Choosing oatmeal porridge and simmered mackerel improves life expectancy in PLOS Medicine: A modeling study.

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Authors: Adam Drewnowski, Jonathan Lara-Arevalo*, Alfonso Mendoza-Velazquez

Center for Public Health Nutrition, University of Washington, Seattle, USA

***Corresponding author:** Jonathan Lara-Arevalo

Abstract

A recent paper in PLOS Medicine showed modeled gains in life expectancy following dietary shifts from a typical Western (TA) to a Feasible (FA) and an Optimal Diet (OD). A Food4HealthyLife calculator was provided on line. However, energy density data for 14 “representative” foods does not correspond to energy density data for 1151 foods in the same food groups from the USDA Department of Agriculture databases. The present recalculation shows that the FA and OD diet plans were lower in saturated fat and added sugar but were higher in energy and sodium, and entailed substantially higher daily diet cost, as based on 2021 national food prices used in the USDA Thrifty Food Plan. First, a diet plan of oatmeal porridge with water, simmered mackerel, half a boiled egg, milk 1%, fresh orange, mixed vegetables, chickpeas, and a handful of nuts and berries is not necessarily the same as a diet of whole grains, seafood, eggs and dairy, vegetables, fruits, nuts and legumes. Second, any well-meaning dietary advice needs to be accompanied by economic feasibility studies and estimates of diet cost. Clinicians, policymakers, and consumers need to understand not only the health impact but also the economic cost of dietary choices. Access to affordable nutrient rich foods is one of the social and political determinants of health.

Dietary choices can have an impact on health outcomes (1). A recent modeling study published in PLOS Medicine (2) showed how modeled life expectancy increased when the typical western (TW) dietary pattern was replaced by a healthier and roughly equicaloric feasible diet (FA) and an optimal diet (OD). Examples of representative foods in each food group were provided in Supplemental data (S3) along with their “typical” energy values. The category examples were simmered mackerel, oatmeal porridge with water, mixed vegetables and potatoes; raw orange; peanuts; chickpeas; boiled egg; milk 1% fat; bread; cutlet; bacon; chicken leg; lemonade; and rapeseed oil. The PLOS Medicine study made a reference to an online Food4HealthyLife calculator that linked gram amounts of the same food groups with desirable health outcomes.

The PLOS Medicine study (2) then made the claim that increasing the consumption of whole grains, fish, legumes, vegetables, fruits, and nuts contributed to longer life when coupled with reduced consumption of red and processed meat, poultry, eggs and dairy, sugar sweetened beverages, and refined grains (2). However, that claim and the dietary advice seem to have been based on 14 foods only.

The PLOS Medicine study (2) was based in part on consumption data for different food groups from the US Department of Agriculture (3–5). Gains in life expectancy for American men and women, along with other nationalities, were calculated for different age groups. The TW diet featured in PLOS Medicine was very similar to the current US eating patterns.

The present study re-calculated daily energy and calculated both nutrient density and cost of the three food plans (TW, FA, and OD) that were featured in PLOS Medicine. Data on energy density, nutrient composition and food prices for 1,151 foods came from the Food and Nutrition Database for Dietary Studies (FNDDS 2015-16) (6) and from Supplemental Data to the Thrifty Food Plan (TFP) (7). The FNDDS and TFP modeling categories assigned foods into food groups that corresponded to those in PLOS Medicine. The food groups selected were vegetables (including starchy vegetables), whole fruit (but not 100% juice), whole and refined grains from the grain group, milk and yogurt (but not cheese), processed meat, red meat and white meat (poultry), eggs, fish (but not shellfish), nuts (but not seeds), plant oils (but not margarine or salad dressings), and sugar sweetened beverages (excluding diet). Grains were selected from the USDA grains group only, thus excluding snacks and sweets, sweet bakery goods and other desserts. The assignment of foods into the whole grain category was based on regulations issued by the Food and Drug Administration (FDA). The FDA allows a product to be called whole grain if it contains more than 50% of whole grain by dry weight (8). The whole grain category included cooked cereals (oatmeal with water), cooked grains (brown rice) as well as whole grain RTE cereals, whole grain pasta and whole grain breads and rolls. All mixed dishes, sauces and condiments, candy, sugars, pizza, and popcorn were excluded.

Energy and retail prices by food group are summarized in **Table 1**. Shown are USDA TFP modeling categories and food groups listed in PLOS Medicine, as well as means, standard errors, and medians for both energy density and price. The PLOS Medicine study used typical energy density values to establish that the three diet plans (TW, FA, and OD) were equicaloric. Table 1 shows that the typical energy density was not typical at all. With two exceptions (plant oils, beverages), mean energy density of PLOS Medicine typical foods was ≥ 3 SEM above or below the USDA group means for the same food groups.

Table 1. Energy density (kcal/100g) and price (\$/100g) by food category based on US Department of Agriculture and FNDDS and Thrifty Food Plan databases.

TFP market basket categories	PLOS groups	PLOS ED kj/100gl		USDA FNDDS ED kj/100g				USDA TFP prices \$/100g			
		N=	kj/100g	N=	Mean	SEM	Median	N=	mean	SEM	median
Vegetables	Vegetables	1	200	180	295	17.7	209	180	0.76	0.07	0.47
Whole fruit	Fruit	1	150	76	411	45.7	239	76	0.82	0.07	0.64
Whole grains	Whole grains	1	400	121	1207	41.4	1365	121	0.68	0.03	0.71
Refined grains	Refined grains	1	1100	198	1196	27.2	1233	198	0.67	0.03	0.68
Milk, yogurt	Milk, yogurt	1	170	85	334	17.3	306	85	0.37	0.03	0.26
Cured meat	Processed meat	1	1900	70	1155	58.7	1174	70	1.68	0.13	1.21
Red meat	Red meat	1	700	63	973	40.8	883	63	1.74	0.08	1.57
Poultry	White meat	1	1000	123	908	18.5	862	123	1.09	0.04	0.93
Eggs	Eggs	1	600	55	723	29.1	737	55	0.51	0.04	0.39
Seafood	Fish	1	600	41	791	33.9	854	41	2.1	0.39	1.46
Nuts, seeds, soy	Nuts	1	2600	52	2413	51.6	2458	52	1.8	0.13	1.84
Oils and fats	Plant oils	1	3700	5	3673	48.0	3701	5	1.13	0.40	1.06
Beverages	SSB	1	200	60	195	20.0	176	60	0.2	0.02	0.14
		14		1151				1151			

In the PLOS Medicine article, energy content of the diet declined on going from TW to the OD diet (8085 kj to 7615 kj) Based on mean energy content of 1151 foods in the same food groups, daily energy intakes increased very substantially from 2350 kcal/d (TW) to 2577 kcal/d (FA) and then to 2804 kcal/d (OD). Based on median energy content by food group, dietary energy intakes increased from 9167 kj (TW) to 11088 kj (OD). These data are shown in Table 2.

Much of the increase in dietary energy was due to whole grain breads and rolls, important sources of whole grains in the US diet. Restricting the whole grains category to oatmeal porridge and cooked rice (energy density 400 kj/100g) still led to an increase in dietary energy from 9,436 kj/d (TW) to 9,928 kj/d (OD). Based on the gram amounts of foods from different food groups, the OD diet plan was lower in added sugar and saturated fat but was higher in sodium.

The present data on national food prices in the US came from the August 2021 revision of the Thrifty Food Plan (TFP) (7). The TFP is a linear programming model used to create an optimized diet that meets multiple nutrition, social, and cost constraints. Among the TFP modeling categories were vegetables, fruit, beans and legumes, nuts, fish, eggs, milk and dairy, red and processed meat, poultry, sweetened beverages, and whole and refined grains.

Table 2 shows that the FA and OD diet plans were associated with higher daily diet costs compared to the TW plan. Daily costs were estimated based on the sum of mean or median prices per food group and specified gram amounts (2). This increase was observed for mean costs (12.03 USD to 15.50 USD) and median costs for each food group (9.40 USD to 11.76 USD). These increases held even when oatmeal porridge with water was the only type of whole grain allowed.

Taking mean prices for foods above and below the median from each food group allowed us to calculate the cost of more affordable and less affordable versions of the TW, FA and OD diet plans. The lower cost version of the OD was estimated at 8.34 USD/d, whereas the higher cost version was estimated at 22.47 USD/d.

Table 2. Energy and nutrient values and total estimated cost for the TW, FA and OD diets.

	Typical Western Diet	Feasibility Approach	Optimized Diet
Fadnes et al (2)	8,085 kJ (1,931 kcal)	7,850 kJ (1,875 kcal)	7,615 kJ (1,819 kcal)
Total Kj (kcal) from means	9,839 (2,350)	10,791 (2,577)	11,743 (2,805)
Total Kj (kcal) from medians	9,167 (2,189)	10,128 (2,419)	11,089 (2,648)
Total cost (mean) USD/day.	12.03	13.77	15.50
Total cost (median) USD/day	9.40	10.58	11.76
Low cost version (mean) USD/day	6.75	7.54	8.34

High cost version (mean) USD/day	17.23	19.85	22.47
Saturated fat (medians)	20.48	18.42	16.37
Total sugar (medians)	120.1	110.34	100.6
Sodium (medians)	3,057.75	3,401.25	3,744.75

Modeling optimized diets with respect to health outcomes depends on multiple assumption and those ought to be driven by the data. When offering model based dietary advice, it is important to be clear on two points. The first is not to base global recommendations on an overly narrow database. A diet plan of oatmeal porridge with water, simmered mackerel, half a boiled egg, and a handful of nuts and berries can be very different from a varied diet of whole grains, seafood, eggs and dairy, fruits, nuts and legumes. Restricting the whole grain category oatmeal porridge and cooked brown rice does not acknowledge the wide range of whole grain foods in the food supply. Broad generalizations to global eating patterns may be out of place when based on very limited nutrient composition data.

Second, model-based dietary advice needs to be economically feasible. Yes, the consumption of vegetables, fruits, legumes, nuts, fish and whole grains has been associated – repeatedly - with positive health outcomes (9,10). It has not escaped anyone’s attention that these foods tend to cost more than refined grains, snacks and sweets, and sugar-sweetened beverages (11). For comparison purposes, the modeled cost of the recently updated Thrifty Food Plan is 8.80USD/d for men aged 19-50 and 7.72USD/d for women aged 19-50y. The USDA calculates the cost of the Moderate Food Plan at 11.00 USD/d and the Liberal Food Plan at 13.50 USD/d. The estimated cost of the OD diet plan (2) ranged from 8.34USD/d (low-cost version) to 22.47USD/d (higher cost version). The lower calculated cost is very close to the modeled TFP that was based on the same 2021 food prices. On the other hand, the higher-cost OD version would cost 8,201 USD/year or potentially over 32,000 USD/y for a family of four. Past studies based on observed dietary patterns (12) found that the cost differential between healthy and less healthy diets in the US was only about 1.50 USD/day. Whether extra 1.50 US per day is little or a lot depends on one’s position along the socioeconomic scale.

Following the approach taken by the USDA Thrifty Food Plan, the healthfulness of diets needs to be assessed against their economic cost. To give one example, the modeled EAT Lancet diet was not affordable by the global poor (13,14). A recent FAO report (15) estimated healthy diets to be up to five times more expensive than diets that met energy requirements through a starchy staple. Other studies pointed to a price differential between energy adequate diets, nutrient adequate diets and optimal healthy diets (16,17). Based on such studies, the USDA acknowledged that former levels of food assistance were inadequate to support healthy diets and increased Supplemental Nutrition Assistance Program (SNAP)

benefits by 21.03% effective October 1, 2021. Mandated by the Farm Bill, that was the first revision of the TFP in 45 years.

When modeling the likely impact of an optimized diet on health, it is important to select a broad range of affordable foods. Modifying intakes of fruits, vegetables, whole grains, refined grains, nuts, legumes, meats, fish, eggs, and milk/dairy may well increase life expectancy. However, broad generalizations to potential health outcomes ought to acknowledge food prices and nutrient density of foods.

Conflicts of Interest:

AD is the original developer of the Naturally Nutrient Rich and the Nutrient Rich Food (NRF) indices. That work was supported at the time by the Nutrient Rich Coalition whose members were The Beef Checkoff Program through the National Cattlemen's Beef Association, California Avocado Commission, California Kiwifruit, California Strawberry Commission, Egg Nutrition Center, Florida Department of Citrus, Grain Foods Foundation, National Dairy Council, National Pork Board, United States Potato Board, Wheat Foods Council, and Wild Blueberry Association of North America. AD has received grants, contracts, and honoraria from entities both public and private with an interest in nutrient density metrics and nutrient profiling of foods. JLA and AMV have no conflict of interest.

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