

High red and processed meat consumption is associated with non-alcoholic fatty liver disease and insulin resistance

- 1 Department of Gastroenterology, Tel Aviv Medical Center, 6423906 Tel Aviv, Israel; School of Public Health, University of Haifa, 3498838 Haifa, Israel. Electronic address: zelbersagi@bezeqint.net.
- 2 School of Public Health, University of Haifa, 3498838 Haifa, Israel.

Background & aims: High red and processed meat consumption is related to type 2 diabetes. In addition, cooking meat at high temperatures for a long duration forms heterocyclic amines (HCAs), which are related to oxidative stress. However, the association between meat consumption and non-alcoholic fatty liver disease (NAFLD) is yet to be thoroughly tested. Therefore, we aimed to test the association of meat type and cooking method with NAFLD and insulin resistance (IR).

Methods: This was a cross-sectional study in individuals who were 40-70 years old and underwent screening colonoscopy between 2013 and 2015 in a single center in Israel. NAFLD and IR were evaluated by ultrasonography and homeostasis model assessment. Meat type and cooking method were measured by a food frequency questionnaire (FFQ) and a detailed meat questionnaire. Unhealthy cooking methods were considered as frying and grilling to a level of well done and very well done. Dietary HCA intake was calculated.

Results: A total of 789 individuals had a valid FFQ and 357 had a valid meat questionnaire. High consumption of total meat (portions/day above the median) (odds ratio [OR] 1.49; 95% CI 1.05-2.13; $p = 0.028$; OR 1.63; 1.12-2.37; $p = 0.011$), red and/or processed meat (OR 1.47; 95% CI 1.04-2.09; $p = 0.031$; OR 1.55; 1.07-2.23; $p = 0.020$) was independently associated with higher odds of NAFLD and IR, respectively, when adjusted for: body mass index, physical activity, smoking, alcohol, energy, saturated fat and cholesterol intake. High intake of meat cooked using unhealthy methods (OR 1.92; 95% CI 1.12-3.30; $p = 0.018$) and HCAs (OR 2.22; 95% CI 1.28-3.86; $p = 0.005$) were independently associated with higher odds of IR.

Conclusion: High consumption of red and/or processed meat is associated with both NAFLD and IR. High HCA intake is associated with IR. If confirmed in prospective studies, limiting the consumption of unhealthy meat types and improving preparation methods may be considered as part of NAFLD lifestyle treatment.

Lay summary: High red and processed meat consumption is related to several diseases. In addition, cooking meat at high temperatures for a long duration forms heterocyclic amines, which have harmful health effects. Non-alcoholic fatty liver disease is a significant public health burden and its formation is strongly related to insulin resistance. In this study, both were found to be more frequent in people who consume relatively high quantities of red and processed meat. In addition, a high intake of heterocyclic amines was associated with insulin resistance.