The Cost Savings of Changes to Healthier Diets in the U.S.

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1 Introduction

The primary objective of this research is to estimate the health costs of the U.S. diet relative to the French, Japanese, Mediterranean, or Nordic diets, all of which are often identified as healthier than U.S. consumption patterns (Duchin, 2005; Adamsson et al., 2010; Renaud & de Lorgeril, 1992). This research is motivated by the increasing recognition that consumer dietary choices have a substantial impact on one's health, and thus, health costs, not all of which are borne solely by the individual. Diet-related health damage may result from being overweight or obesity, a weight status measured by one's body mass index (BMI)[1]. Being overweight or obese is defined as having a BMI greater than 25 or greater than 30, respectively.

The proportion of the population that is overweight or obese has increased over the past few decades, growing to 1.4 billion adults worldwide in 2008 (World Health Organization, 2013a). Of these 1.4 billion, 500 million were obese (FAO, 2013b). The prevalence of overweight and obesity for each of the countries considered in this research is shown in Table 1. In 2010, a total of 69.4 percent of the adult population in the United States was overweight or obese. Of this 69.4 percent, 32.9 percent were overweight and 36.5 percent were classified as obese (OECD, 2013b). The OECD data show that the rates have increased from 47.4 percent of the U.S. population experiencing excess weight in 1978, with 32.4 percent of the population overweight and 15 percent of the population obese.

[1] BMI is calculated by dividing weight (in kilograms) by height (in m^2) (World Health Organization, 2014).

Table 1

Prevalence of Overweight and Obesity

Country	**% of Population Obese or Overweight**	**% of Population Obese**
Japan	25.5	4.1
France	42.9	12.9
Finland	50.8	16.6
Greece	55.7	17.3
United States	69.4	36.5

Note. Data are from OECD (2013b). The most recent year for each country is reported; Japan (2011, measured), Greece (2009, self-reported), United States (2010, measured), France (2010, self-reported), Finland (2011, self-reported).

Finkelstein et al. (2012) predict that U.S. obesity prevalence will increase through 2030. Using a time trend forecast, the authors estimate 51 percent of the population will be obese and 9 percent will be severely obese within the next fifteen years. Then, using a nonlinear regression model, the authors predict that 42 percent of the population will be obese and 11 percent will be severely obese. Finkelstein et al. (2012) define severe obesity as having a BMI greater than or equal to 40.

The obesity rates among adults, and also among children, have become a public health concern since being overweight or obese is a risk factor for other non-communicable diseases such as heart disease, hypertension, diabetes, cancer, cerebrovascular disease, gallstones, osteoarthritis as well as a number of other conditions (Stein & Colditz, 2004).

Extensive work has been done on the cost of obesity which can inform this research. In 2009, the national health expenditure in the United States was $2.5 trillion, 17.9 percent of GDP (Martin, Lassman, Washington, Catlin, & Team, 2012). In OECD countries, the direct costs of obesity account for between one and three percent of health expenditures. In the United States, this percentage is five to ten percent (OECD, 2012).

Obesity generates both direct and indirect health care costs. Direct costs include medical visits and pharmaceuticals whereas indirect costs include presenteeism—or reduced productivity on the job—and increased absenteeism, or days of work missed due to obesity-related health problems (Finkelstein, Stromotne, & Popkin, 2010). Additionally, disability and worker's compensation claims are submitted more frequently and with higher pay-outs for obese employees.

In 1998, the total economic costs of obesity were estimated to be $99.2 billion, of which $51.64 billion were found to be direct costs, measured in 1995 dollars (Wolf & Colditz, 1998). For the same year, Finkelstein, Fiebelkorn, and Wang (2003) estimate obesity-related expenditures to be $78.5 billion. Finkelstein, Trogdon, Cohen, and Dietz (2009) conclude that obesity-related medical expenses in 2008 were as much as $147 billion, accounting for ten percent of total medical spending. Finkelstein et al. (2012) estimate that if obesity levels are constant, rather than increasing, between 2010 and 2030, then medical expenditures savings amount to $549.5 billion. On an individual level, OECD reports that health expenditures are 25 percent higher for an obese individual compared to a normal-weight individual (OECD, 2012).

Much of the research related to obesity has focused on the United States and has utilized micro-level data sources including BRFSS, NHANES, and the Framingham Heart Study (Chou, Grossman, & Saffer, 2004; Christakis & Fowler, 2007; Rashad, Grossman, & Chou, 2005). Dubois, Griffith, and Nevo (2013) compare household data across countries while others use aggregate country-level data to study obesity including De Vogli, Kouvonen, and Gimeno (2011), Loureiro and Nayga (2005), and Mazzocchi and Traill (2011). Since our focus is on the link between diet and BMI across different countries, our research is similar to the work of Loureiro and Nayga (2005) and Mazzocchi and Traill (2011) who also utilize OECD data and some of the same variables. However, we build on their work by decomposing the total energy consumed in each country, measured in kilocalories (kcal), into product categories to better understand the effects of consumption choices on BMI.

2 Model

2.1 Data Set Development and Regressions

As a first step to measuring health costs, we estimate the association between the five diets and BMI using pooled cross-section time-series data on France, Finland, Greece, Japan, and the United States. These countries represent the French, Nordic, Mediterranean, Japanese, and U.S. diets, respectively. The dependent variable in the regression model is BMI. We use age-standardized estimates of BMI for ages twenty and older pulled from World Health Organization data (2013b). The data are reported separately for males and females, so a simple average is calculated to get the average BMI for each country in each year over the entire population. The explanatory variables include dietary variables and socio-economic variables shown in Table 2. There are 9 dietary variables, each representing daily per capita kcal consumption from nine sources: plants, dairy, fish and seafood, other animals, eggs, poultry, pork, mutton and goat, and beef. The socio-economic variables used are annual per capita GDP, percentage of the population living in urban areas, the consumer price index for food, internet users per hundred people, hours worked per capita weekly, and grams of tobacco smoked per person annually.

Table 2

Regression Variables

Variable	**Unit**	**Definition**	**Data Source**
BMI	kg/(meters squared)		WHO
PLANTS	kcal per person per day	All plant-based products	FAO
DAIRY	kcal per person per day	Composite of butter, ghee, cream and milk	FAO
FISHSEAFOOD	kcal per person per day	Composite of fish, seafood, fish liver oil and fish body oil	FAO
OTHERANIMAL	kcal per person per day	Composite of offal, raw animal fat and other animal meat	FAO
EGGS	kcal per person per day		FAO
POULTRY	kcal per person per day		FAO
PORK	kcal per person per day		FAO
MUTTONGOAT	kcal per person per day		FAO
BEEF	kcal per person per day		FAO
RGDPK	Annual per capita GDP in constant 2005 U.S. dollars		Work Bank Database
URBAN	Percentage of the population living in an urban area		Work Bank Database
CPIFOOD	U.S. dollars, 2010 = 100	Proxy for food prices	OECD
INTERNET	Internet users per 100 people	Proxy for screen time	Work Bank Database
HRSWORKED	Hours worked per person per week		OECD
QSMOKE	Grams of tobacco smoked per capita per year		OECD

Descriptive statistics for the variables are reported in Appendix Table A.1. Dummy variables are added to capture differences among countries, with the United States as the base country. Additional dummy variables are included to account for variation among the years where 2009 is the base year. The period of analysis is 1980-2009 yielding 150 observations total among the five countries.

Since the dietary variables are of primary interest, we check the robustness of their relationship with BMI by performing four ordinary least squares (OLS) regressions and increasing the set of socioeconomic variables and country and year-specific dummy variables. The regression results are reported in Appendix Table A.2. The standard errors are reported in parentheses under the coefficient estimates. In all regressions, a set of dietary variables is consistently statistically significant. For our purpose, we focus on results from Regression 4 because the model includes the complete set of socio-economic variables and the yearly dummy variables. The estimated coefficients on the dietary variables PLANTS, DAIRY, FISHSEAFOOD, OTHERANIMAL, EGGS, and POULTRY are statistically significant. CPIFOOD and DJPN are also significant. The adjusted R^2 for this regression is 0.9948.

A significant, positive coefficient estimate was expected for each of the dietary variables because consumption is thought to increase BMI regardless of the sources of kcal being consumed. However, the variables FISHSEAFOOD, OTHERANIMAL, MUTTONGOAT, and BEEF all have negative signs, though the latter two were not statistically significant. This may be due to correlation between country-specific consumption patterns and unobserved variables that affect BMI. For example, the Japanese, who have a lower BMI, consume the most fish and seafood compared to the other countries; if the Japanese engage in exercise, a variable not observed in the data, more than other nationalities, the estimate of FISHSEAFOOD could misattribute the effect of exercise on BMI to seafood consumption.

2.2 Estimating Change in BMI

With the regression estimates in hand, we develop a simple method to estimate how a shift from the 2009 U.S. diet to the four alternative diets would affect U.S. BMI. We consider two scenarios. Scenario 1 considers a shift from the U.S. diet to the other diets, holding total kcal constant at the U.S. level of 3,688 kcal per person per day in 2009. We refer to this scenario as the fixed kcal scenario. Examples of studies using the fixed kcal scenario include Eshel and Martin (2006), Saxe, Larsen, and Mogensen (2013), and Tukker et al. (2011). Scenario 2 considers a shift from the U.S. diet to the other diets, allowing total kcal to decrease to the respective levels consumed in the countries representing the alternative diets in 2009 as reported by FAO (2013a). We refer to this scenario as the varying kcal scenario. We chose 2009 because it is the most recent year of data available.

We take the total differential of the regression, so that the change in BMI is expressed as the sum of the weighted changes (measured in kcal) of the nine dietary variables. The change in BMI from a dietary shift is calculated as the product of the change in kcal consumed for a particular food category and the regression coefficient estimated for that category. Denoting each dietary variable by x_i, for i =1, 2, …, 9, the change in BMI (*dBMI*) can be written as:

$$\sum_{i=1}^{9}\left[\frac{\partial BMI}{\partial x_i} \times dx_i\right] = dBMI \qquad (1)$$

The change in the dietary variable, dx_i, is measured by the difference in the 2009 consumption of each dietary component i between the reference country and the United States; that is, dx_i = $\left(x_i^j - x_i^{USA}\right)$, where $j = \{Finland, France, Greece, Japan\}$.

In what follows, we measure the change in U.S. BMI for the fixed kcal scenario. As shown in Appendix Table A.3, the change in U.S. BMI is calculated by normalizing the dietary composition of the alternative diets to the U.S. level of daily per capita consumption: 3,688 kcal. The first column shows the proportion of each product category in the diets. For instance, plant-based products in the Japanese diet represent 79 percent of kcal consumed. As shown in the second numerical column, if the U.S. diet were to be 79 percent plant-based, it would require consumption of 2,923 calories from plants. Referring to the third numeric column and focusing on Japan, dx_i gives the difference between the U.S. and Japanese kcal intake in each of the nine dietary categories. Take beef and poultry, for example. A shift to the Japanese diet would reduce beef consumption by 72 kcal and reduce consumption of poultry by 117 kcal daily. On the other hand, a shift to Japanese diet would increase fish and seafood consumption by 170 kcal every day.

The resulting total change in U.S. BMI given a shift in diet composition, but holding total kcal fixed at the U.S. level in 2009, is shown in Table 3. Our model predicts that shifting to the Mediterranean-type diet yields a 2.57 unit reduction in BMI, even while maintaining U.S. levels of consumption.

Table 3

Change in U.S. BMI for Fixed Kcal Scenario

	Japanese	**Mediterranean**	**French**	**Nordic**
dBMI	-1.48	-2.57	-1.96	-2.13

Appendix Table A.4 shows the calculations for the varying kcal scenario. The columns are calculated in the same way as in Appendix Table A.3, except that the Caloric Fraction of Diet column is unnecessary since total kcal is not constrained to the U.S. total. Table 4 sums up the changes by diet. The sum reveals that a switch from the U.S. to a Japanese-type diet results in a decrease in U.S. BMI of 3.05 units. A switch to a Mediterranean, French, or Nordic diet results in a decrease in U.S. BMI of 2.60, 2.19, and 2.78 units, respectively. Obviously, the change in BMI in this scenario is of larger magnitude than in the fixed kcal scenario because the U.S. kcal consumption is allowed to adjust downwards.

Table 4

Change in U.S. BMI for Varying Kcal Scenario

	Japanese	**Mediterranean**	**French**	**Nordic**
dBMI	-3.05	-2.60	-2.19	-2.78

In summary, the largest reduction in U.S. BMI (3.05) occurs when shifting to a Japanese-type diet and reducing consumption to the Japanese level of 2,723 total kcal per capita per day. Similarly, shifting both consumption levels and composition to a Nordic or Mediterranean-type diet would lead to more than a two-unit reduction in U.S. BMI. The effects of a shift to a Mediterranean-type diet on U.S. BMI are a decrease of 2.57 and 2.60 for a shift and a shift plus a change in total kcal, respectively. This highlights the similarity in the total amount of kcal consumed in the Mediterranean diet and the U.S. diet; consumption in the Mediterranean diet is only 27 kcal fewer per day than in the U.S. diet. The 2.6 reduction in BMI in the fixed kcal scenario is a substantial decrease in BMI due only to shifts in types of food products consumed. Our estimates indicate that significant reductions U.S. BMI levels could be achieved by simply shifting dietary composition.

2.3 Cost Estimates

We now estimate the health cost associated with diet. The relationship we use is:

$$\frac{dhcosts}{ddiet} = \frac{dhcosts}{dBMI} \times \frac{dBMI}{ddiet}. \qquad (2)$$

The change in health costs due a change in diet $\left(\frac{dhcosts}{ddiet}\right)$ is the product of the change in health costs resulting from a one unit increase in BMI $\left(\frac{dhcosts}{dBMI}\right)$ and the change in BMI due to a change in diet $\left(\frac{dBMI}{ddiet}\right)$. Our estimates of the change in BMI due to a change in diet are taken from results reported in Section 2.2. The estimate of the change in health care costs from a change in BMI is obtained from Wang et al. (2006).

In the study, Wang et al. (2006) estimate the marginal health cost for a unit increase in U.S. BMI. Their sample consisted of 372,979 active and retired employees and spouses who chose an indemnity or preferred provider option (PPO) medical insurance plan from the General

Motors Corporation and International Union, United Automobile, Aerospace and Agricultural Implement Workers of America. The average pay-out in the sample of normal weight individuals is $2,750 for medical claims and $1,179 for drug claims, summing to a total of $3,929 in annual healthcare costs. The marginal cost for each increased unit of BMI over 25 is $119.70 for medical costs and $82.60 for pharmaceutical costs. Thus, the increase in health costs associated with a one-unit increase in BMI is $202.30. We use this amount for $\frac{dhcosts}{dBMI}$ in Equation 2.

While BMI and health costs are thought to have a nonlinear, J-shaped relationship over the full range of BMI values (Wang et al., 2006), the authors note that the relationship between health costs and BMI is linear and increasing when BMI is between 25 and 45. Since the average BMI in the United States in 2009 was 28.45 and BMI would remain above 25 irrespective of any shift to the other diets considered, we use the estimates from Wang et al. (2006) as the change in health care costs per unit change in BMI. Results are shown in Table 5 for the fixed kcal scenario.

Table 5

Health Costs for Fixed Kcal Scenario

Diet	**Change in BMI[a]***	**Cost Difference Relative to U.S. Diet[b]***	**Cost Difference Relative to U.S. Diet (billions)**	**Percentage Difference**
Japanese	-1.48	-$299.73	-$92.2	-3.7%
Mediterranean	-2.57	-$519.37	-$159.8	-6.4%
French	-1.96	-$396.05	-$121.9	-4.9%
Nordic	-2.13	-$430.69	-$132.5	-5.3%

[a] Reported in Table 3
[b] *Change in BMI* column multiplied by $202.30
* Per capita per year

Results show that a shift to any of the alternative diets would generate health care cost savings. The largest decrease in health care costs occurs when shifting to the Mediterranean diet; we estimate health care costs would have decreased by $519 per capita in 2009. Shifting to the Mediterranean diet could reduce health costs in the United States by almost $160 billion dollars, which is over 6.4 percent of the total health expenditures in 2009 of $2.5 trillion.

Cost savings are more pronounced in the varying kcal scenario. The annual health-related cost savings from shifting both dietary composition and total kcal intake ranges from $444 to $617 per capita in the United States. These savings are shown in Table 6. Switching to the Japanese diet leads to the largest health cost savings. Health costs in the United States could be reduced by $190 billion dollars if the population adopted a Japanese-type diet.

Table 6

Health Costs for Varying Kcal Scenario

Diet	Change in BMI[a]*	Cost Difference Relative to U.S. Diet[b]*	Cost Difference Relative to U.S. Diet (billions of dollars)	Percentage Difference
Japanese	-3.05	-$617.36	-$190.0	-7.6%
Mediterranean	-2.60	-$526.65	-$162.0	-6.5%
French	-2.19	-$443.63	-$136.5	-5.5%
Nordic	-2.78	-$562.24	-$173.0	-6.9%

[a] Reported in Table 4
[b] *Change in BMI* column multiplied by $202.30
* Per capita per year

Summary and Conclusions

This paper evaluates the health costs of the U.S. diet relative to the French, Japanese, Mediterranean, and Nordic diets, represented by France, Japan, Greece, and Finland, respectively. The Mediterranean diet results in the largest reduction in BMI (2.57 units) in the fixed kcal scenario. The Japanese diet results in the largest reduction (3.05 BMI units) in the varying kcal scenario. The take-away is that a shift in dietary composition may have substantial effects on BMI. In fact, we estimate that a shift to any of the alternative diets, with or without a decrease in caloric intake, would result in a reduction in BMI.

We then calculate the health costs of the diets by multiplying the per-unit health costs of increasing BMI by our estimates of the change in U.S. BMI when shifting to one of the alternative diets. All four alternative diets in both scenarios result in reduced BMI and, hence, reduced health costs. The Mediterranean diet is the least costly under the fixed kcal scenario, while the Japanese diet is the least costly in the varying kcal scenario.

Several caveats are in order. First, new research is constantly redefining our understanding of the causes of obesity and non-communicable health problems, so food supply may not accurately capture causal relationships between diet and health (Ludwig & Friedman, 2014). Second, BMI is an imperfect measure of weight status and health costs, and our cost estimates are a combination of private and public costs (though they likely underestimate both public and private costs). Third, the FAO food supply data represent average diets, which likely overestimates actual caloric intake. This is not a problem if the data overestimate intake consistently across countries, but could affect our conclusions if errors differ in magnitude by country. Fourth, this research does not address demand or supply response considerations. For a large-scale shift to any other diet, the supply of foods that make up the diet would have to change to accommodate the shift either through domestic production, imports, or both. Though some of the shift may be induced by non-price factors, relative prices may play a larger role in leading consumers to demand foods that make up healthier diets and induce producers to supply them. Additionally, U.S. public policy may shape incentives to consume and produce such foods. These could be areas of future research. Despite the caveats, this research provides a useful basis upon which future efforts can assess the costs of transitioning to healthier diets more fully.

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Appendix

Table A.1

Summary Statistics

Variable	*N*	*Mean*	*Std Dev*	*Minimum*	*Maximum*
BMI	150	24.92	1.64	21.70	28.45
Plants	150	2344.34	323.97	1704.00	2878.00
Dairy	150	428.29	173.90	117.00	770.00
FishSeafood	150	77.66	63.38	27.00	226.00
OtherAnimal	150	57.85	39.84	19.00	146.00
Eggs	150	53.04	14.00	32.00	80.00
Poultry	150	77.13	50.79	11.00	210.00
Pork	150	189.71	111.71	58.00	374.00
MuttonGoat	150	21.90	27.98	1.00	82.00
Beef	150	80.28	34.69	16.00	141.00
Internet	150	19.57	26.87	0.00	83.67
CPIFood	150	74.42	22.90	6.10	103.50
Qsmoke	150	2208.48	939.53	0.00	3741.00
Urban	150	74.50	8.34	57.73	89.63
HrsWork	150	1801.89	317.76	0.00	2208.00
RGDPK	150	28507.72	7839.34	14268.68	45431.03

Table A.2

Selected Regression Results

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	21.26909***	21.98154***	22.38338***	18.11478***
	(0.7830)	(1.1747)	(1.1425)	(1.5748)
Plants	0.00107***	0.000672***	0.00094633***	0.00117***
	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Dairy	0.00402***	0.00322***	0.00203***	0.00201***
	(0.0005)	(0.0005)	(0.0005)	(0.0006)
FishSeafood	-0.00713***	-0.00592***	-0.00634***	-0.00572***
	(0.0018)	(0.0018)	(0.0015)	(0.0015)
OtherAnimal	-0.01283***	-0.00951***	-0.00406***	-0.00621***
	(0.0013)	(0.0013)	(0.0013)	(0.0016)
Eggs	-0.01655***	-0.02029***	0.02072***	0.02322***
	(0.0042)	(0.0042)	(0.0048)	(0.0050)
Poultry	0.01835***	0.01445***	0.01338***	0.01507***
	(0.0017)	(0.0017)	(0.0016)	(0.0017)
Pork	0.00161**	-0.000198	-0.000676	0.000214
	(0.0007)	(0.0008)	(0.0008)	(0.0008)
MuttonGoat	-0.00969**	-0.002270	-0.01121*	-0.008030
	(0.0040)	-(0.0023)	(0.0058)	(0.0074)
Beef	0.000965	0.00972***	-0.002750	-0.000101
	(0.0027)	(0.0028)	(0.0028)	(0.0029)
Internet		0.00347**	0.00645***	0.002600
		(0.0017)	(0.0013)	(0.0028)
CPIFood		0.00465***	0.00981***	0.01243***
		(0.0018)	(0.0015)	(0.0021)
Qsmoke		-0.000089**	-0.000044	-0.000020
		(0.0000)	(0.0000)	(0.0000)
Urban		-0.006710	-0.02049*	0.009920
		(0.0117)	(0.0110)	(0.0148)
HrsWork		0.000113	0.000084	0.000066
		(0.0001)	(0.0001)	(0.0001)
RGDPK		0.000012	-0.000011	0.000002
			(0.0000)	(0.0000)
DFIN			0.86847***	1.05566***
			(0.2918)	(0.3371)
DFRA			-0.54949**	-0.324830
			(0.2698)	(0.2747)

(continued)

Variable	Model 1	Model 2	Model 3	Model 4
DGRE			-0.130550	0.679930
			(0.4930)	(0.6403)
DJPN			-2.38809***	-2.1838***
			(0.4366)	(0.4502)
Year1980				0.428450
				(0.3181)
Year1981				0.364090
				(0.3114)
Year1982				0.265070
				(0.3077)
Year1983				0.369650
				(0.2933)
Year1984				0.328570
				(0.2849)
Year1985				0.283120
				(0.2781)
Year1986				0.212520
				(0.2724)
Year1987				0.151170
				(0.2764)
Year1988				0.036460
				(0.2738)
Year1989				0.026980
				(0.2664)
Year1990				0.025250
				(0.2571)
Year1991				-0.029810
				(0.2489)
Year1992				-0.035150
				(0.2484)
Year1993				0.057970
				(0.2400)
Year1994				0.032090
				(0.2302)
Year1995				0.026990
				(0.2237)
Year1996				0.038130
				(0.2159)

(continued)

Variable	Model 1	Model 2	Model 3	Model 4
Year1997				0.051650
				(0.2042)
Year1998				-0.017990
				(0.1906)
Year1999				-0.073470
				(0.1840)
Year2000				-0.060680
				(0.1646)
Year2001				-0.124590
				(0.1484)
Year2002				-0.151430
				(0.1291)
Year2003				-0.143860
				(0.1161)
Year2004				-0.109880
				(0.1072)
Year2005				-0.087450
				(0.1008)
Year2006				0.022150
				(0.0941)
Year2007				-0.023740
				(0.0889)
Year2008				-0.087130
				(0.0812)
N	150	150	150	150
F-value	881.94	748.74	1303.18	597.8
R-squared	0.9827	0.9882	0.9948	0.9965
Adj. R-squared	0.9816	0.9869	0.9940	0.9948

$^*p < 0.05$. $^{**}p < 0.01$. $^{***}p < 0.001$

Table A.3

Change in BMI for Fixed Kcal Scenario

Diet	**Product Category**	**Caloric Fraction of Diet**	**kcal**	**Difference from U.S.**	**Regression Coefficients**	**Change in BMI**	**Total Change in BMI**
				dx_i	$\frac{\partial BMI}{\partial x_i}$	$\left[\frac{\partial BMI}{\partial x_i} \times dx_i\right]$	$dBMI$
Japanese	Animal, Other	0.01	26	-41	-0.00621	0.26	-1.48
	Beef	0.01	38	-72	-0.00010	0.01	
	Dairy	0.05	194	-222	0.00201	-0.45	
	Eggs	0.03	103	49	0.02322	1.14	
	Fish & Seafood	0.06	209	170	-0.00572	-0.97	
	Mutton & Goat	0.00	1	-2	-0.00803	0.01	
	Plants	0.79	2923	248	0.00117	0.29	
	Pork	0.03	122	-10	0.00021	0.00	
	Poultry	0.02	76	-117	0.01507	-1.77	
Mediterranean	Animal, Other	0.01	25	-42	-0.00621	0.26	-2.57
	Beef	0.01	52	-58	-0.00010	0.01	
	Dairy	0.13	468	52	0.00201	0.11	
	Eggs	0.01	37	-17	0.02322	-0.39	
	Fish & Seafood	0.01	37	-2	-0.00572	0.01	
	Mutton & Goat	0.02	71	68	-0.00803	-0.54	
	Plants	0.77	2829	154	0.00117	0.18	
	Pork	0.03	121	-11	0.00021	0.00	
	Poultry	0.01	47	-146	0.01507	-2.19	

(continued)

Diet	Product Category	Caloric Fraction of Diet	kcal	Difference from U.S.	Regression Coefficients	Change in BMI	Total Change in BMI
				dx_i	$\frac{\partial BMI}{\partial x_i}$	$\left[\frac{\partial BMI}{\partial x_i} \times dx_i\right]$	$dBMI$
French	Animal, Other	0.03	104	37	-0.00621	-0.23	-1.96
	Beef	0.02	86	-24	-0.00010	0.00	
	Dairy	0.15	554	138	0.00201	0.28	
	Eggs	0.02	57	3	0.02322	0.08	
	Fish & Seafood	0.02	83	44	-0.00572	-0.25	
	Mutton & Goat	0.01	22	19	-0.00803	-0.15	
	Plants	0.66	2452	-223	0.00117	-0.26	
	Pork	0.06	234	102	0.00021	0.02	
	Poultry	0.03	97	-96	0.01507	-1.44	
Nordic	Animal, Other	0.01	34	-33	-0.00621	0.20	-2.13
	Beef	0.03	99	-11	-0.00010	0.00	
	Dairy	0.17	644	228	0.00201	0.46	
	Eggs	0.01	38	-16	0.02322	-0.38	
	Fish & Seafood	0.02	82	43	-0.00572	-0.25	
	Mutton & Goat	0.00	3	0	-0.00803	0.00	
	Plants	0.62	2292	-383	0.00117	-0.45	
	Pork	0.11	420	288	0.00021	0.06	
	Poultry	0.02	75	-118	0.01507	-1.78	

Table A.4

Change in BMI for Varying Kcal Scenario

Diet	**Product Category**	**Difference From U.S.**	**Regression Coefficients**	**Change in BMI**	**Total Change in BMI**
		dx_i	$\frac{\partial BMI}{\partial x_i}$	$\left[\frac{\partial BMI}{\partial x_i} \times dx_i\right]$	$dBMI$
Japanese	Animal, Other	-48	-0.00621	0.30	-3.05
	Beef	-82	-0.00010	0.01	
	Dairy	-273	0.00201	-0.55	
	Eggs	22	0.02322	0.51	
	Fish & Seafood	115	-0.00572	-0.66	
	Mutton & Goat	-2	-0.00803	0.02	
	Plants	-517	0.00117	-0.60	
	Pork	-42	0.00021	-0.01	
	Poultry	-137	0.01507	-2.06	
Mediterranean	Animal, Other	-42	-0.00621	0.26	-2.60
	Beef	-58	-0.00010	0.01	
	Dairy	49	0.00201	0.10	
	Eggs	-17	0.02322	0.51	
	Fish & Seafood	-2	-0.00572	0.01	
	Mutton & Goat	67	-0.00803	-0.54	
	Plants	133	0.00117	0.16	
	Pork	-12	0.00021	0.00	
	Poultry	-146	0.01507	-2.20	

(continued)

Diet	Product Category	Difference From U.S.	Regression Coefficients	Change in BMI	Total Change in BMI
		dx_i	$\frac{\partial BMI}{\partial x_i}$	$\left[\frac{\partial BMI}{\partial x_i} \times dx_i\right]$	$dBMI$
French	Animal, Other	33	-0.00621	-0.20	-2.19
	Beef	-28	-0.00010	0.00	
	Dairy	114	0.00201	0.23	
	Eggs	1	0.02322	0.02	
	Fish & Seafood	40	-0.00572	-0.23	
	Mutton & Goat	18	-0.00803	-0.14	
	Plants	-327	0.00117	-0.38	
	Pork	92	0.00021	0.02	
	Poultry	-100	0.01507	-1.51	
Nordic	Animal, Other	-37	-0.00621	0.23	-2.78
	Beef	-23	-0.00010	0.00	
	Dairy	150	0.00201	0.30	
	Eggs	-21	0.02322	-0.49	
	Fish & Seafood	33	-0.00572	-0.19	
	Mutton & Goat	0	-0.00803	0.00	
	Plants	-661	0.00117	-0.77	
	Pork	237	0.00021	0.05	
	Poultry	-127	0.01507	-1.91	