The Importance of Whole Grains in Improving Diet Quality: Is it a Valid Public Health Policy Goal?

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The importance of including whole grains in the diet on health outcomes has once again been clearly demonstrated in the series of systematic reviews and meta-analyses on the role of carbohydrate quality and human health by Reynolds *et al.* (Reynolds *et al.*, 2019). The results of this extensive piece of work confirm that mortality from all causes, individual cardiovascular diseases and some cancers was significantly reduced during follow-up comparing the highest with the lowest whole grain consumers. This is entirely consistent with all previous publications. Researchers have for some time tried to explain these health benefits by evaluating changes in risk biomarkers in randomized trials, and the Reynolds *et al.* paper also reports beneficial effects on some of these (body weight, glycated hemoglobin, total cholesterol and systolic blood pressure). Although individual effects are relatively small, their summative effects are likely to drive the observed health benefits. There are countless publications suggesting that so-called 'prudent' or 'healthy' diet patterns are good for health. All of these diets include higher intakes of whole grain alongside higher intakes of other plant-based foods and unsaturated fatty acids, and lower intakes of animal protein and saturated fats.

Adoption of this diet pattern has recently been strongly endorsed by the EAT-*Lancet* Commission (Willett *et al.*, 2019). Their report focusses on the production of healthy diets from a sustainable food system, with an emphasis on the production of healthy foods. The diet is mainly plant-based with only small quantities of meat and animal products. The authors recommend that total carbohydrate intake should deliver 60% of daily energy, that cereals should provide up to 60% of this this and that they should *all* be as whole grains. They calculated that this should be 232 g of whole grains per day. This would be a remarkable level of intake to achieve at a global level and one that will be a major challenge to the majority of the global population. It is important to emphasize here that this is 232g of whole grain per day, not whole-grain food; taking into account the water content of whole-grain foods his would translate into the equivalent of more than 10 medium slices of whole-grain bread, about 360g of cooked rice or pasta or about 5 bowls of a whole-grain breakfast cereal. Translating this information into advice so that consumers can identify appropriate proportions of a variety of whole-grain foods to meet the target will undoubtedly prove very challenging for public health agencies.

Whole-grain foods contribute to a better diet quality by delivering a better profile of dietary carbohydrate (higher amounts of starch and complex carbohydrates) as discussed in the May/June Cereal Foods World (2018) issue. Whole grains also contribute significantly to mineral, vitamin and phytochemical (polyphenolics) intakes since these components are naturally higher in the bran and germ components of the grain which are lost during the refining process. Table 1 shows the key differences between white and whole-grain wheat pasta and rice to illustrate this difference. The table also illustrates the difference between different cereal grains; no two species of grains are alike so where possible mixtures of grains should be consumed.

As a consequence of the differences in nutrient composition between refined and whole-grain cereal products the nutrient profile of the whole diet can change and be improved. For example, our analysis of dietary intake data from the UK National Diet and Nutrition Survey (NDNS) (Mann *et al.*, 2015) showed that nutrient intakes in high whole grain consumers were closer to dietary reference values than for low whole grain consumers. Fibre intake was 50% higher in the highest quartile of

whole grain intake compared with the lowest quartile. Energy-adjusted intake of whole grains was also positively associated with quartile of fibre intake in Australian adults (Fayet-Moore *et al.*, 2018). In both the UK and the Australian populations, breads and ready to eat breakfast cereals were the dominant sources of whole grain in the diet, so making simple switches can be an easy way to improve diet quality, and would be a simple public health message to disseminate. We have modelled the potential impact of making these exchanges on fiber intake again using the NDNS dataset (Mann *et al.*, 2018). Baseline fiber intake in the adult population was 18.3g per day (well below the current UK recommendation of 30g per day). After making all the substitutions possible in breads, pasta, rice and ready to eat breakfast cereals currently consumed, fiber intake would potentially rise to 21.7g per day. Whole grain intake would rise from the current 24g per day to 74g per day. Overall diet quality was also improved, but the increase in fiber intake was less than we had predicted, probably because the difference between fiber content of refined and whole-grain foods is not large when considering the amounts of foods consumed. The results confirm that switching cereal foods to those based on whole grains has a positive impact on diet quality and fiber intake. However, if fiber intake is to increase further, the overall diet pattern has to change to accommodate more whole-grain cereal-based foods and other high-fiber foods such as pulses in the diet. This reinforces the magnitude of change suggested by the EAT-*Lancet* commission where UK consumers would have to consume three times as much cereal-based foods than they currently consume to meet the 232g per day target.

If the health benefits of whole grain are accepted, and I strongly believe they should be, there should be a concerted effort to increase intakes in all populations. Currently intake of whole grain remains very low, with Denmark and other North-European countries performing better than most (Mann *et al.*, 2017). Public Health agencies are charged with delivering dietary guidelines, and it is important that recommendations for whole grain intake are embedded within these guidelines. The strength of these recommendations varies, however, from county to country (Seal *et al.*, 2016). At the very least all countries should now be able with confidence to recommend consuming whole grains whenever possible. Quantitative recommendations may be more difficult to harmonize due to cultural differences in foods consumed. Health Canada have recently released their latest Dietary Guidelines (Health Canada, 2019), where whole grains are included as one of the foundations for healthy eating and should be consumed regularly. The new USDA Dietary Guidelines are currently in negotiation and whole grains are expected to be prominent. The Whole Grain Initiative (WGI) has been launched (http://www.wholegraininitiative.org/en/) recently as a global initiative to bring together a number of international partners with the stated aim of increasing whole grain consumption globally. Importantly, the initiative emphasizes that a concerted joined-up effort is required across the food chain from producers, food manufacturers and technologists, public agencies and consumers if this important public health goal is to be achieved.

Table 1. Nutrient composition of refined and whole-grain wheat pasta and rice (Public Health England, 2015)

	Wheat Pasta		Rice	
	White	Wholemeal	White	Brown
Protein (g/100g)	11.3	12.6	6.7	7.7
Fat (g/100g)	1.6	2.5	1.0	1.5
Carbohydrate (g/100g)	75.6	68.3	85.1	77.0
Energy (KJ/100g)	1461	1400	1513	1418
AOAC Fiber (g/100g)	4.9*	11.7	1.1	3.0
Sodium (mg/100g)	2	3	1	Trace
Potassium (mg/100g)	232	426	87	243
Calcium(mg/100g)	24	39	16	11
Magnesium (mg/100g)	47	103	25	116
Phosphorus (mg/100g)	179	333	117	323
Iron (mg/100g)	1.59	3.25	0.26	1.05
Copper (mg/100g)	0.30	0.54	0.18	0.22
Zinc (mg/100g)	1.2	2.8	1.4	1.8
Manganese (mg/100g)	0.77	2.54	1.05	2.49
Selenium (µg/100g)	22	15	13	10
Vitamin E (mg/100g)	0.30	0.60	0.03	0.37
Thiamin (mg/100g)	0.17	0.33	0.12	0.30
Riboflavin (mg/100g)	0.03	0.06	Trace	0.06
Niacin (mg/100g)	3.3	5.6	1.4	4.3
Vitamin B6 (mg/100g)	0.14	3.31	0.12	0.19
Folate (µg/100g)	19	29	14	22

* Non-starch polysaccharide (NSP) x 1.33

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