated with risk of the metabolic syndrome among the Iranian population [35]. It has been shown that a dietary intervention based on a typical Italian Mediterranean Diet reduces the cardiovascular risk factors in subjects with metabolic syndrome [36]. On the other hand, reducing saturated fatty acids has no effect on insulin sensitivity in obese subjects with metabolic syndrome [37].

Obesity has an important role in cardiometabolic disturbances, but BMI is not an accurate measurement for classification of obesity [7]. Not only a high degree of metabolic dysregulation may be present in individuals with normal BMI [2], but also any metabolic abnormalities may be absent in individuals with high body weight by BMI [3].

The present study had some limitations including its cross-sectional design and the absence of visceral fat and total fat mass measurements. Using BMI to define obesity and to assess body composition is also a limitation of this study. There are limited data about contributing factors in normal weight obesity and the strength of our study was investigating normal weight participants.

In conclusion, higher meat consumption was associated with IR in normal weight men. Higher meat consumption and lower dairy products consumption were associated with higher means of HOMA-IR.

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Compliance with ethical standards

Conflict of interest Nothing to declare.

Ethical standards This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the ethics committee of Qazvin University of medical sciences.

Informed consent Written informed consent was obtained from all subjects.

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