From the Mediterranean diet to the microbiome

Caroline E. Childs

Faculty of Medicine, University of Southampton, Southampton General Hospital, Southampton SO16 6YD, UK. Email: c.e.childs@soton.ac.uk Tel: +44 (0)23 8120 6925

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Diet quality in nutrition research is frequently characterised by how closely the dietary pattern adheres to either a ‘Mediterranean’ or ‘Western’ pattern. The Mediterranean diet is characterised as one rich in olive oil, fruits and vegetables, legumes nuts and seafood, with moderate alcohol intake, and low intakes of red meats and saturated fats. This is in contrast to the ‘Western’ diet typified by consumption of sugar sweetened soft-drinks, processed meats and refined grains. While broadly understood to be ‘healthy’, the high oil content of the Mediterranean diet places it in a position of conflict with current public health dietary recommendations. Current UK guidelines advise that oils and spreads be used “in small amounts” (1). In the USA, while the 2015-2020 dietary guidelines includes a section on a “Healthy Mediterranean-Style Eating Pattern”, this document recommends consuming less than two tablespoons of oils per day (2). This is in contrast to the higher reported habitual intakes of monounsaturated and polyunsaturated oils among those in Mediterranean regions (3).

The Mediterranean diet is associated with a reduced risk of mortality, cardiovascular diseases, cancer, neurodegenerative diseases and diabetes (4). The increasing incidence of obesity and metabolic syndrome among Western populations places a significant burden upon both individual health and health care systems. There is therefore significant interest in identifying whether dietary interventions can be an effective tool in reducing non-communicable disease risk or optimising health status. As any specific bioactive nutrients or components within the Mediterranean diet are identified, there may be the potential to reduce mortality or disease risk through targeted dietary interventions or recommendations. It would be of particular value if the simple addition of target foods could confer benefits among those following an otherwise ‘Western’ diet, particularly within established at-risk groups such as those with features of metabolic syndrome.

As a result, studies of walnuts and walnut oil have been conducted to assess whether short or long term regular consumption might confer health benefits. Studies to date have reported beneficial effects with potential to mitigate the incidence of obesity and metabolic syndrome. Acute consumption of walnuts is demonstrated to significantly increase post-meal satiety (5), with evidence that these effects may be exerted through changes to post-prandial gut hormones (6) or adipokines (7). Longer-term dietary interventions have also altered markers of cardiovascular risk, such as favourable changes to blood lipid profiles (8,9), apolipoprotein B (10), and measures of endothelial function (11,12). However, it is clear that the design of such studies and the characteristics of the cohort assessed significantly influences the results observed, with null findings among studies providing lower daily nut intakes (13) or in interventions conducted on obese participants (14, 15).

Walnuts contain a number of nutrients and components which may underpin their observed health effects. Walnuts are a rich source of polyunsaturated and monounsaturated fatty acids, but are also a source of protein, phytochemicals, fibre and minerals. Each of these features may confer distinct outcomes, or there may be additive or synergistic health effects arising from the multiple components. For example, the indigestible fibres contained within walnuts may have a role in influencing the composition of the gut microbiota. Observational studies have identified that broader dietary patterns influence the composition of the gut microbiota, with clear differences between those following a Western diet typified by animal protein and saturated fats when compared with those following a mainly vegetarian dietary pattern richer in carbohydrates (16). Given that there are significant differences between the gut microbiota of individuals with obesity or metabolic syndrome and that of healthy controls (17), the question arises as to whether modifying the pattern of foods within an individual’s diet can induce changes to the microbiome and thereby confer health benefits. Nutrition intervention studies which aim to influence the microbiome have tended to focus on foods with a known direct effect upon the gut microbiota such as probiotics or prebiotics, typically provided as supplements or within fortified foods.

In the current issue of the journal, Holscher et al. have investigated the effect of walnut consumption upon both serum lipid profiles and the gut microbiota. In this study, participants were provided with 42g of walnut pieces per day over a 3 week period, and serum and faecal samples were collected before and after treatment. This intervention lead to significant changes in the abundance of bacterial genera, including *Feacalibacterium* and *Bifidobacteria* and associated reductions in LDL cholesterol. It is of particular interest that the healthy population studied in this USA cohort could be described as a profile of a pre-symptomatic ‘at risk’ Western population, with an average age of 53 and BMI of 29, but with blood pressure measurements and plasma lipid concentrations within normal ranges.

These observations are supported by available evidence that dietary interventions targeting the gut microbiota can alter blood lipid profiles, with several meta-analyses indicating that probiotics can induce significant reductions in LDL cholesterol (18, 19). One mechanism by which the gut microbiome may influence blood cholesterol concentrations is via the action of gut bacteria upon bile acids (20). The work by Holscher et al. has identified that walnut consumption resulted in lower levels of toxic secondary bile acids and that these changes were correlated to the changes observed in the gut microbiota. This therefore provides a plausible mechanism by which consumption of walnuts may provide benefits to blood lipid profiles beyond those which can be attributed to the increased consumption of unsaturated oils within the nut.

Integration of microbiome analysis within nutrition science research will be fundamental to ensuring our full understanding of the complex and synergistic effects that foods or dietary patterns can have upon human health. This work by Holscher et al. provides a fascinating example of study design which interrogates both the direct and indirect health effect arising from foods consumed. Further studies will be required for full exploration of the translational value of such findings in improving individual health or as a potential public health message which could mitigate the broader burden of non-communicable diseases such as cardiovascular disease and metabolic syndrome. Ultimately, ensuring that any review of dietary advice given in public health messaging around consumption of oils or foods rich in polyunsaturated oils is informed by the scientific evidence will depend upon the effective and timely communication of nutrition science to policy makers.

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