Demand for Nutrients in Chain Restaurants in Canada

Jeewani Fernando, PhD Candidate, Department of Rural Economy, University of Alberta

Email: jeewani@ualberta.ca

Ellen Goddard, Professor, Department of Rural Economy, University of Alberta

Email: Ellen.goddard@ualberta.ca

Sandeep Mohapatra, Assistant Professor, Department of Rural Economy, University of Alberta

Email: Sandeep.Mohapatra@ualberta.ca

James Rude , Associate Professor, Department of Rural Economy, University of Alberta

Email: James.Rude@ualberta.ca

Selected Paper prepared for presentation at the Agricultural & Applied Economics Association 2010. AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

DEMAND FOR NUTRIENTS IN CHAIN RESTAURANTS IN CANADA

INTRODUCTION

In recent years, the determinants of nutrient demand have been the focus of a number of economic studies (Abdulai and Aubert 2004; Beatty and LaFrance 2005; Beatty 2007; Blaylock *et al* 1999; Briefel and Johnson 2004; Dhehibi *et al* 2003; Drewnowski 2003; Fousekis and Lazaridis 2003; Huang & Lin 2000; Nayga *et al* 1999; Nestle 2002; Park and Davis 2001; Popkin 2006; Richards *et al* 2007; Variyam *et al* 2002). With an increasing awareness of diet related diseases and increasing interest in public policy interventions, the need for a more complete understanding of nutrient consumption patterns has grown. Despite many studies which have been undertaken by nutritionists to explore the nutrient quality of food away from home (FAFH), especially fast foods (Baric *et al* 2003; Binkley 2008; Bowman *et al* 2004; Fitzpatrick *et al* 1997; Guthrie *et al* 2002; Lin *et al* 2000; Nayga and Capps 1994; Paeratakul *et al* 2003; Variyam 2004), the economic studies focused on FAFH in general, are limited. Given an increasing trend in FAFH spending (Statistics Canada 2006) and the possible link between FAFH and diet related diseases, an empirical analysis of nutrient demand in FAFH is timely. In addition, from a policy formulation view, understanding nutrient demand is important as many policies[1] are directly targeted at certain nutrient or nutrients.

Some studies that are available on the nutritional aspects of FAFH (Lin *et al* 1999; Guthrie *et al* 2002) make comparisons between food prepared at home and FAFH (using data from USDA Nationwide Food Consumption Surveys and Continuing Survey of Food Intakes by Individuals and calculating nutrient density measures) and provide information as to how the food intake of Americans have changed over a period of time. According to Lin *et al* (1999), over the period 1977 to 1995, Americans have had only small nutritional improvements in FAFH consumption (foods obtained at various places other than retail stores) as these foods contain more of the nutrients over consumed (calories from fat and saturated fats) and fewer of nutrients under consumed (calcium and fibre). Guthrie *et al* (2002) had the same findings, as well as the fact that FAFH foods are also sodium and cholesterol dense. Binkley (2006) added nutrition variables (consumers'

[1] Proposed trans fat regulations, fat taxes, regulations on sodium etc.

concerns and knowledge about nutrition) to standard demographic measures in explaining demand for FAFH. According to his consumer survey data analysis, Binkley (2006) showed that nutrition oriented consumers tended to have lower fast food consumption. There are a number of other studies, which focus on the nutrition aspect of only one segment of FAFH such as fast food consumption. Nutritionists have undertaken these studies and the general finding is that frequent fast food consumption leads to higher energy and fat intake and a lower intake of healthful nutrients. See table 3.1 for a list of studies done on nutritional aspects of foods including FAFH. Meanwhile, many researchers have also shown that there is a correlation between FAFH food, especially fast food consumption and the obesity epidemic in U.S. (French *et al* 2000; French *et al* 2001; Binkley *et al* 2000; Taveras *et al* 2001).

A number of economic studies have focused on specifying the influence of socio-demographic characteristics on food nutrient demand in general (Ardrian and Daniel 1976; Devaney and Fraker 1989; Basiotis 1983; Nayga 1994; Nayga 1999; Ramezame 1995; Subramanium and Deaton 1996; Dhehibi *et al* 2003). As most of these studies highlight, information on the differential effects of socio-demographic characteristics on nutrient intake may be useful in designing and targeting nutrition education. According to Ardrian and Daniel (1976), since certain commodities or commodity groups are primary sources of specific nutrients, specification of these relationships can also provide information concerning future demand trends, which will directly affect the types of agricultural products produced and marketed. However, Huang (1996) argues that if this measurement of nutrition contribution is to be a better guide for decision making in policy and business, it needs to be better tied to demand for food supplied. While these concerns were expressed with regard to food consumption in general, it will be interesting to analyze FAFH consumption in the above context for a better understanding.

The overall goal of this study is to understand the consumer demand for nutrients in FAFH foods in Canada in a comprehensive manner. A joint effort by Canadian Restaurant and Food Services Association and Canada’s largest restaurant chains to launch a Nutrition Information Program in February 2005, made it easier for consumers to obtain detailed nutrition information for standardized menu items in the majority of chain restaurants in Canada. With this situation, consumers can at least have access to information on which to base food choices. Therefore, the specific objective is to estimate the demand for nutrients in the FAFH market focusing on chain restaurants and to identify socio-demographic characteristics affecting this demand.

Literature Review

In looking for a conceptual framework to analyze the demand for food by nutrients, one can find different studies that bear some relevance in the economic literature. To look at the impact of nutrition information on changing behaviour, some have used a nutrient information index as a variable in demand equations (Brown and Schrader 1990; Capps and Schmitz 1991; Burton and Young 1996; Kinnucan *et al* 1997; Kim and Chern 1999). However, these studies did not measure the demand for nutrients directly and have focused instead on examining consumers' knowledge of nutrition in food demand. According to Dhehibi *et al* (2003), two different measurement techniques have been used to analyse the demand for nutrients. The first method is the "direct method" where demand equations for specific nutrients are specified as functions of socio-demographic and economic variables (Ardrian and Daniel 1976; Devaney and Fraker 1989; Basiotis 1983; Nagya 1994; Subramanium and Deaton 1996; Ramazame 1995). In the second method-"indirect method"- authors have used a two-step process where first, relevant variable effects on the demand for food products are calculated by estimating a demand system and second, nutrient intake effects are obtained by applying a nutrient conversion factor to these specific food effects (Huang 1996 and 1999; Beatty and Lafrance 2005; Dhehibi *et al* 2003). Recently, a few other studies using different analytical methods have become available. For example, the maximum entropy principle has been used by Beatty (2007) to recover the shadow value of food nutrients and the semi-parametric quantile regression approach has been used by Variyam *et al.* (2002) and Fousekis and Lazaidis (2005) to analyse the demand for selected nutrients. Dhehibi *et al* (2003) used a panel data model (a differential consumer demand system[2]) incorporating nutrients as attributes and Richards *et al* (2007) investigated nutrient addiction using a random coefficient (mixed) logit model. These above methods are briefly reviewed in the next sections in order to gain some insight on nutrient demand estimation.

In most of the empirical work in the direct method, the demand for nutrients by households is approximated via an Engel curve relationship in which per capita intake of a nutrient is specified as a function of a per capita food consumption expenditure and a vector of household socio-demographic characteristics (Ardrian and Daniel 1976; Huang and Misra 1991; Devaney and Fraker 1989; Nayga 1994, Nayga and Capps 1994; Biotosis *et al* 1983). According to Fousekis and Lazaidis and (2005), this specification is consistent with Becker's household production model as well as with Lancaster's goods characteristics model. In Becker' model, nutrients can be considered as inputs in production of health along with other activities such as regular physical activities and consumption of medical services (Grossman 1972; Grossman and Kaestner 1997 in Fousekis and Lazaidis (2005). In the Lancaster model, foods can be considered to have positive attributes (taste and essential nutrients) as well as negative attributes such as health risks (Chern and Rickertsen 2003). In both Becker's and Lancaster's models, socio-demographic and economic variables enter the utility function as they influence consumers' decision making in healthy dietary choices (Variyam and Golan 2002).

With regard to the relationship between nutrient demand and consumers' socio-demographic and economic variables, Morgan (1986) highlights the fact that the literature contains a diversity of findings. Morgan (1986) and Davis (1982) suggest a need for more interdisciplinary research to better understand the relationship between nutrient intake and socio-demographic and economic characteristics. Given this and assuming that variation could be attributed to different functional form specifications, Ramezani (1995) has used AVAS (Additivity and Variance Stabilization), a non

[2] This demand system is called as CBS demand system and it comes from the institution in which the model developers (Keller and Van Driel (1985) worked: Dutch Central Bureau of Statistics

parametric method to specify a multivariate function and then to estimate the demand for nutrients.

According to the above description, the direct method of nutrient demand seems appealing for obtaining information related to healthy dietary choices. However, this method has been criticized by some others arguing that the applicability of the results of such methods is limited as consumers are observed choosing foods not nutrients and therefore, nutrients are not directly available in the market (Dhehibi *et al* 2003). Nonetheless, in the Canadian FAFH market, this has become less and less the case as nutrient information is available for the majority of foods provided by the largest chain restaurants. Specifically, in February 2005, the Canadian Restaurant and Foodservices Association and Canada's largest restaurant chains jointly launched a Nutrition Information Program to provide detailed nutrition information for standardized menu items. (Also this became evident according to a survey carried out by authors who examined restaurant companies' websites and collected nutrition data on site of menu restaurants). Further, public health policy is requiring more and more nutrition information to be made available to the FAFH consumers in order for them to make informed and healthful food choices (CSPI 2008; Parliament of Canada 2006).

The studies under the indirect method have tried to link food choices with nutritional status in the context of the classical demand framework (Huang 1996; Beatty and Lafrance 2005). Huang (1996) developed a procedure, first of estimating interdependent demand relationships including own-price, cross-price and income effects and then incorporating these elasticity estimates directly into the measurement of nutrient elasticities. For elasticity estimations he has used time series data on quantities and prices of selected food items using a demand system (Huang 1996). Beatty and Lafrance (2005) introduced another new model which nests a large class of functional forms for income and prices within a flexible demand system. Then, combining demand estimates with data on the nutrient content of foods, they make inferences on the nutritional impacts of changes in food consumption. These methods of nutrient demand estimation first require an estimation of demand for each food product under consideration using price and other relevant information. Although these methods of measuring nutrition contribution can be tied to demand for food supplied and provide useful policy relevant information, in FAFH consumption, this method will not be plausible given the large number of products and the unavailability of individual product price data. Instead of individual food product prices, FAFH purchase data usually provide total expenditure for a purchase occasion (for an example NPD CREST data (NPD Group Inc.) provides total expenditure for a purchase occasion and a purchase occasion may include a number of food products).

Recently, a few studies have been undertaken with new methodological approaches. Beatty (2007) investigated the shadow value of twenty-eight different nutrients. In his study the unit prices of foods were linked to the shadow values of nutrients by building on a utility theoretic model proposed by Gorman. Maximum entropy principles are then used to estimate the values of the parameters of interest. However, Beatty (2007) did not use FAFH food intake. The Semi-parametric quantile regression approach has been used by Variyam *et al.* (2002) and Fousekis and Lazaidis (2003) to analyse the demand for selected nutrients. In quantile regression method, a nutrient intake is specified as a dependent variable in a conditional quantile function and solved for as a minimization problem. According to Variyam *et al* (2002), in nutrient demand analysis, the marginal effects of explanatory variables estimated at the conditional mean using ordinary least squares may be of limited value as the risk of dietary inadequacy or excess is greater at the tails of the nutrient intake distribution. Quantile regression is effective in this situation since it can be used to estimate conditional functions at any part of the distribution (Variyam 2002; Fousekis and Lazaidis 2003). Dhehibi *et al* (2007), using a panel data set (for eight quarters) and incorporating nutrients as attributes directly , estimated a demand system, in which food quantities are considered as dependent variables. Again in all of the above studies, FAFH consumption is omitted due to the unavailability of product quantities in their data. In these studies identification of different products, their quantity, and their nutrient composition is important to construct the models. All of these new approaches require proper identification of products and quantities consumed. Given that FAFH contains a very large number of products with different portion or serving sizes, applicability of these methods in FAFH nutrient demand analysis is limited due to computational difficulties. An economic model, specifically a random coefficient (mixed) logit model was used by Richards *et al* (2007) to test nutrient addiction and to identify the relationship between obesity and nutrition consumption.

One of the caveats in nutrient demand studies is the measure of the nutrient content of foods (Beatty *et al* 2007). Very often, studies have used per capita nutrient intake on weight basis. When food intake data is available in the form of food groups and their quantities, calculation of nutrients using nutrition information sources (may be actual nutrition information of foods or assumed averages of food groups) is plausible. However, calculation of per capita nutrient intake on a weight basis is computationally difficult in FAFH due to serving size differences. Among many measures of the nutrient content of foods, nutrition density measures are considered to be a promising tool (Drewnowski 2005), which can be applied to FAFH consumption. Nutrition density measures the amount of each nutrient for each 1000 or 2000 calories provided by a food item. Since this standard is calculated using the number of calories as the basis, the resulting nutrient density ratio is independent of the serving size (Hansen 1979). Given a large variety of meal items and portion sizes in FAFH consumption measuring exact nutrient content is difficult due to human error. Therefore, nutrient density can be considered to be a suitable measure of nutrients for FAFH to avoid the complexity of calculating exact nutrient content by product and aggregating them.

A majority of the nutrient demand studies have used cross sectional data, while only a few have used time series data (Huang 2000; Beatty and Lafrance 2005) and panel data (Dhehibi *et al* 2003; Richards *et al* 2007). Some of the modelling issues in cross sectional nutrient demand studies are described in Park and Davis (2001). The number of nutrients that are analysed varies from one nutrient (Calories-Subramanium and Deaton 1996) to twenty-eight nutrients (Beatty 2007). Non-technical descriptive analysis and reviews on the relationship between food demand and nutrition are also included. Among these, Blaylock *et al* 1999 examined the role and influence of economic factors on consumer food choices, and hence, nutritional outcomes. Drewnowski (2003) examined the link between income and macro-nutrients (fat and sugar) in developed and developing countries as well as lower income groups in developed countries. He suggests that obesity in US and similar societies may be a socio-economic issue. Nestle (2002) describe how food industry influence nutrition and health of consumers. Popkin (2006) provides a commentary on global nutrition dynamics and highlights the effects of fast food and bottled soft drinks industries on the nutrition shift.

Some studies which are related to nutrients and FAFH have focused on the link between FAFH and obesity (Gills and Bar-Or 2003; Thompson *et al* 2004; French *et al* 2000, 2001; Pereira *et al* 2005; Duffey et al 2007; Burns *et al* 2001). These studies tried to link relatively high energy and fat intake from FAFH to obesity. A few studies looked at the nutrient contribution of FAFH over the years (Lin *et al* 2000, Gruthrie *et al* 2001). Other studies reported in this review have examined different aspects of FAFH and nutrition. For example, nutrition associated with restaurant diet and its effects on university students (Baric *et al* 2003), caloric and gram differences between meals at fast foods and table service restaurants(Binkley 2008), effects of fast food on children's and adults diet (Brown et al 2003; Paerataket et al 2003), low fat restaurant menus and customer satisfaction (Fitzpatric *et al* 1997) and socio-demographic factors on individual intake of saturated fat and cholesterol from FAFH (Nayga and Capps 1994), nutrition labelling of restaurant foods (Varityam 2005). In addition, information on nutrition labelling in restaurants and food services in Canada (Health Canada 2008) and nutrition database information provided by USDA (USDA 2008) are also reviewed.

Data

This study used a data set on Canadians' food away from home food consumption from the year 2001 to 2006 obtained from NPD Group Inc., Consumer Reports on Eating Share Trends (CREST) database. Based on a voluntary program starting in 2005 (CRFA 2005), nutrition information is supposed to be available for all chain restaurants in Canada. As a part of this study collection of a significant amount of nutritional fact information by Canadian restaurants over the past four years (2006 to 2009) has been undertaken and this has revealed that nutrition information is available for a majority of large chain restaurants in Canada. In the CREST data set, despite approximately equal levels of annual average spending by households on chain and non-chains over the sample period (about $110 to $125), the annual percentage of total purchase occasions are higher for chain than for non-chain restaurants (63% for chain restaurants and 37% for non chain restaurants). Therefore, given access to nutrition information and frequency of purchases, household purchase data for chain restaurants is the focus for this study. The data set contains a variety of information on each household's socio-demographics, total expenditure on each purchase occasion, the type of the restaurant visited and its name and food speciality, and detailed information on the meal and beverage items purchased (NPD Group Inc. 2007).

The collection of nutrition fact information from restaurants in Canada revealed that number of restaurants that provided nutrition information increased from 22 in 2006 to about 70 in 2009. In 2009, about 50% of the restaurants have provided information on all 14 nutrients which are required in nutrition facts panels for processed food products (Health Canada 2008).

Focusing on households who consistently report their visits to chain restaurants yearly from January 2001 to December 2006, a sample of 1202 households was selected. To understand the representativeness of this sample as compared to that of Canadian population, descriptive statistics for the sample of 1202 households in year 2001 are given in Table 1 with a comparison to 2001 census data and also to the entire NPD CREST data set in 2006.

Table 1: Descriptive Statistics of the Sample, Compared to Census and Whole NPD CREST Data Set in Year 2006

Variable definition	***Census* (*30,007,094*)**	***NPD CREST data set (4790 households)***	***Study sample (1202) households)***
	Mean values of categories and ratios of sub groups		
Annual income of household			
Low income (under $30,000)	0.56	0.23	0.27
Middle income ($30,000 to $60,000)	0.29	0.38	0.42
High income (more than $60,000)	0.15	0.39	0.31
Age of household head		**53.15**	**53.21**

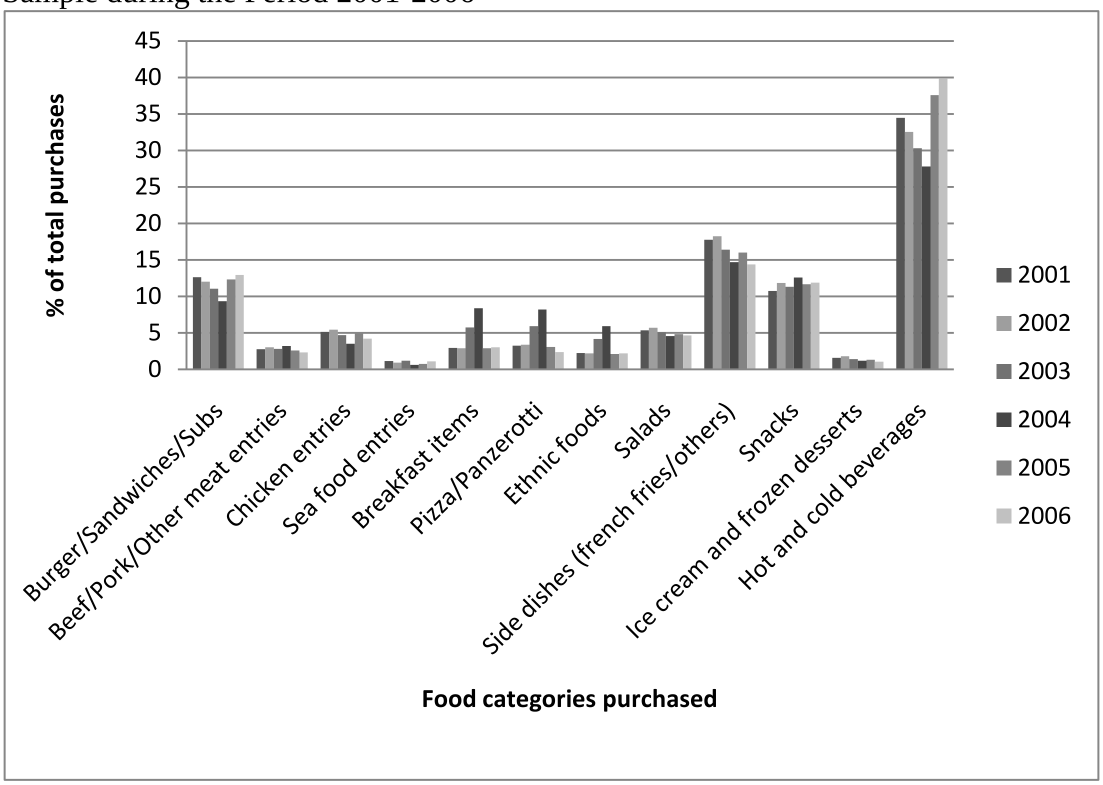
Under 15	0.18	0.00	0.00
15 years to 44yearss	0.41	0.32	0.31
45 years to 65 years	0.27	0.45	0.47
above 65 years	0.14	0.23	0.24
Education			
Junior high or less	0.08	0.02	0.02
Senior high, college certificate diploma	0.78	0.69	0.71
University degree	0.14	0.29	0.27
Region			
British Columbia /West Coast	0.13	0.20	0.18
Alberta	0.11	0.14	0.14
Saskatchewan	0.03	0.06	0.05
Manitoba	0.04	0.05	0.06
Prairie Provinces	0.17	0.25	0.25
Ontario (+ HULL, PQ)	0.38	0.29	0.30
Quebec(- HULL, PQ)	0.24	0.17	0.15
New Brunswick	0.02	0.05	0.05
Prince Edward Island	0.004	0.004	0.003
Nova Scotia	0.03	0.05	0.05
Newfoundland	0.02	0.01	0.01
Atlantic Provinces	0.11	0.114	0.113
Household composition			
Households with children		0.74	0.77
Households without children		0.26	0.23
Total annual expenditure on FAFH		188.01	347.58

Source; Canadian Census 2006, Statistics Canada 2009, NPD CREST data 2001-2007

As compared to Census data and NPD data, the study sample can generally be considered to be a representative sample of the NPD data set and the Canadian population, with some variations. One variation is that the representation of low-income households is low in both the NPD sample and the study sample as compared to Census data while the representation of middle-income households is higher in both the NPD sample and the study sample. The average age of the household head is higher in the study sample, with no representatives from the age group below 15 years. Representation from the educational sub- groups and the regional sub groups are more or less similar in all three data sets. The regional representations are more or less similar across three groups of data, except the fact that representation from Newfoundland is lower than the Census data and the NPD data. Comparisons of household composition and the average FAFH expenses were made only between the NPD data set. The proportion of households with children is lower in the study sample while average spending on FAFH is higher in the study sample. However, as the study sample is generally representative of Canadian population, the study results can be extrapolated.

Different categories of food items purchased from chain restaurants by the sample households over the six year period are presented in Figure 1. Hot and cold beverages were the most purchased category. Side dishes were the second most purchased category. Hamburger/Sandwiches/Subs category and snack food category purchases are in the range of 10% to 13% of the total purchases, but with some yearly variations. Chicken entries and Salad categories also show similar level of purchases (about 5% of the purchases in each year). Breakfast, Pizza/Panzerotti and Ethnic foods show similar patterns of purchases where purchases increased towards 2004 and decreased towards 2006. Seafood entries and ice cream and frozen dessert categories are the least purchased categories.

Figure 1: Food and Beverage Items Purchased by the 1201 Households in the Study Sample during the Period 2001-2006



The most purchased food or beverage item for each of the above categories are identified as follows:

Burger/Sandwiches/Subs - Hamburger

Beef/Pork/Other meat entries – Steak

Chicken entries – Fried chicken

Seafood entries – Fried fish

Breakfast items – Egg based breakfast sandwiches

Pizza/Panzerotti – Regular Pizza

Ethnic foods- Chinese

Salads – Coleslaw side dish size

Side dishes – French fries

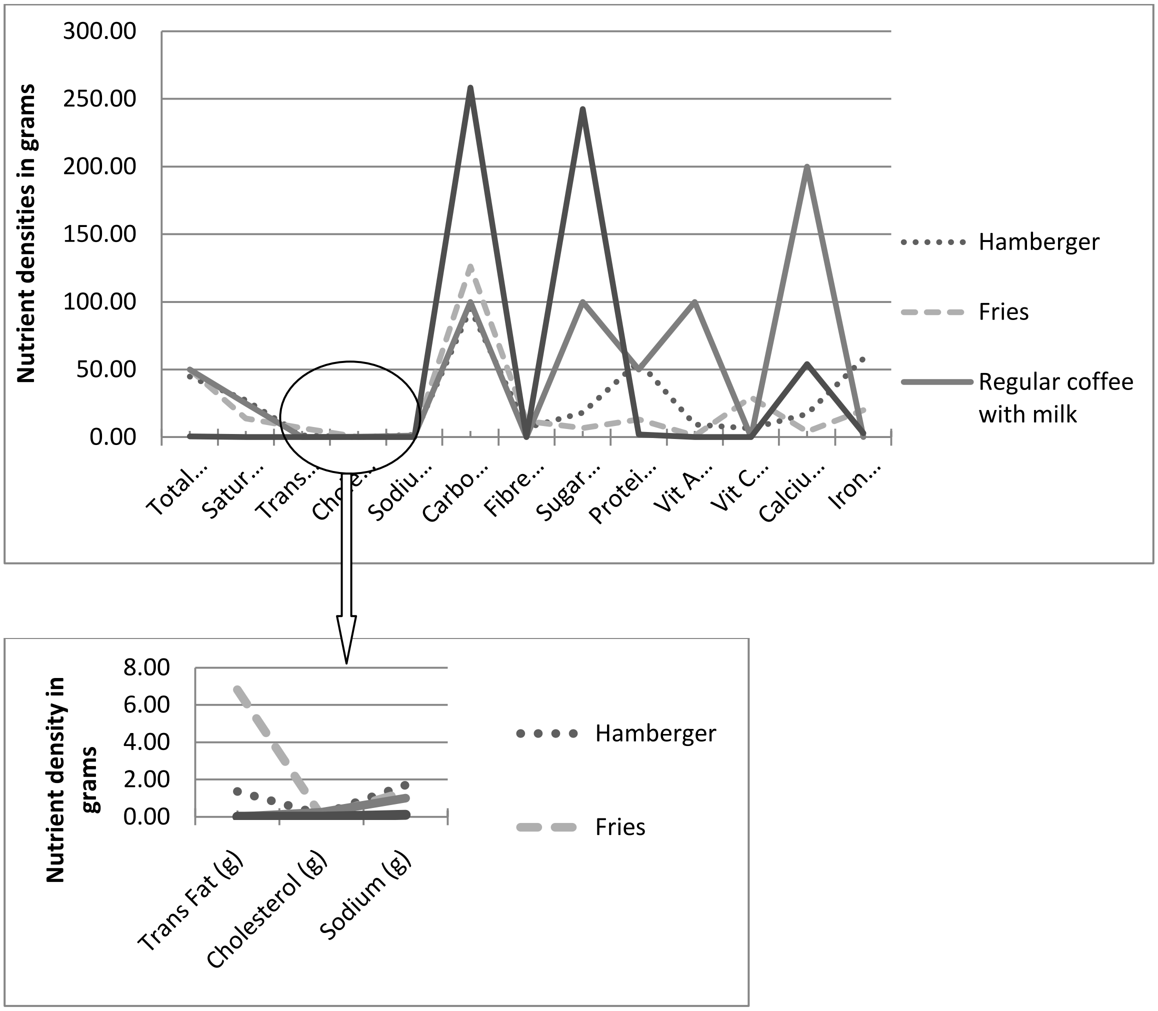
Snacks – Donuts

Ice cream and frozen desserts – Soft cones

Hot and cold beverage – Regular coffee with milk

To create nutrition data, first, all of the foods and beverage items purchased by households in the sample from various chain restaurants for the selected period were identified. Second, the nutrient composition of each identified meal and beverage item was obtained from the restaurants' nutrition data collected by the authors and for items not identified by specific restaurants, average data was obtained from USDA National Nutrition Data base (USDA 2007). The USDA data base was used as a representation when no restaurant specific data is available. In the data set containing sample household's FAFH purchases, there are 120 food and beverage items. The restaurant specific nutrition data were not available for 30 food and beverage items (about 25% of the items).Third, nutrient density, which measures the amount of a nutrient for each 1000 calories, provided by each meal or beverage item was calculated and matched with the meal and beverage item purchases by the identified households. Finally, annual aggregate nutrient densities (for 13 nutrients) were calculated for each household in the sample and were used in the nutrient demand estimations. A nutrition profile of the most demanded food and beverage products: Hamburger, French fries, Regular coffee with milk and Cola-medium is provided in Figure 2.

Figure 2: Nutrient Densities of Selected Popular Food and Beverage Items in FAFH



The above figures on the nutrition profiles illustrate that out of the most popular food and beverage items, cola beverages contain the highest density for carbohydrates , sugars and calcium. In terms of trans-fat densities, french fries contain the highest density followed by hamburgers.

Empirical Model Specification

The objective of this study is to estimate the demand for nutrients in chain restaurants in the FAFH market and to identify socio-demographic characteristics affecting this demand using panel data. Among the available methodological approaches, the methods described in the ‘indirect methods’ of nutrient demand analysis and in the ‘other methods’ of nutrient demand analysis require food quantity, food prices or both quantity and prices. In our FAFH dataset, there is a large variety of food choices and available household level data do not provide individual food prices. Our data only contain total expenditure for a meal occasion. Given that the application of indirect methods and other methods described in the conceptual framework is not possible. However, the ‘direct methods’ for nutrient demand are possible in this study context. Therefore, to achieve the study objective, a simple structural equation based on an Engel curve, as used by Devaney and Fraker (1989), Nayga (1994), Nayga and Capps (1994) is used with the following derivation:

in maximizing a consumer's utility subject to a budget constraint will lead to demand functions for commodities

$$q_j = g_j(y, p), \quad (1)$$

where q_j denotes the quantity of a good j, y denotes income and p is a price vector for all relevant goods. By extending this model to examine the demand for nutrients, the intake of nutrient k is given by:

$$N_k = \sum_j a_{kj} q_j \quad (2)$$

where a_{kj} denotes the amount of nutrient k contained in each unit of commodity q_j (Devaney and Fraker 1989). Substituting equation (1) into equation (2) leads to demand functions for nutrients of the following form:

$$N_k = f_j(y, p) \quad (3)$$

Assuming that households face identical prices so that explanation of behavioural differences is sought through differences in total expenditure and household characteristics, linear regression equations of the following form can be specified for each of the k nutrients:

$$N_{ki} = h_{ki}(y_i, S) \quad (4)$$

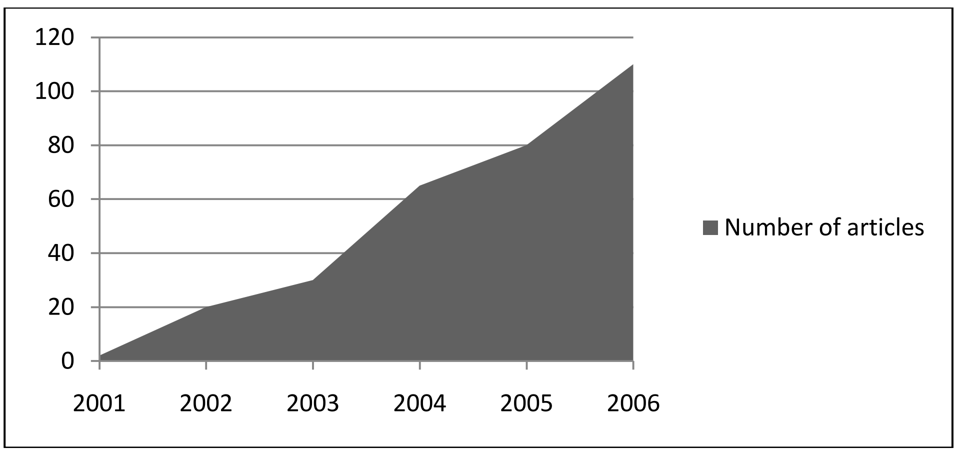
where N_{ki} corresponds to the intake of nutrient *k* by household *i* (in this study aggregate nutrient density)*; y,* corresponds to the income level of household *i*; and *S* is a vector representing various socio-demographic and economic factors that may affect nutrient intake.

This theoretical model suggests the estimation of the following model;

$$N_{ht} = f(TEC_{ht}, TENC_{ht}, N_{ht-1}, AD_t, HHA_{ht}, HHI_{ht}, HHED_{ht}, HHC_{ht}, HFL_{ht}, RD_{ht}, T_t, MI_t) \qquad (5)$$

where N_{ht} is the annual aggregated nutrient density of h^{th} household in time *t*, TEC_{ht} is the total expenditure on chain restaurants by household *h* at time *t*; $TENC_{ht}$ is the expenditure on non-chain restaurants by household *h* at time *t*; N_{ht-1} is the lagged nutrient density of h^{th} household in time *t; AD* is the total advertising expenditure by chain restaurants in year *t;*HHA_{ht} is household head's age; HHI ht is the household income; $HHED_{ht}$ is the household head's education (to capture the effect of nutrition knowledge) ; HHC_{ht} is the household composition; HFL_{ht} is the household's first language (to capture the effect of ethnic diversity); and RD_{ht} is the households region of living: ten Canadian regions were categorized into five regions- West Coast, Prairie provinces, Ontario, Quebec and Atlantic Provinces. The equation (5) is specified for thirteen (the fourteenth; calories are not included as nutrient density measure calculations are based on calories) nutrients which are encouraged for use in nutrition facts tables in restaurants and food services in Canada (Health Canada 2008). The thirteen nutrients are: Total Fat, Saturated Fat, Trans Fat, Cholesterol, Sodium, Carbohydrate, Fibre, Sugar, Protein, Vitamin A, Vitamin C, Calcium and Iron. In order to find out the effect of the agreement between Canadian Restaurants and Foodservice Association and the government to provide voluntary nutrition information, a dummy variable for the year 2005 was added to the model (*T5*). The model was also extended to include a media index (*MI*) to test the hypothesis that information on nutrition quality of FAFH: trans fatty acids, sodium, fat and so on, may have impacted the types of food consumers would purchase in this market. To construct a media variable, the Factiva data base was used to search the Canadian newspaper Globe and Mail. Using key word “nutrition” and selecting ‘food/beverage/tobacco’ and ‘hotels/restaurants/casino’ as industries, newspaper articles for the 6 years period were searched. The Canadian newspaper Globe and Mail was used as this is the Canada’s largest circulation national newspaper with a weekly readership of 935,000 among English speakers (National Audience Databank Survey 2008). The media variable was constructed using the number of articles found containing the key words (Figure 3). However, it should be noted that media index construction using French newspapers may have been different.

Figure 3: Number of Articles Containing the Word 'Nutrition' in 'Food/Beverage/Tobacco' and 'Hotels/Restaurants/Casino' Industries Related News



According to Figure 3, in selected industries, one can see an increasing number of articles containing the word ‘nutrition’ over the years. This may be an indication that people are having access to more and more information on restaurant food nutrition.

In this study, one objective is to identify whether there are habit forming preferences for selected nutrients. To analyse that, a lagged dependent variable was introduced into the model. However, the introduction of a lagged dependent variable into the model potentially creates biases in model estimation due to autocorrelation (Baltagi 2005).The standard approach to use is instrumental variable estimation. In a panel data context, a dynamic panel data model introduced by Arellano and Bond (1991) and Arellano and Bover (1995) (hereafter AB) is commonly used. The AB method can handle many econometric problems that may arise in these model estimations. Other than the lagged dependent variable which gives rise to autocorrelation, the time –invariant characteristics such as demographics and geography (fixed effects) may be correlated with explanatory variables. The short time dimension in the panel also may contribute to biases in estimation.

The AB method is a generalized method of moments (GMM) using two types of instruments: lagged levels of endogenous variables for the equation in first differences, and lagged first differences of endogenous variables for the equation in levels. In the AB models it is assumed that the endogenous variables have a constant correlation with the household specific effects. According to Browning and Collado (2007), this assumption allows the validity of AB models is tested with a Sargan test (Sargan 1958). This method can be applied to above equations (5) specified for each nutrient. Descriptive statistics of the data sample are given in Table 2.

Table 2: Descriptive Statistics of the Study Sample

Variable definition	*Variable name and sub-groups*	*Mean 2001*	*Mean 2002*	*Mean 2003*	*Mean 2004*	*Mean 2005*	*Mean 2006*
Dependent variables							
Nutrient Density							
Total Fat	**TF**	40.38	39.69	40.99	40.18	41.88	41.12
Saturated Fat	**SF**	14.92	14.63	14.85	14.24	14.96	15.21
Trans Fat	**TRF**	2.00	1.98	2.02	1.99	2.26	1.96
Cholesterol	**CHL**	171.27	170.34	182.94	184.62	176.34	183.92
Sodium	**SOD**	1697.29	1711.00	1778.11	1716.52	1813.36	1825.03
Carbohydrate	**CARB**	125.01	126.28	122.60	125.09	120.20	120.06
Fibre	**FIB**	6.83	6.88	6.90	7.44	7.49	6.92
Sugar	**SUG**	51.52	52.25	48.45	47.98	33.94	33.85
Protein	**PRO**	36.20	36.15	37.34	35.71	37.25	39.55
Vitamin A	**VITA**	4976.94	7615.65	5492.38	5124.08	4281.20	4632.00
Vitamin C	**VITC**	55.88	62.25	58.51	62.31	59.68	56.79
Calcium	**CAL**	620.69	621.57	621.33	636.07	606.74	636.11
Iron	**IRN**	3.02	2.94	2.99	3.19	3.10	3.12
Independent variables							
Expenditure on chain restaurants	EXC	109.67	119.67	121.45	115.27	116.46	114.84
Expenditure on non-chain restaurants	EXNC	110.56	116.57	115.71	121.33	125.88	232.74
Restaurants' advertising expenditure	AD	0.22	0.22	0.23	0.26	0.28	0.30
Annual income of household	HHI	45653.62	45693.17	45326.81	45995.00	47458.36	46280.00
Age of household head	HHA	53	54	55	56	57	58

Region	**RD**						
West Coast=1, otherwise=0	RD1	0.19	0.19	0.19	0.19	0.19	0.19
Prairie Provinces=1, otherwise=0	RD2	0.25	0.25	0.25	0.25	0.25	0.25
Ontario=1,otherwise=0	RD3	0.30	0.30	0.30	0.30	0.30	0.30
Quebec=1, otherwise=0	RD4	0.15	0.15	0.15	0.15	0.15	0.15
Atlantic Provinces=1, otherwise=0	RD5	0.11	0.11	0.11	0.11	0.11	0.11
Household composition	**HHC**						
Households without children	0	0.23	0.22	0.21	0.21	0.20	0.20
Households with children (<12 yrs)	1						
Household's first language	**HFL**						
English=1; otherwise=0	HFL1	0.73	0.73	0.73	0.73	0.73	0.73
French=1; otherwise=0	HFL2	0.16	0.16	0.16	0.16	0.16	0.16
Chinese=1;otherwise=0	HFL3	0.01	0.01	0.01	0.01	0.01	0.01
Other=1;otherwise=0	HFL4	0.09	0.09	0.09	0.09	0.09	0.09

According to Table 2, there are no clear trends in mean values of the nutrient densities for any nutrients over the years. Similarly, mean expenditure on chain and non-chain restaurants also do not have clear trends. However, restaurant advertising (one period lag per capita advertising) and has been increasing over the years in the sample. Table 2 also provides mean values of household income, age of household head, provincial and ethnic representation of the sample.

Results and Discussion

The AB models were estimated for the thirteen nutrients identified. According to the Sargan test statistics, the set of instruments used in the AB models for each nutrient was not rejected. Therefore, model estimations could be considered as valid. AB model estimations are provided in Table 3.

Table 3: AB Model Estimations for Thirteen Nutrients

	Total Fat	**Saturated Fat**	**Trans Fat**	**Cholesterol**	**Sodium**	**Carbohydrate**	**Fibre**	**Sugar**	**Protein**	**Vit A**	**Vit C**	**Calcium**	**Iron**
Constant	**42.709*** (4.538)**	**8.135*** (0.006)**	**2.335*** (0.050)**	**325.509*** (68.686)**	**1694.33** (306.936)**	**145.752*** (18.780)**	**11.817*** (1.810)**	**112.436*** (17.945)**	**23.115*** (5.043)**	**3184.9*** (1136.66)**	**148.52*** (36.017)**	**866.91*** (318.46)**	**4.178*** (0.704)**
Lagged nutrient density	-0.084 (0.099)	-0.054 (0.113)	-0.068 (0.091)	-0.145 (0.111)	-0.086 (0.115)	-0.069 (0.107)	-0.006 (0.106)	-0.011 (0.109)	-0.109 (0.103)	**0.195* (0.113)**	-0.066 (0.098)	**-0.286*** (0.129)**	-0.154 (0.107)
Expenditure on chain restaurants	0.197 (0.123)	0.064 (0.62)	0.010 (0.017)	0.284 (1.994)	-0.801 (8.011)	0.449 (0.348)	-0.021 (0.044)	0.192 (0.387)	-0.100 (0.154)	-153.513 (314.947)	0.559 (1.092)	-5.011 (10.076)	-0.017 (0.018)
Expenditure on non-chain restaurants	-0.146 (0.091)	-0.024 (0.047)	0.009 (0.013)	-1.318 (1.450)	-3.267 (6.065)	0.127 (0.259)	**-0.063* (0.033)**	0.079 (0.296)	0.063 (0.116)	293.006 (239.854)	0.466 (0.834)	-3.204 (7.759)	-0.005 (0.014)
Restaurants' advertising expenditure	**13.540*** (4.138)**	**38.978*** (9.822)**	-0.410 (2.417)	-385.710 (262.449)	865.935 (1083.26)	**-81.097* (48.670)**	**-24.804*** (6.472)**	**-301.231*** (63.138)**	**92.444*** (23.243)**	**-1622.44*** (493.80)**	**-423.026*** (153.29)**	-175.90 (1379.53)	-1.886 (2.592)
Annual income of household	0.0005 (0.0008)	**0.0008* (0.0004)**	-0.0001 (0.0001)	**0.032** (0.013)**	0.004 (0.055)	-0.002 (0.002)	-0.0004 (0.0003)	-0.001 (0.002)	**0.003*** (0.001)**	**-4.231* (2.190)**	-0.002 (0.007)	0.041 (0.072)	0.0001 (0.0001)
Age of household head	-0.078 (0.015)	-0.001 (0.007)	0.0008 (0.001)	**-0.508** (0.213)**	-0.021 (0.885)	0.056 (0.038)	-0.002 (0.004)	**0.088* (0.043)**	**-0.040** (0.017)**	15.095 (35.990)	-0.132 (0.122)	0.697 (1.123)	**-0.006*** (0.002)**
Education level of household head	-0.284 (0.481)	-0.257 (0.249)	0.069 (0.070)	-10.793 (7.760)	-20.766 (31.367)	0.981 (1.352)	0.229 (0.173)	1.359 (1.536)	-0.520 (0.605)	**2150.67* (1245.044)**	4.570 (4.302)	-11.265 (40.132)	-0.054 (0.074)
Region													
West Coast	**-1.369* (0.782)**	**-0.764* (0.406)**	-0.008 (0.114)	-4.029 (12.325)	9.749 (51.485)	1.265 (2.202)	0.308 (0.285)	-2.093 (2.536)	-0.131 (0.993)	**4417.22** (2022.49)**	4.028 (7.074)	-61.066 (65.528)	0.123 (0.123)
Prairie Provinces	**-1.694** (0.714)**	-0.576 (0.386)	0.012 (0.109)	-10.100 (11.656)	43.324 (49.164)	2.924 (2.082)	0.400 (0.273)	-2.503 (2.460)	-0.128 (0.933)	**4319.34** (1915.04)**	0.936 (6.657)	-22.163 (62.551)	0.160 (0.117)
Ontario	-1.071 (0.725)	-0.346 (0.376)	0.091 (0.106)	-8.936 (11.404)	53.190 (48.529)	0.856 (2.037)	0.301 (0.266)	-3.294 (2.398)	0.207 (0.916)	**4043.24** (1868.72)**	2.228 (6.536)	**-103.55* (60.704)**	0.128 (0.114)
Quebec	**-1.924* (0.993)**	-0.371 (0.517)	0.023 (0.145)	**-40.254** (15.839)**	1.514 (65.148)	**5.402* (2.810)**	0.075 (0.106)	-0.920 (3.177)	**-2.103* (1.254)**	2264.29 (2557.10)	-5.701 (8.913)	-48.986 (82.377)	-0.154 (0.155)
Atlantic Provinces							Reference Group						
Household composition	-0.818 (0.702)	-0.157 (0.363)	0.039 (0.102)	-16.397 (11.042)	0.310 (46.023)	2.328 (1.989)	-0.046 (0.257)	1.803 (2.252)	**-1.784** (0.888)**	-374.93 (1849.53)	-7.217 (6.306)	83.365 (58.438)	**-0.195* (0.109)**

Household's first language													
English	Reference Group												
French	0.040	-0.271	0.00009	34.573***	-36.878	-0.545	-0.165	1.910	1.272	1249.62	12.060	-24.016	0.113
	(0.830)	(0.428)	(0.121)	(13.093)	(55.271)	(2.334)	(0.301)	(2.707)	(1.048)	(2157.41)	(7.464)	(69.313)	(0.130)
Chinese	0.020	-1.004	0.148	-20.787	40.672	5.852	1.435*	-5.036	-9.409***	654.13	13.748	-188.11	-0.202
	(2.073)	(1.070)	(0.301)	(32.440)	(135.323)	(5.830)	(0.753)	(6.618)	(2.600)	(5326.05)	(18.660)	(171.94)	(0.324)
Other	1.618**	0.237	0.080	22.507*	28.971	-3.747*	-0.024	-2.578	0.635	-50.96	-3.981	-110.43*	0.089
	(0.763)	(0.394)	(0.111)	(11.979)	(50.037)	(2.141)	(0.280)	(2.452)	(0.961)	(2014.96)	(6.880)	(63.470)	(0.119)
Nutrition information availability (dummy variable)	1.285***	-0.361**	0.332***	-8.765*	36.513*	-1.600*	0.550***	-5.764***	-1.372***	1962.15**	2.793	-42.308*	-0.051*
	(0.307)	(0.156)	(0.046)	(4.646)	(19.445)	(0.835)	(0.121)	(1.138)	(0.390)	(817.74)	(2.656)	(25.049)	(0.045)
Media Index	-0.0006	-0.023***	-0.0004	0.457**	0.448	0.002	0.018***	0.035	-0.031**	68.64**	0.266**	0.451	0.003*
	(0.011)	(0.006)	(0.001)	(0.185)	(0.764)	(0.033)	(0.004)	(0.037)	(0.015)	(31.700)	(0.107)	(0.965)	(0.001)
Income elasticities													
Short tem	0.57	2.45	-2.24	8.53	0.11	-0.73	-2.67	-0.89	3.78	-38.81	-1.63	3.02	1.51
Long term	0.57	2.49	-2.26	8.27	0.10	-0.75	-2.60	-1.03	3.73	-36.41	-1.56	3.03	1.51
Expenditure elasticities													
Short term	0.54	0.47	0.55	0.18	-0.05	0.39	-0.34	0.41	-0.30	-3.38	1.10	-0.89	-0.62
Long term	0.56	0.50	0.57	0.19	-0.05	0.42	-0.34	0.50	-0.31	-3.33	1.10	-0.93	-0.65
Sarg. test	31.87	128.00	95.84	142.34	267.35	8.86	667.89	203.84	64.63	13.27	171.00	88.22	99.91
d.f	87	87	87	87	87	87	87	87	87	87	87	87	87
***p*-value**	0.9921	0.4321	0.2572	0.0010	0.9843	0.9954	0.0031	0.9971	0.9987	0.9992	0.0023	0.4478	0.1628

*** Statistically significant at 1%. ** Statistically significant at 5%. * Statistically significant at 10%.

In spite of no priori expectations of the patterns of demand for the nutrients in chain restaurants, depending on the analysis of purchase patterns and the analysis of nutrient densities of the purchased food items, the model estimations can be considered acceptable.

Expenditure at chain restaurants and non-chain restaurants does not affect the household consumption or intake of selected nutrients significantly. However, it is interesting to see that for households who spend significantly more on non- chain restaurants, the fibre density of food and beverages purchased from chain restaurants is significantly low. Annual household income has a significant positive effect on saturated fat, cholesterol, and protein intake, and has a significant negative effect on vitamin A intake from the chain restaurants. The model estimates suggest that the older the household head the higher the intake of sugar. An increase in sugar intake could be attributed to the highly demanded beverage categories such as cola soft drinks and coffee with milk. Cholesterol, protein and iron intakes are significantly lower as household head's become older.

It was expected that as the level of education of the household head increases, the intake of unhealthy nutrients should decrease and the intake of healthy nutrients should increase. However, for all the nutrients, with the exception of vitamin A, this relationship is not significant in our model. The higher the level of education of the household head the higher the intake of Vitamin A. Bowman *et al* (2004) found that children who consume FAFH have higher intakes of unhealthy nutrients than the children who do not eat FAFH. In addition to this study, there are concerns that sugary drinks and fast foods containing trans fat adversely affect children's nutrient intake. However, according to our results, there is a significantly lower intake of vitamin A and iron by households with children. Even though the trans fat, sodium, carbohydrate and sugar intakes show positive impacts, these estimates are not significant in this analysis**.**

Differences in nutrient intake among different ethnic categories were tested using the household's first language as a variable. English speaking households were considered to be the reference group. As compared to English speaking households, the other language speaking households consume significantly higher levels of total fat and cholesterol and significantly lower level of carbohydrates and calcium. Intake of cholesterol is higher in French speaking households as compared to English speaking households. Chinese speaking households consume significantly higher level of fibre and significantly lower levels of protein as compared to English speaking households**.**

The ten provinces in Canada are categorised into five main regions: West Coast, Prairie provinces, Ontario, Quebec and Atlantic provinces. Atlantic provinces were considered to be the reference group. As compared to households in Atlantic provinces, households on the West Coast consume less total fat and saturated fat, and more vitamin A and iron; households in the Prairie provinces consume less total fat and more vitamin A; households in Ontario consume more vitamin A and iron and less calcium; households in Quebec consume less total fat, cholesterol and protein and, more sugar.

Households' habits forming preferences for selected nutrients were modeled using a lagged dependent variable; nutrient density of each nutrient. Results indicate that only in the case of vitamin A, there is evidence of habit forming preferences. Restaurant advertising is believed to affect households' FAFH purchasing behaviour and therefore nutrient intake from these foods and beverages. Our models suggest that total fat, saturated fat and protein intakes significantly increased with increasing restaurant advertising expenditure while carbohydrate, fibre, sugar, vitamin A and vitamin are significantly lower with increasing advertising expenditure**.**

It is expected that the agreement between the Canadian Restaurant and Food Service Association and the main chain restaurants in Canada to make available nutrition information to consumers might have impacted households' food purchasing behaviour and nutrient intake. It is hypothesised that after February 2005, when the Canadian chain restaurants voluntarily started to provide their menu nutrition information through their web sites, leaflets and by various other means, households became more aware of the nutrient content of different FAFH food and beverage items and therefore, may have selected healthier menu options. To capture the effect of this scenario, a dummy variable was used. The results suggest that there are significant reductions in saturated fat, cholesterol, carbohydrate, sugar, protein, calcium and iron intake while there are significant increases in total fat, trans fat, sodium, fibre and vitamin A intake after the above agreement. One should expect that problematic nutrient intake to be reduced as households have more access to nutrition information. However, according to our results, households have not shown any concern purchasing items especially with high trans fat or sodium contents, which are considered very unhealthy nutrients. Meanwhile looking at the media indices developed for trans fat and sodium (Figure 4 and 5 -in a similar manner for the nutrition information coverage in general), one can see that media coverage on trans fat and sodium has started to increase only towards the end of the sample period of this study and therefore, results may not reflect any consumer concerns regarding these unhealthy nutrients.

Figure 1: Media Index for Trans Fat in 'Food/Beverage/Tobacco' and 'Hotels/Restaurants/Casino' Industries Related News

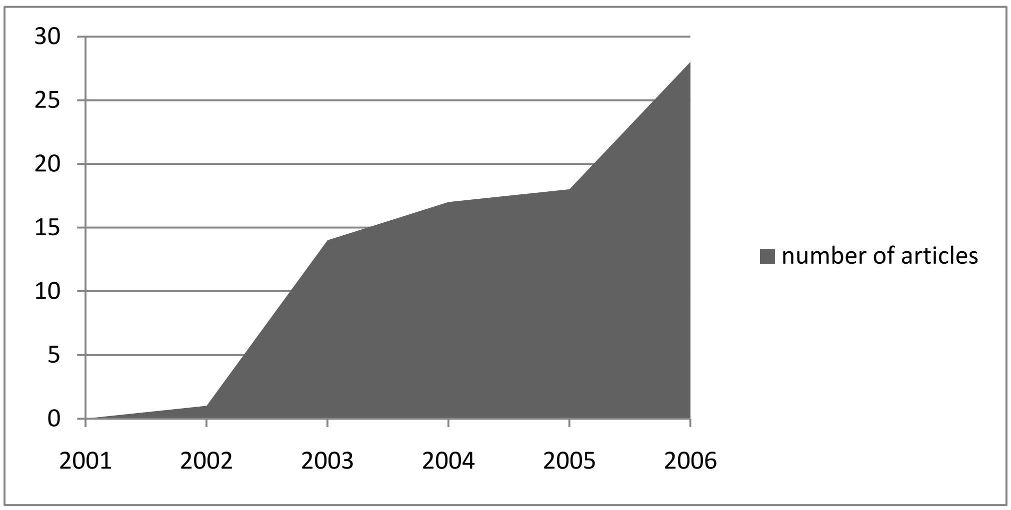
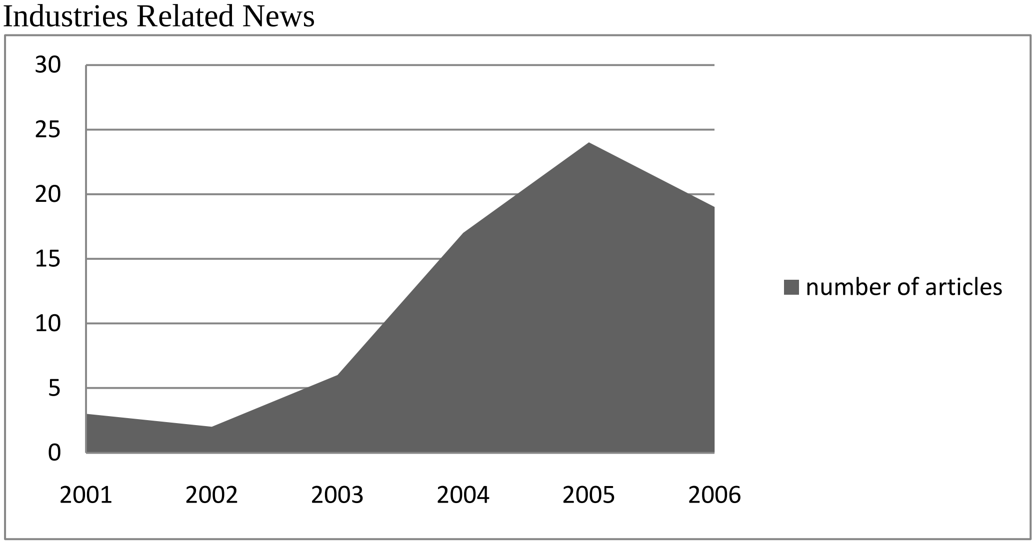


Figure 2: Media Index foe Sodium in Food/Beverage/Tobacco' and Hotels/Restaurants/Casino' Industries Related News



A media index was used as a proxy to understand the impact of households' awareness of nutrition of foods and beverages purchased from FAFH markets. Our results explains that media index is correlated with lower saturated fat and protein intake while it has positive relationship with cholesterol, fibre, vitamin A, vitamin C and iron intake.

The estimates for the dummy variable which was used to capture availability of nutrition information and the media index variable both provide evidence that households have used nutrition information to reduce their intake of saturated fat and protein and to increase their intake of fibre and vitamin A. Our results do not provide evidence that households have used information to reduce trans fat intake despite the fact that trans fat has received wide media coverage recently. Again the reason could be attributed to higher media coverage towards the end of the study period and therefore may not be reflected in consumer consumption behaviour in this sample.

Estimated income elasticities imply that trans-fats, carbohydrate, fibre, sugar and vitamin C are inferior goods; total fat and sodium are necessities; saturated fat, cholesterol, protein, calcium and iron are luxuries. Estimated expenditure elasticities imply that vitamin A and vitamin C are expenditure elastic and all the other nutrients are expenditure inelastic. While there are no studies available on nutrient demand for restaurant foods, income and expenditure elasticity estimations are widely variable in other nutrient demand studies in other contexts.

Conclusions and Recommendations

This study examined the demand for selected nutrients from foods and beverages in Canadian chain restaurants. Given that nutrition information is available for chain restaurants in Canada, a balanced panel data set consisted of 1202 households who have purchased from chain restaurants in Canada over the period 2001 to 2006 was selected for this study. The panel data was obtained from the NPD/Crest data base. Allowing for habit forming preferences, a demand model was specified for 13 nutrients. Nutrient densities were specified as a function of selected economic and socio-demographic characteristics, lagged nutrient densities, advertising, media index and a dummy variable to capture the possible impact of increasing availability of restaurant nutrition information to consumers.

As no previous studies have been undertaken to examine nutrient demand in FAFH foods, there were no a priori expectations as to how different socio-economic and demographic factors might affect different nutrient intakes. This study therefore, provides interesting new information about nutrient consumption from chain restaurants in the FAFH market.

It is disconcerting to learn from our results that household intake of some of the problematic nutrients, such as saturated fat and cholesterol increase with increasing household head's income. Moreover, sugar intake is increasing with increasing household heads' age. Given that Canadian household heads are aging and have higher incomes, our results suggest higher levels of unhealthy nutrient intake by Canadian chain restaurant food consumers. There are some significant variations in nutrient intake among ethnic groups and households in different regions. Another important finding is the comparatively low levels of vitamin A and iron intake of households with children as compared to households without children. These findings suggest that households with children are choosing unhealthy meal items which are low in some important healthy nutrients. Only vitamin A is found to have habit forming preferences. The absence of habits or addiction to most of the selected unhealthy nutrients does not suggest any barriers in designing education programs to promote healthy nutrient intake. However, the inelastic nature of expenditure on unhealthy nutrients such as sodium, cholesterol, fat, saturated fat and trans fat may have some implications for the success of imposing nutrient based tax policies.

Another important finding is the impact of restaurant advertising on nutrient demand. Restaurant advertising can be considered to be promoting certain kinds of food and beverage products which may enhance the intake of problematic nutrients in chain restaurants in the FAFH market: especially total fat and saturated fat. In our study fat, saturated fat, carbohydrates, fibre, sugar, protein, vitamin A and vitamin C intake was potentially affected by restaurant advertising. The study finding can be used in many ways to design and target nutrition education programs and to develop and implement policy tools to promote healthy eating in FAFH market.

In spite of the efforts to reduce the effects of endogenous variables and fixed effects through the AB model applications, the highly significant coefficient estimates on the constant terms imply that there may be omitted variables explaining nutrient demand in chain restaurants in FAFH market. Some of the important omitted variables could be individual tastes, attitudes, perceptions, and individual product prices. In this study, given that the modeling is done at the household level for nutrients, the above important variables were not available. Therefore, future analysis of stated preference data with the above variables is recommended to obtain more in-depth information about individual nutrient intake in chain restaurants in the FAFH market. Another limitation of this study is that model is estimated only for the chain restaurants in FAFH market and therefore, may not represent the total demand for nutrients in all FAFH purchases. Unavailability of nutrition information for the menus offered by non -chain restaurants prevented us from including non-chain restaurants in the study. Perhaps all restaurants should be required to develop representative or average nutrient information for menu items.

Reference

Abdulai, A., and D. Aubert. 2004. A Cross-Section Analysis of Household Demand for Food and Nutrients in Tanzania. *Agricultural Economics.* 31: 67-79.

Adrian, J., and R. Daniel . 1976. Impact of Socioeconomic Factors on Consumption of Selected Food Nutrients in the United States. *American Journal of Agricultural Economics* 58, no. 1: 31-38.

Baltagi, B. H. 1995. Econometric Analysis of Panel Data. Third Edition ed. England: John Wiley & Sons Ltd.

Baltagi, B.H. 2005. Econometric Analysis of Panel Data. Third Edition. Chichester: Wiley.

Bareham, J.R . 2004. Can Consumers be Predictable or are they Unmanageable? *International Journal of Contemporary Hospitality Management.* 16, no. 3: 159-65.

Baric,I.C, Z. Satalic and Z.Lukecic. 2003. Nutritive Value of Meals, Dietary Habits and Nutritive Status in Croatian University Students According to Gender. *International Journal of Food Sciences and Nutrition*. 54, no.6:473-484.

Basiotis, P., M. Brown, S. R. Johnson, and K. J. Morgan. 1983. Nutrient Availability, Food Costs, and Food Stamps. *American Journal of Agricultural Economics.* 65, no. 4: 685-93.

Beatty, T.K.M. 2007. Recovering the Shadow Value of Nutrients. *American Journal of Agricultural Economics.* 89, no.1:52-62.

Beatty,T. K. M., and J. T. Lafrance. 2006. United States Demand for Food and Nutrition in the Twentieth Century. *American Journal of Agricultural Economics.* 87, no. 5: 1159–1166.

Binkley, J. K. 2006. The Effect of Demographic, Economic and Nutrition Factors on the Frequency of Food Away From Home. *The Journal of Consumer Affairs.* 40, no. 2: 372-91.

Binkley, J.K., J. Eales, and M. Jekanowskei. 2000. The Relation between Dietary Change and Rising US Obesity. *International Journal of Obesity*. 24, no. 8:1032-1039.

Binkley, J. 2008. Calorie and Gram Differences between Meals at Fast Food and Table Service Restaurants. *Review of Agricultural Economic*. 30,no.4:750-763

Blaylock, J., D. Smallwood, K. Kassel, J.N.Variyam, and L.Aldrich. 1999. Economics, Food Choices and Nutrition. *Food Policy.* 24:269-286.

Bowman, S. A., and B. T. Vinyard. 2004. Fast Food Consumption of U.S. Adults: Impact on Energy and Nutrient Intakes and Overweight Status. *Journal of the American College of Nutrition.* 23, no. 2: 163-68.

Bowman, S.A., S.L. Gortmaker, G.B. Ebbeling, M.A. Pereira, and D.S. Ludwig. 2004. Effects of Fast Foods Consumption on Energy Intake and Diet Quality among Children in a

Nutritional Households Survey. *Paediatrics*. 113:112-118.

Briefel, R.R. and C.L.Johnson. 2004. Secular Trends in Dietary Intake In The United States. *Annual Review of Nutrition*. 24:401-431

Brown, D.J., and L.F. Schrader. 1990. Cholesterol Information and Shell Egg Consumption. A*merican Journal of Agricultural Economics*. 72, no. 3:548-555.

Browning, M., and M.D. Collado. 2007. Habits and Heterogeneity in Demands: A Panel Data Analysis. *Journal of Applied Econometrics.* 22, no. 3: 625-40

Burns, C., M. Jackson, C. Gibbsons, and R.M. Stoney. 2001. Foods Prepared Outside the Home: Association with Selected Nutrients and Body Mass Index in Adult Australians. *Public Health Nutrition*. 5, no.3:441-448.

Burton, M. P. and T. Young. 1996. The Impact of BSE on the Demand for Beef and Other Meats in Great Britain. *Applied Economics.* 28: 687-93.

Capps, O. Jr., and J.D. Schmitz. 1991. A Recognition of Health and Nutrition Factors in Food Demand Analysis. *Western Journal of Agricultural Economics*. 16, no.1:21-35.

Chern, W.S., and K. Rickertsen. 2003. Health, Nutrition and Food Demand. CABI publishing. Wallingford, Oxon, UK.

CSPI. Center for Science in the Public Interest. 2008. “Trans Fat”. Web page [accessed 2008]. Available at http://www.cspinet.org/transfat/index.html.

Davis, C.G. 1997. The Logic of Testing Structural Change in Meat Demand: A Methodological Analysis and Appraisal. *American Journal of Agricultural Economics.* 79, no. 4: 1186-92.

Davis, C.G. 1982. Linkages Between Socioeconomic Characteristics, Food Expenditure Patterns, and Nutritional Status of Low Income Households: A Critical Review. *American Journal of Agricultural Economics.* 68:1017-1025.

Devaney, B, and T. Fraker. 1989. The Dietary Impacts of the School Breakfast Program. *American Journal of Agricultural Economics* 71, no. 4: 932-48.

Dhehibi, B., J. M. Gil, and A. M. Angulo. 2003. Nutrient Effects on Consumer Demand: A Panel Data Approach. Proceedings of the 25th International Conference of Agricultural Economists (IAAE).

Drewnowski, A. 2005. Concept of a Nutritious Food: Toward A Nutrient Density Score. *American Journal of Clinical Nutrition.* 82, no. 4: 721-32.

Drewnowski, A. 2003. Fat and Sugar: An Economic Analysis. *The Journal of Nutrition*. 133:838S-840S.

Duffey, K.J., P.G. Larsen, D.R. Jacobs, Jr., O. D. Williams, and B.M. Popkin. 2007. Differential Association of Fast Food and Restaurant Food Consumption with 3-Yr Change in Body Mass Index: The Coronary Artery Risk Development in Young Adult Study. *American Journal of Clinical Nutrition*. 85:201-208.

Eastwood, D. B., J.R. Brooker, and D.E. Terry. 1986. Household Nutrient Demand: Use of Characteristics Theory and a Common Attribute Model. *Southern Journal of Agricultural Economic.* 18, no.2:235-246.

Fitzpatrick, M.P., G.E. Chapman, and S.I. Barr. 1997. Lower-Fat Menu Items In Restaurants Satisfy Customers. *Journal of American Dietetic Association*. 97, no.5:510-514.

Fousekis, P., and P. Lazaridis. 2005. The Demand for Selected Nutrients by Greek Households: An Empirical Analysis with Quantile Regressions. *Agricultural Economics*. 32:267-279.

French, S. A., M. Story, D. Neumark-Sztainer, J. A. Fulkerson , and H. Hannan. 2001**.** Fast Food Restaurant Use among Adolescents: Associations with Nutrient Intake, Food Choices and Behavioural and Psychosocial Variables. *International Journal of Obesity.* 25, no. 12: 1823-33.

French, S. A., M. Story, and R. W. Jeffery. 2001. Environmental Influences on Eating and Physical Activity. *Annual Review of Public Health.* 22: 309-35.

French, S.A., L. Harnack, and R.W. Jeffery. 2000. Fast Food Restaurant Use Among Women In the Pound of Preservation Study: Dietary, Behavioural and Demographic Correlates. *International Journal of Obesity*. 24;1353-1359.

Gills, L.J., O. Bar-Or. 2003. Food Away from Home, Sugar Sweetened Drink Consumption and Juvenile Obesity. *Journal of American College of Nutrition*. 22, no.6:539-545.

Guthrie, J., F. B. Lin, and E. Frazao. 2002. Role of Food Prepared Away From Home in the American Diet, 1977-78 versus 1994-96: Changes and Consequences. *Journal of Nutrition Education and Behaviour.* 34, no. 3: 140-150.

Grossman, M. 1972. On The Concept of Health Capital and Demand For Health. *Journal of Political Economics*. 80, 223–255.

Grossman, M., R.Kaestner. 1997. Effects of Education On Health. In Behrman, J. R., Stacey, N. G. (Eds.) The Social Benefits of Education. University of Michigan Press, Ann Arbor, MI, pp. 69–123.

Hansen R.G., B.W. Wyse, and A.W. Sorenson. 1979. Nutrition Quality Index of Food. Westport: CT: AVI Publishing Co.

Health Canada. 2008. Food and Nutrition: Food Labelling. Web page [accessed 2008]. Available at http://www.hc-sc.gc.ca/fn-an/pubs/label-etiquet/index-eng.php

Huang, K.S. and B.H.Lin. 2000. Estimation of Food Demand and Nutrition Elasticities from Household Survey Data. Food and Rural Economic Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1887.

Huang, C.L., and S. Misra. 1991. Assessing Nutritional Adequacy of Americans Based on Individual Food Intake Patterns. *Journal of Consumer Studies and Home Economics*. 15:147-159.

Kim, S.R., and W.S. Chern. 1999. Alternative Measures of Health Information and Demand for Fats and Oils In Japan. *The Journal of Consumer Affairs*. 30, no. 1:92-109.

Kinnucan, H.W., H. Xiao, C.J.Hsia, and J.D.Jackson. 1997. Effects of Health Information and Generic Advertising on U.S. Meat Demand. *American Journal of Agricultural Economics.* 79, no. 1: 13-23.

Morgan, K.J., 1986. Socio-Economic Factors Affecting Dietary Status: An Appraisal. *American Journal of Agricultural Economics.* 68, no.5:1240-1246.

Nayga, R. M. Jr., and O.Capps. Jr. 1994. Analysis of Away-from-Home and At-Home Intake of Saturated Fat and Cholesterol. *Review of Agricultural Economics*. 16, no. 3: 387-98.

Nayga, R. M. Jr., 1994. Effects of Socioeconomic and Demographic Factors on Consumption of Selected Food Nutrients. *Agricultural and Resource Economics Review*.23, no.2:171-182.

Nayga, R. M. Jr., and O. Capps, Jr. 1992. Determinants of Food Away from Home Consumption: - An Update. *Agribusiness.* 8, no. 6: 549-59.

Nayga, R. M. Jr., J. Beverly, T.L. Rosenzweig. 1999. Assessing The Importance of Health Related Factors on Food Demand: A Variable Preference Investigation. *Applied Economics*. 31:1541-1549.

Nestle, M. 2002. Food Politics: How the Food Industry Influences Nutrition and Health: Revised and expanded version. The University of California Press.

NPD Group Inc. 2007. “Food Service: Consumer Tracking”. Web page, [accessed 2007]. Available at http://www.npd.com/corpServlet?nextpage=foodservice-crest_s.html.

Paeratakul, S., D.P. Ferdinand, C. M. Champagne, D.H. Ryan, and G. A. Bray. 2003. Fast-Food Consumption Among US Adults and Children: Dietary and Nutrient Intake Profile. *Journal of American Dietetic Association.* 103, no. 10: 1332-1338.

Patra,J., S. Popaya, J.Rehm, S.Bondy, R. Flint and N. Giesbrecht. 2007. Economic Cost of Chronic Diseases in Canada 1995-2003. Report prepared for the Ontario Chronic Diseases Prevention Alliances and the Ontario Public health Association.

Patric, H. and T.A.Nicklas. 2005. A review of Family and Social Determinants of Children’s Eating Patterns and Diet Quality. *Journal of American College of Nutrition.* 24,no2:83-92.

Pereira, M. A., A. Kartashov, C.B. Ebbeling, L.V. Horn, M.L. Slattery, D.R. Jacobs, Jr., and D.S. Ludwig. 2005. Fast Food Habits, Weights Gain and Insulin Resistance (The CARDIA Study):15-Year Prospective Analysis. *Lancet*. 365: 36-42.

Park, J., G.C. Davis. 2001. The Theory and Econometrics of Health Information in Cross-Sectional Nutrient Demand Analysis. *American Journal of Agricultural Economics.* 84, no. 4:840-851.

Parliament of Canada. 2006. Bill C-283. Web page, [accessed in 2008]. Available at http://www2.parl.gc.ca/content/hoc/Bills/391/Private/C-283/C-283_1/C-283_1.PDF

Patterson, R. E., P. S. Haines, and B. M Popkin. 1994. Diet Quality Index: Capturing A Multidimensional Behaviour. *Journal of the American Dietetic Association.* 94, no. 1: 57-64.

Popkin, B.M. 2006. Global Nutrition Dynamics: The World is Shifting Rapidly Towards a Diet Linked With Non-Communicable Diseases. *The American Journal of Clinical Nutrition. 84:289-98.*

Ramezani, C. A., 1995. Determinants of Nutrient Demand: A Nonparametric Analysis. *Journal of Agricultural and Resource Economics.* 20, no. 1: 165-77.

Richards, T. J., P.M. Patterson, M. Paul , and S.Hamilton. 2007. Fast Food, Addiction, and Market Power. *Journal of Agricultural and Resource Economics.* 32: 425-47.

Rickertsen, K., 1998. The Effects of Advertising in an Inverse Demand System: Norwegian Vegetables Revisited. *European Review of Agricultural Economics.* 25, no. 1: 129-40.

Statistics Canada. 2007. "Survey of Household Spending and CANSIM II (table no. 203-0002)." Web page, [accessed January 2008]. Available at http://www.statcan.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=3508&lang=en&db=imdb&dbg=f&adm=8&dis=2 .

Subramanian, S., and A. Deaton. 1996. The Demand for Food and Calories. *The Journal of Political Economy.* 104, no. 1: 133-62.

Tansel, A. 1993. Cigarette Demand, Health Scares and Education in Turkey. *Applied Economics.* 25: 521-29.

Thompson, O.M., C. Ballew, K. Resnicow, A. Must, L.G.Bandini, H. Cyr, and W.H. Dietz. 2004. Food Purchased Away From Home as a Predictor of Change in BMI-Z Score Among Girls. *International Journal of Obesity*. 28:282-289.

Taveras, E.M., C.S. Berkey, S. L. Rifas-Shiman, D.S. Ludwig, H.R.H. Rockett, A.E. Field, G. A. Colditz, and M.W. Gillman. 2001. Association of Consumption of Fried Food Away From Home with Body Mass Index and Diet Quality in Older Children and Adolescents. *Paediatrics*. 116, no. 4:e518-e524.

USDA National Nutrient Data Base. 2007. "Nutrient Data Laboratory". Web page [accessesd in 2007]. Also available at http://www.nal.usda.gov/fnic/foodcomp/search/

Variyam, J. N., and E. Golan. 2002. New Health Information is Reshaping Food Choices. *Food Review*. 25, no.1:13-18.

Variyam, J. N. 2005. Nutrition Labelling in the Food-Away-From-Home Sector: An Economic Assessment. *USDA-ERS Economic Research Report.* Report no.4.

Variyam, J. N., J. Blaylock, and D. Smallwood. 2002. Characterizing the Distribution of Macronutrients Intake among U.S. Adults: A Quantile Regression Approach. *American Journal of Agricultural Economics*. 84, no. 2:454-466.

Verlegh, P.W.J. and M.J.J.M.Candel. 1999. Consumption of Convenience Foods: Reference Groups and Eating Situations. *Food Quality and Preference*. 10:457-464.