REPUBLIC OF TURKEY
YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS
MASTER OF ARTS PROGRAMME IN ECONOMICS

MASTER'S THESIS

ESTIMATION OF FOOD PRICE-NUTRIENT AND NUTRIENT-EXPENDITURE ELASTICITIES FOR TURKEY

NESLİHAN DÖNMEZ
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Prof. Dr. HÜSEYİN TAŞTAN

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ABSTRACT

ESTIMATION OF FOOD PRICE-NUTRIENT AND NUTRIENT-EXPENDITURE ELASTICITIES FOR TURKEY

Neslihan DÖNMEZ

July, 2019

This study explores the effects of total food expenditure and food prices on nutrient intake in Turkey by estimating nutrient elasticities and aims to make an important contribution to the literature on nutrient demand. For this purpose, first, the Quadratic Almost Ideal Demand System (QUAIDS) is estimated for 12 food groups by using Turkish Household Budget Survey Data Set for the year 2003 in order to compute the expenditure and price elasticities. The expenditure elasticities for each food group are found to be positive, the own-price elasticities for each food group found to be negative; besides, all the demand elasticities are found to be statistically significant. In the second stage of the analysis, the nutrient values of the food groups are compiled from Türkomp National Food Composition Database to compute the nutrient shares in the food groups for selected 21 nutrient types. The obtained nutrient shares and the expenditure and own-price elasticities are used to estimate the expenditure-nutrient and food price-nutrient elasticities. It is found that an increase in total food expenditure increases the intake of all nutrients, and an increase in food prices reduces the intake of almost all nutrients. Since most nutrient types are provided from cereals, bread, meat and fish, dairy products, vegetables and fruits, increases in these food prices significantly affect most nutrients intakes. Finally, besides nutrient elasticities, the daily values of individual nutrient intake are calculated and compared with reference values. Results show that individual iodine, and vitamin A intakes are low while individual carbohydrate, protein, and sodium intakes are high for individuals. The most important finding in this analysis is that individual iodine intake is lower than the reference value and the increase in total expenditures does not have a large effect on iodine intake. Moreover, individual carbohydrate intake is found to be very high; however, a rise in total expenditure increases carbohydrate intake by one to one; hence, carbohydrate intake would be much higher. Likewise, changes in food prices also affect nutrient intake, but this effect is not large enough. Given all this, policies to be implemented on income and food prices may not produce desirable results for nutrient intake. The empirical findings of this study imply that income and food prices may not be effective policy tools for nutrient intake; therefore, the nutrition policy for improving individual nutritional status should be implemented considering all factors in addition to income and prices by policymakers.

Key Words: Nutrient Elasticities, Demand System, Turkey, Household Survey Data, Food Demand

ÖZ

TÜRKİYE İÇİN GIDA FİYATI-BESİN VE BESİN-HARCAMA ESNEKLİKLERİNİN TAHMİNİ

Neslihan Dönmez

Temmuz, 2019

Bu çalışmada Türkiye için besin esneklikleri hesaplanarak gıda fiyatlarının ve toplam gıda harcamalarının besin alımı üzerindeki etkileri araştırılmıştır ve bu çalışma ile besin talebi üzerine literatüre önemli bir katkı sağlanması amaçlanmıştır. Bunun için ilk olarak 2003 yılı Türkiye Hanehalkı Bütçe Anketi Veri Seti kullanılarak İkinci Dereceden Yaklaşık İdeal Talep Sistemi (QUAIDS) modeli 12 gıda grubu için tahmin edilmiş ve bu gıda grupları için harcama ve fiyat esneklikleri hesaplanmıştır. Ekonomik teoriye tutarlı olarak tüm gıda grupları için harcama esneklikleri pozitif, kendi fiyat esneklikleri negatif bulunmuş ve hepsi istatistiksel olarak da anlamlı çıkmıştır. Analizin ikinci aşamasında bu çalışmanın asıl konusu olan besin esnekliklerini hesaplamak için öncelikle 21 besin türü seçilerek tüketilen gıdaların besin değerleri Türkomp Ulusal Gıda Kompozisyonu Veri Tabanı'ndan derlenmiştir ve gıda grupları içindeki besin payları hesaplanmıştır. Besin payları ile birlikte gıda talebinden elde edilen harcama ve gıdaların kendi fiyat esneklikleri kullanılarak harcama-besin ve gıda fiyatı-besin esneklikleri hesaplanmıştır. Sonuçlara göre, toplam gıda harcamalarındaki artış tüm besin türlerinin alımını artırmaktadır ve gıda fiyatlarındaki artış ise neredeyse tüm besin türlerinin alımını azaltmaktadır. Besin türleri alımının çoğu tahıllar, ekmek, et ve balık, süt ve süt ürünleri, sebze ve meyve gıda gruplarından sağlandığı için bu gıdaların fiyatlarındaki artışlar hemen hemen tüm besin türlerinin alımını önemli ölçüde etkilemektedir. Son olarak, besin esnekliklerine ek olarak analize dahil edilen bireylerin günlük aldıkları besin değerleri hesaplanmış ve referans değerleri ile karşılaştırılmıştır. Sonuçlara göre bireylerin iyot ve A vitamini alımı düşük, fakat karbonhidrat, protein ve sodyum alımı yüksek çıkmıştır. Tüm bulgular göz önüne alındığında şöyle bir sonuç çıkmaktadır; gelir üzerinden yapılacak politikalar beklenilen sonuçları veremeyebilir. Bu çalışmanın ampirik bulguları, gelir ve gıda fiyatlarının besin alımı için etkili politika araçları olamayacağı; bu nedenle, bireysel beslenme durumunun iyileştirilmesine yönelik beslenme politikası, politika yapıcılar tarafından gelir ve fiyatların yanı sıra tüm faktörler göz önünde bulundurularak uygulanmalıdır.

Anahtar Kelimeler: Besin esneklikleri, Talep Sistemi, Türkiye, Hanehalkı Bütçe Anketi Verisi, Gıda Talebi

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AIDS : Almost Ideal Demand System

Calo. : Calorie

Carb. : Carbohydrate

Chol. : Cholesterol

COICOP : Classification of Individual Consumption By Purpose

DW : Durbin-Watson

FAO : Food and Agricultural Organisation

F & O : Fats and Oils

G. : Gram

GDP : Gross Domestic Products

Gluc. : Glucose

IAD : Indirect Addilog Model

Iod. : Iodine

KCAL : Kilocalorie

LA : Linear Approximation

LAAIDS : Linearly Approximated Almost Ideal Demand System

LES : Linear Expenditure System

Mag. : Magnesium

MCG : Microgram

MRS : Marginal Rate of Substitution

M & DP : Milk and Dairy Products

M & F : Meat and Fish

NAB : Non-Alcoholic Beverages

ND : Not Defined

Nia : Niacin

NLSUR : Nonlinear Seemingly Unrelated Regression

NUTS: Nomenclature of Territorial Units for Statistics

OLS : Ordinary Least Square

Other F. : Other Food

Phos. : Phosphor

PIGLOG : Price-Independent Generalized Logarithmic

Pot. : Potassium

Prot. : Protein

RE: Retinol equivalent

QES : Quadratic Expenditure System

QUAIDS : Quadratic Almost Ideal Demand System

Sod. : Sodium

Thi : Thiamin

TukStat : Turkish Statistical Institution

T & C : Tea and Coffee

USA: United States of America

Veg. : Vegetables

Vit.A : Vitamin A

V.B6 : Vitamin B6

V.B12 : Vitamin B12

V.C : Vitamin C

WHO : World Health Organisation

1. INTRODUCTION

Nutrition is one of the basic requirements for the human survival. With the developments in the world from past to present, efficiency in food production has increased and the distribution of produced food has been facilitated throughout the world and it has become easier for people to access food. In contrast to the developments in food production, malnutrition[1] has become one of the main problems for people in the world that affects human health, working life, and social situation significantly.

There are many types of malnutrition such as undernutrition[2], nutrient deficiency[3], and obesity, and they still continue to exist as significant problems. In all countries, at least one type of malnutrition is seen, and its effects are various; the human productivitydecreases, health problems get wider, and health expenditures of both individuals and countries increase. Moreover, societies and countries are affected economically by increasing health expenses and preventing sustainable development by malnutrition as well as individuals.

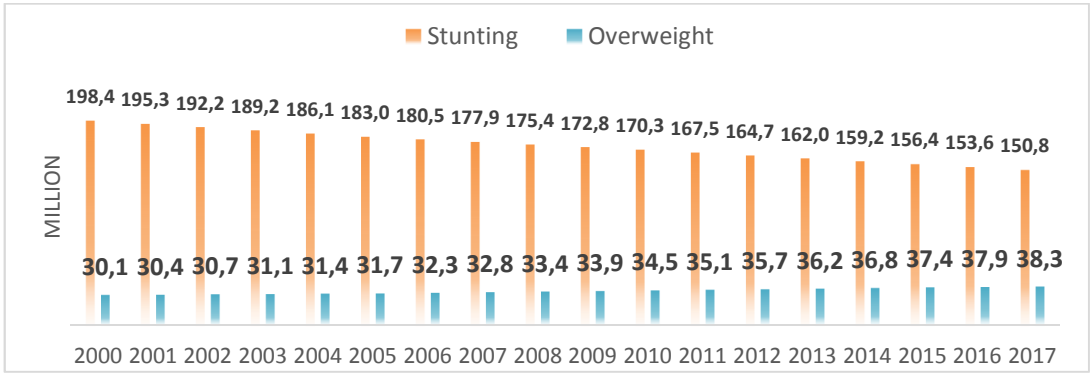

Figure 1: Number of Children Affected By Malnutrition (Million of Children)

This figure is adapted from Development Initiatives, **Global Nutrition Report 2018Report: Shining a light to spur action on nutrition** (Bristol, 2018).

[1] World Health Organisation defines malnutrition as excesses, imbalances or deficiencies in an individual's calorie and/or nutrient intake.
[2] Undernutrition refers to deficiencies in an individual's calorie, macronutrients (protein, fat, carbohydrate) and/or micronutrients (Environmental Change Institute).
[3] Nutrient deficiency is defined as insufficient nutrient intake such as vitamins and minerals.

Some malnutrition types are gradually decreasing, however, in some cases, such as anemia, the level is stable, but there has been an increase in obesity and overnutrition. Figure 1 presents the statistics related with stunting[4] and overweight in the world and it shows that the number of child stunting decreases over the years; however, the overweight problem cannot be interpreted in the same line. A slow increase in the number of overweighted children throughout years is visible in Figure 1, in addition, child stunting decreased by 47.6 million in seventeen years. Besides, 50.5 million children face with wasting[5] in 2017 (Development Initiatives, 2018). In addition, the health problems among children aged 0-6 years were investigated in Turkey, and anemia is one of the crucial health problems for children. However, the ratio of anemia has decreased over the years, while it was 11.3 percent in 2008, this rate decreased to 9.2 percent in 2012 and to 5.4 percent in 2016 (TurkStat).

Table 1: Obesity Statistics for Adults Over Years

	World (Aged 18 and More)			**Turkey** (Aged 15 and More)		
Year	**Total**	**Men**	**Women**	**Total**	**Men**	**Women**
2008	10.7 %	8.6 %	12.6 %	15.2 %	12.3 %	18.5 %
2010	11.2 %	9.2 %	13.2 %	16.9 %	13.2 %	21 %
2012	11.8 %	9.8 %	13.8 %	17.2 %	13.7 %	20.9 %
2014	12.5 %	10.4 %	14.4 %	19.9 %	15.3 %	24.5 %
2016	13.1 %	11.1 %	15.1 %	19.6 %	15.2 %	23.9 %

This table is adapted from Development Initiatives, **2018 Global Nutrition Report: Shining a light to spur action on nutrition** (Bristol, 2018) and Turkish Statistical Institute, **Turkey Health Survey 2016**.

Table 1 presents the statistics of obese adults in the world and obesity in adults increases over the years. Likewise, in the world, obesity problem is an important issue in Turkey. An increase in obesity throughout the world, has the same increasing trend

[4] Stunting refers to children under 5 years of age having low height for their age.
[5] Wasting refers to children under 5 years of age having low weight for their height.

in Turkey. In addition, obesity problem is more widespread among women than men in both Turkey and the world. This rate is 15.1 percent for women and 11.1 percent for men worldwide, while 23.9 percent for women and 15.2 percent for men in Turkey. Almost one in five people suffer from obesity and in 2016, 19.6 percent of the population aged 15 and over faced with the problem of obesity in Turkey.

The nutritional problems arise mainly from low-quality food consumption, inadequate access to health services, and unhealthy environmental conditions. Table 2 shows 141 countries affected by three types of malnutrition. The overweight problem is seen the only malnutrition problem in 11 countries that are Argentina, Australia, Brunei Darussalam, Chile, Costa Rica, Germany, Mexico, Mongolia, Nicaragua, Peru, and the USA. On the other hand, 5 countries, China, Japan, Republic of Korea, Singapore, and Sri Lanka, have only anemia. These are Asian countries and their diet are based on mostly seafood and rice, which could be the reason why they have only anemia. Moreover, only one country, Philippines, is suffered by stunting.

Table 2: Number of Countries Affected By Types of Malnutrition

Types of Malnutrion	Number of Countries
Overweight (Only)	11
Anemia (Only)	5
Stunting (Only)	1
Overweight and Anemia	54
Overweight and Stunting	3
Anemia and Stunting	26
Overweight, Anemia and Stunting	41

Development Initiatives, **2018 Global Nutrition Report: Shining a light to spur action on nutrition** (Bristol, 2018).

Overweight and stunting are seen in three countries at the same time; Ecuador, Guatemala, and Honduras. In addition, 26 countries have anemia and stunting, 41 countries face three types of malnutrition at the same time, and lastly, 54 countries suffer overweight and anemia at the same time. All 141 countries having malnutrition are shown in Table 19 and Table 20, and Turkey is one of these countries that suffer from both overweight and anemia.

What are the effects of malnutrition in human life? Malnutrition reduces human productivity and potential that cause health problems and expose human bodies to diseases; as a result, they induce to fight against diseases become difficult. However, if individuals can nourish enough and take the required calories and other nutrients, it provides positive returns for their lives, communities, and countries. Good nutrition can help to break the cycle of poverty, contribute to sustainable development, as well as leading to a positive impact on the economy. Akinleye and Rahji (2007) state that calorie intake is an important connection for productivity and health.

Besides the effects of malnutrition on human life, it has effects on the economy. From an economic point of view, studies indicate that there is a strong relationship between income and household calorie intake. It is a positive relationship that is particularly large in low income groups. But the strong relationship between these two cannot be interpreted as an effective nutrient intake. In fact, people may even switch to unhealthier food when their income increase. On the other hand, a decrease in individual income does not result in a reduction in calorie consumption. This means that people can shift their consumption to food with lower nutritional value but higher calorie value, so that there may be no change in calorie consumption or a staggering change. In other words, people substitute low-nutrient food with high-nutrient ones. . There have been two arguments in the literature on this subject. First, increasing income of the poor increase nutrient intake, and income growth decreases malnutrition. In this case, income-nutrient elasticity is different from zero. Secondly; an increase in income may not provide a significant change or improvement in nutrient intake for people. As a result, nutrient intake is reduced when the household income decreases.

Economic research on calorie consumption has gained more importance over the years. However, a pure investigation on the relationship between calorie and income does not provide enough information for policymakers. In other words, it is difficult to find solutions for every type of malnutrition by analyzing the only calorie-income relationship because calorie and other nutrients intakes may not change in the same way as income grows, and these studies cannot provide any information about it. For this reason, the effect of income on the other macronutrients and micronutrients intakes should be examined. This can provide important information to make improvements in nutrition.

Most studies on nutrient intake employ food demand analysis as an instrument to obtain nutrient elasticities. The estimated food demand elasticities give information about the impacts of changes in income and food prices on household food consumption. In addition, this demand system is also applied to the nutrient intake; thus, price and income-related nutrient elasticities can be calculated. Then, the effects of changes in both income and food prices on nutrient consumption can be seen. In the literature on this subject, two approaches are used to estimate nutrient elasticities. The first approach is a direct method that helps to estimate a demand model on nutrient intake by using nutrient values instead of amounts of food. In this method, the nutritional values of food consumed are calculated, and the prices for nutrients are derived by the calculation of consumption values, consumption amounts and nutritional values of the food.

Contrary to the direct method, nutrient elasticity in the indirect method is computed from the price and income elasticities of food. The first step, a demand model is estimated on the consumed food commodities and the income and price elasticities are computed. Then, nutrient elasticities are calculated by using the nutritional values of the food consumed and the estimated income and price elasticities. However, in studies using the direct method such as Behrman and Deolalikar (1987), it is stated that the nutrient elasticities calculated using the indirect method are estimated larger than the direct method, therefore, they have used the direct method in their studies. On the other hand, the indirect method used in the studies indicates that demand is for food, not for nutrients. In other words, consumption decisions are made for food commodities rather than nutrients.

In the world, malnutrition has a large impact on economies. Therefore, the issue of nutrition should be examined economically. Many institutions and organizations work on nutrition; at the same time, researchers have examined this issue in the academic sense. There is a literature of empirical studies about the analysis of economic factors' impacts on nutrition for different countries and this study is motivated by a lack of an implication for Turkey; thus, it fills the gap in the literature.

In this context, this study aims to examine the economic aspects of nutrition issues in Turkey. To this end, a food demand model is estimated to observe the nutritional habits in Turkey and then, the impacts of food prices and total food expenditure on nutrient intake for Turkish households are illustrated. For this purpose, in this study, the

nutrient elasticities are computed over the household food demand and the indirect method is used to obtain the nutrient elasticities.

By employing the indirect method, the food demand system is estimated by using Household Budget Survey Data for the year 2003. The reason for using 2003 data is that current data sets do not provide some information about the amount of consumption for food and some characteristics of households. In the data set, there are 25,764 households that completed the budget survey correctly. However, all these households could not be included in the analysis; hence, only 6,048 households are included. The number of observations is decreased due to several factors; the information about food consumption for 17 households was missing, the nutrient values are only matched with 597 food commodities instead of 1,408 food commodities, and the zero consumption of food commodities are excluded. Given these factors, the demand model is estimated with 6,048 households' food consumption values and their demographic characteristics such as household size, marital status, total food expenditure instead of income and working status are also included in the demand analysis.

In order to use in the food demand analysis, 12 aggregated food groups are obtained from 6,048 households' consumption of food commodities; these food groups are bread, meat and fish, milk and dairy products, eggs, fats and oils, fruits, vegetables, sugar, tea and coffee, non-alcoholic beverages and the other food commodities. The Quadratic Almost Ideal Demand System developed by Banks, Blundell, and Lewbel (1997) is constructed to estimate the food demand model in order to compute the expenditure and price elasticities for 12 food groups. This model is analyzed by using the expenditure shares of each food groups and their unit values instead of the food prices.

The expenditure shares of food groups are computed, and they represent the preferences of households regarding those groups. The findings show that the expenditure share of vegetables constitutes the highest share in total food expenditure. In addition, expenditure shares of bread, meat and fish and cereals are also higher compared to other food groups. The expenditure shares do not differ with respect to location and income levels; specifically, they are found to be similar in urban and rural areas and among different income groups. According to the demand model results, the expenditure elasticities of 12 food groups are found to be positive and statistically

significant. The expenditure elasticity of meat and fish is found to be the highest expenditure elasticity; hence, most households increase consumption of meat and fish when their total food expenditure increases. Likewise, the expenditure elasticities of some other food groups such as cereals, fruits, vegetables and sugar are also found to be high. The results show that total food expenditure by each household strongly affects the expenditures of some food groups. Furthermore, all the own price elasticities are found to be negative and uncompensated price elasticities show that while the highest price responsive food groups are cereals and vegetables, eggs and bread have the lowest ones. Lastly, almost all the compensated cross price elasticities are found to be positive indicating that most food groups are substitutable.

The second part of the analysis is the estimation of nutrient elasticities, which is the main objective of this study. For this purpose, the nutrient shares of food groups and the expenditure and uncompensated price elasticities are used to estimate the nutrient elasticities. First of all, the shares of 21 different nutrient types are computed for all food groups so that the proportion of nutrient intakes as a result of household food consumption can be observed. Among the food groups, bread is found to be the largest nutrient source even serving as the largest protein provider for Turkish households. Cereals, vegetables, meat and fish groups provide high nutrient intakes to households.

The results of the nutrient elasticities are represented, and the expenditure-nutrient elasticities are found to be positive for each nutrient and this is interpreted as an increase in the total food expenditure increase all the nutrient intake for households. Most of the expenditure-nutrient elasticities are around to unity, some of them are around 0.8 and only three of them are lower which are iodine, sodium, and calcium. Furthermore, most of the food price-nutrient elasticities are found to be negative and some of the food groups' prices, which are cereals, bread, meat and fish, vegetables, milk and dairy products, affect nutrient intakes more than the other food groups. Those can be represented as increases in food prices decrease most of the nutrient intakes.

In this study, the individuals daily nutrient requirements are represented as the reference values and daily nutrient intakes of individuals in Turkey are computed in order to compare with the reference values to see the nutritional situation of Turkish people. Individuals in the households consume vitamin A and iodine less than the reference values, and carbohydrate, sodium and protein more than the reference values. These findings are also consistent with the expenditure shares of food groups because

the expenditure shares of bread, meat and fish, and vegetables are higher in the total food expenditure and those food groups provide most of the nutrients for households. Especially bread and cereal consumption are higher for households and a high carbohydrate intake is computed as it is expected in this situation. The largest sources of household protein intake are bread with a share of 30.6 percent, meat and fish with 16.8 percent and cereals with 15.4 percent. Hence, most of the protein intake is connected with high carbohydrate-based food groups.

According to the results, vitamin A intake is found lower, and the consumption of vegetables is not enough to reach the daily requirement level. Likewise, the iodine intake is found really low for individuals and it can be understood that the consumption of fish and the other food commodities such as iodized salt, bread or water does not provide the daily requirement. The results of the expenditure-nutrient elasticities indicate that increases in the total food expenditure increase all the nutrient intake, however, the expenditure elasticity of iodine is low and the increase in total food expenditure does not affect to the iodine intake efficiently.

Governments and institutions try to produce policies and programs to achieve good nutrition for all people. The most common policy is the consumer subsidies, for example, distribution of food, or to make improvements in households' income. In this situation, increases in households' income may increase the consumption of nutrient-dense food, but also it may increase the consumption of less nutrient-dense food. Therefore, the policy on income should be implemented carefully. The second way to support households' nutrition can be taxation on food prices. If the prices of nutrient-dense food are decreased by taxes or if the prices of less nutrient-dense food are increased by taxes, they may help to increase households' nutrient intake and provide good nutrition for them. However, the other factors such as culture and preferences also affect food consumption and this taxation way may not be efficient to achieve good nutrition. Furthermore, the school feeding, consumer subsidies, or food vouchers may help to decrease bad nutrition in the local places, but those programs do not indicate that they will be efficient in all countries or in the world.

All those factors affect food availabilities which are the most important factor for adequate nutrient intake. Likewise, food transportation, trade policy, agribusiness policy, investments on nutrition, labeling regulations, fortification policy, cash transfers, agricultural research policies, land and water access are also considered to

understood food availability for people (Global Panel, 2016). The Global Panel, an independent group tackling global challenges in food and nutrition security, published recommendations for identifying the problems, for understanding the reasons of malnutrition and for overcoming all problems. The direct and indirect costs of every type of malnutrition should be calculated by countries, effective communication must be provided by adequate data to policymakers, practicable options for policy and programs should be provided for food systems, monitor and report on progress should be provided, cost-effective actions should be provided by generating data, and data deficiencies and knowledge gaps should be eliminated.

As a result, nutrition is an important factor for human survival and bad nutrition or malnutrition may cause some problems to people, communities, countries and the world. Therefore, many organizations, institutions, and international independent groups work on the importance of nutrition; which are World Bank, World Health Organisation (WHO), Food and Agricultural Organizations (FAO), Global Panel, Global Nutrition Report. These organizations conduct research on nutrition, bad nutrition, the different types of malnutrition, and their main goal is to increase awareness about the effects and consequences of malnutrition.

This study is organized as follows. Chapter 2 provides a review of the recent theoretical and empirical literature on nutrition economics. Chapter 3 represents a description of model and estimation. Chapter 4 introduces the data and Chapter 5 reports empirical results. The last chapter represents the conclusion.

2. NUTRITION ECONOMICS

Adequate nutrition is one of the main factors for a healthier life. However, there are various types of malnutrition and each country in the world suffer at least one of them. Malnutrition may be in the form of undernutrition or overnutrition. Undernutrition is seen mostly in developing countries such as African and some Asian countries and overnutrition is seen mostly in developed countries. There are some undernutrition types which are stunting, wasting, anemia, nutrient deficiency. In addition, there are some overnutrition types which are overweight and obesity.

The number of hungry people in the world was 821 million in 2017 reported by FAO, which shows that 1 in every 9 people is hungry and its distribution to regions is as follows; 515 million people in Asia, 256.5 million people in Africa, 39 million people in Latin America and the Caribbean. Malnutrition affects mainly children and women. The statistics reported by FAO show that children under 5 years old are affected by stunting (low height for age), wasting (low weight for height) and overweight. In the world, 150.8 million children suffer from stunting, 50.5 million children suffer from wasting and 38.3 million suffer children from overweight. Moreover, 32.8 % of women at reproductive age in the world are affected by anemia. Furthermore, the number of adults who are obese is 672 million.

The statistics are important because there are health, economic and social consequences of malnutrition. First, the types of malnutrition affect health differently. Micronutrient deficiencies cause mental retardation, anemia, and various illnesses, undernutrition causes physical and cognitive problems, and overweight causes hypertension, heart disease, cancer and an increase in the risk of type 2 diabetes.

Second, there are social consequences of malnutrition and pregnant women and children are particularlyaffected. For instance, if children suffer from malnutrition and it continues a long time, this may cause children to be stunting, wasting or overweight. As a consequence, the number of educated people may decrease (Bagbin & Neuser, 2014). Moreover, malnutrition may cause impaired social development, deteriorations

in the social structure, and losses in labour productivity and income (Global Panel 2016).

Malnutrition negatively affects all economies in the world. The health problems due to malnutrition increase health systems, insurance, and medical bills, in other words, it causes large health expenditures and high losses in human capital. Malnutrition may cause a decrease in education level. Low education level could prevent development of countries. In addition, a poverty cycle may occur due to malnutrition.

Nutrition should not only be perceived as a necessity for human survival but also as an important factor for the development of countries (Global Panel 2016). Likewise, malnutrition should not be perceived as a problem only for people, it also has economic and other consequences. Since this study will be conducted at the household level, the issue of nutrition within the framework of microeconomics has been discussed.

2.1. Microeconomic Perspective

Babu, Gajanan and Hallam. (2017) argue that individual nutritional status is determined by consumption decisions. Decision on food consumption is influenced by income, food prices, socio-demographic conditions and other factors. First, people make their consumption decisions based on their income and savings. It is important to know how they decide to distribute their income on goods in order to understand their consumption behavior. Understanding consumption behavior may be useful in making appropriate nutritional policies and programs.

One of the most important factors affecting nutrient intake is food consumption. Preferences on consumption determine a large part of their food demand. In addition, all factors affecting food demand and other factors, such as access to clean water, health services, cultural factors, geographical and environmental factors, also affect nutrient intake. As a result, they all affect nutritional status and should be considered in the studies on nutrition.

Households maximize their welfare by using limited resources. This is also defined for nutrition intake as households try to find appropriate nutrition with their limited budgets. Nutritional status is also affected by factors affecting food consumption; preferences, budget, food prices, and prices of other goods. First of all, if the budget

constraint is formulated for two food groups in a simple way; p_1 and p_2 are prices of two food, q_1 and q_2 are the amount of food consumed, and Y is total budget,

$$p_1 q_1 + p_2 q_2 = Y. \quad (1)$$

Budget constraint show the combination of food and services that can be purchased when the consumer spends their entire income. While making the decision on the amount of consumption between two food, preferences are also an important factor. The utility function for two food depends on the amount of consumption.

$$U = u(q_1, q_2). \quad (2)$$

An equilibrium occurs for households where the budget constraint and utility intersect. This equilibrium is shown by the budget line and the indifference curve. There is no change in the household utility levels if there is any change in the prices of food commodities or when the preferences in the consumption of the two food commodities change, if the budget is fixed. There are two almost similar concepts that characterize this situation which are the marginal rate of substitution (MRS) and the marginal utility. MRS is the rate that shows how much food 2 (q_2) should be forgone by the consumer to increase a unit of food 1 (q_1) . The reason for this may be that the price of food 2 (p_2) has increased, or the consumer's preferences may have changed. In this case of marginal utility, for example, it is the effect of one-unit increase in the amount of food 1 (q_1) on the total utility. If one food is consumed more than the other, the marginal utility of a one-unit increase in the consumption of this food is lower than the other food consumed.

The household equilibrium where the budget constraint and indifference curve intersect cannot explain household nutritional status adequately as it is an analysis of only the choice of basket for two different goods. Nutrition varies depending on more complicated factors; food availability, the quality of food consumed, pereferences, etc. If these are not well understood, policies and programs for malnutrition are implemented around certain malnutrition, others can be ignored.

Analysis of food demand is an important resource for research on nutrition. Since people do not make direct demand to the nutrient, their demands are formed through the food they consume. The quantity of food consumed affect the nutritional status of people as well as income and prices. Therefore, demand curves should be examined in

relation to price and quantity within the framework of food demand as this relationship affects consumption preferences.

In the theory of demand, when the price of a commodity increases, the demand for other commodities increases when if they are substitutes. Hence, as nutrient-dense food and less-nutrient-dense food are substitutes, if price of one of them increases, so the consumption of the other does. In other words, people substitute low nutrient with high nutrient. However, the demand for food is changing not only because of price change but also due to income change. With an increase in income, people might be expected to increase the demand for food with higher nutritional value. However, this does not always happen. As individual income grows, one may either increase demand for food with high nutritional value or the one with low nutritional value but high-calorie value.

The effect of the changes in income and prices on food demand is indicated by the elasticities. These effects are calculated through own-price, cross-price, and income elasticities. The own price elasticities are expected to be negative and the income elasticities are expected to be positive. If these elasticities are equal to one, or unitary, that is, a 1 percent change in income or prices changes the consumption of the related good by 1 percent. In addition, if elasticities are smaller than 1, they are called inelastic, and if higher than 1, they are called elastic.

Most of the work on this subject is related to the effect of income on food consumption and these studies are generally made on low-income households. In this way, the effects of the change in income on food consumption for low-income households were calculated and recommendations were made regarding the appropriate policy.

In conclusion, it can be said that household food consumption and non-food consumption decisions are in the first place, but many factors such as size and socio-demographic characteristics affect the nutritional status. A good understanding of all of these is important to reduce malnutrition.

2.2. Literature

Two strands of literature are presented in this study; food demand and nutrient demand.

Food demand system is one of the most common methods to analyze the effects of income and food prices on the consumption of food; thus, many studies on food

demand take part in literature. Those studies employed different data sets such as time series, panel, and cross-section to analyze food demand system for different countries. Various demand models are used in empirical implications; Engel Curves, Linear Expenditure System (LES), Indirect Addilog Model (IAD), Rotterdam Model, Transcendental Logarithmic Demand System, Generalized Addilog Demand System, Almost Ideal Demand System (AIDS) and Quadratic Almost Ideal Demand System (QUAIDS). Among all of these, the AIDS model has been frequently employed in demand studies because it provides the axioms of choice and restrictions of consumption theory. Then, QUAIDS has been developed by adding a quadratic term to the AIDS model and it has become a common method after AIDS. Food demand studies are presented in the first and second subsections.

The demand for nutrient has become more important in recent years and studies on this subject are gradually increasing in the literature. Nutrition demand analysis tries to explain malnutrition in terms of demand and to propose solutions for these problems for countries having any type of malnutrition. There are two methods in the nutrient demand literature; "direct method" and "indirect method". In the direct method, nutrient demand is estimated by using the share of nutrients instead of the expenditure share of food and the prices of nutrients obtained from food prices. In the indirect method, there are two steps to estimate the demand model; first, a food demand model is estimated and the income (or expenditure) and price elasticities are obtained, secondly, the nutrient elasticities are computed by using the demand elasticities of food and the shares of nutrients.

2.2.1. Food Demand Studies

Deaton and Muellbauer (1980) developed a new model, Almost Ideal Demand System, that gives an arbitrary first-order approximation to the demand system. It performs axioms of choice completely, has a functional form consistent with household survey data, and is easy to estimate. The homogeneity and symmetry can be tested, and the adding-up restrictions are satisfied automatically. Deaton and Muellbauer estimate demand model by using annual British data from 1954 to 1974 on eight nondurable good groups; food, clothing, housing services, fuel, drink and tobacco, transport and communication services, other goods, and other services. According to results, the food and housing services are found to be a necessity, and other groups are luxuries.

Moreover, the price elasticity for food is found to be positive but not significant, transport and communication are price elastic and the other groups are price inelastic.

Pollak and Wales (1978) estimate the demand model in the United Kingdom by using Family Expenditure Survey data for the two years 1966 and 1972. They assumed all household in a particular period faces the same prices. therefore, they use the price index for each good category. In addition, the expenditure shares of goods are calculated and used in the model instead of the expenditure of goods to decrease heteroskedasticity. Linear Expenditure System (LES) and Quadratic Expenditure System is estimated with three good groups, which are food, clothing and miscellaneous. According to their results, the expenditure share of food increases and the expenditure share of clothing and miscellaneous decreases as family size increases. The own price elasticities are negative for every good and comparing the results from two systems, the price elasticities for QES are estimated higher than for LES.

Dong and others (2004) use 1998 Expenditure Survey of Mexican households and the AIDS model to estimate a censored food system by Amemiya-Tobin approach for Mexico. Most of the demand estimations with demographic variables are found to be statistically significant and demographic characteristics such as regional variations or refrigerator ownership are found to be important in food expenditure. The results show that the own-price and cross-price elasticities are statistically significant and there are substitution effects for some food commodities. Milk is the most substitutable food with the other food commodities, in addition, pork is found to be also substitutable food according to the cross-price elasticities. Moreover, they stated that having a young child affects milk consumption less, having a refrigerator increases the consumption of meat and fish more compared to other food commodities, and the consumption of cereals and legumes less.

Yen and others (2004) estimate a household food demand with Translog Demand System using Urban Households Survey for the year 2000 in China. The demographic variables significantly affect different food consumption, specifically household income. All the food commodities are found to be normal goods in their analysis, though, milk is seen as a luxury good for Chinese people. They stated that in Asian countries, rice is the main food commodity and it is found to be inferior food for most of them; however, rice is a normal good in China. The consumption of fish and seafood increases more than the other food commodities.

Yen and others (2002) analyze the US household demand for fats and oils using the Nationwide Food Consumption Survey for the year 1987-88 by employing a two-step estimation procedure. The products are butter, margarine, shortening, cooking oil, and salad dressing; among all household included in the analysis, only 35 households consume all types of fat and oil and most of the other household consume two or three types. The effects of income and education on butter, cooking oil and salad dressing are positive, and their effects on margarine are negative. All the cross-price elasticities are statistically insignificant, the own-price elasticities for butter, margarine and salad dressing are negative and statistically significant, and all the expenditure elasticities are positive and statistically significant. As a result, the significant expenditure elasticities are closed to unity, it shows that price has a substantial effect on the consumption of fat and oil.

Shamim and Ahmad (2007) examine the household consumption patterns in Pakistan using the Household Integrated Economic Survey for the year 2001-2002. They separate the way household living in urban or rural areas and estimate the Engel curves by spline quadratic expenditure system for 18 commodity groups. The consumption of cereals, edible oil, vegetables and fruits, spices, and clothes and footwear are found to be necessaries; in addition, transportation, accommodation, and health are luxury goods for households living in urban areas. Education is a luxury good for poor households and necessaries for rich households. On the other hand, poultry, fruits, various food, electricity, entertainment, transportation, education, clothes and footwear, durable and other nonfood goods are found to be luxury goods for household living rural areas.

Phuong and others (2015) apply a Double-Hurdle Model to Vietnamese data for estimating the effects of household characteristics on expenditure for dairy products in 2010. Price is not included in the analysis because they supposed all household facing with the same price. Half of the household do not consume dairy products in the analysis and the consumption of dairy products increases as income-level increase. According to the results, household size has a positive effect on the decision of buying dairy products, at the same time it has a negative effect on the amount of milk and dairy products consumption. In urban areas, household consumes dairy products and participate in the market more than in rural areas. Moreover, having children, head of the household gender and education level have a positive effect on the dairy products

market participation and its consumption. The cultural diversity in regions has a significant effect on food consumption.

2.2.2. Food Demand Studies in Turkey

Tansel (1986) produce the first study for household demand in Turkey and the Urban Household Income and Consumption Expenditures Survey for the year 1978-79 is used in the analysis, which nine functional forms are derived from the maximization of some utility functions. Among these functions, the Working-Leser model performs better compared to the others according to the ranking results. Eleven good groups, household size, and the total expenditures are included and eight of them are found to be statistically significant. According to the results, the households size effect is significant for food, cultural spendings, and transportation. The results of the elasticity estimation, the food expenditure has the lowest elasticity (0,45 with Linear (1) and 0.73 with Log-Share Linear). In the other food groups, the housing expenditure elasticity is lower than unity, furniture and Health-care expenditure elasticities are almost equal to unity and in addition, for the remaining good groups, the expenditure elasticities are greater than unity, hence these good groups are luxuries. Food and housing are found to be necessities and the household size elasticities are low for them.

There are some studies that have worked with the household income and consumption expenditure survey for the 1994 year. Alpay and Koç (1998) work with the 1994 survey data set to estimate price elasticities for some aggregated commodities. In the food studies, this study for the first time estimates the price elasticities and employes the AIDS model. The price elasticities for ten different goods are obtained and the coefficients of most explanatory variables are statistically significant. There is a complementary relationship between three goods; food, transportation, tourism. The household size negatively affects the consumption of food and housing spendings.

Hüseyin Özer (2003) uses the Turkish Household Income and Consumption Expenditure Survey for the year 1994. The purpose of this study is to examine the demand elasticities of price and expenditure using Linearly Expenditure System (LES) for the aggregated eight good categories. The prices of goods are obtained from the year 1995 Wholesale Price Index and the Consumer Price Index. All the estimation of marginal budget shares is positive and significantly different from zero. The expenditure elasticities of food, housing, transportation, and communication are found

to be a necessity. The expenditure elasticity of health is equal to unitary, and the other elasticities are higher than unity.

Murat Nişancı (2003) analyzes the Engel Curve for Turkey using the year 1994 Household Income and Consumption Expenditure Survey. Six functional forms are considered to estimate demand system, and the household size is included as an explanatory variable in the analysis. For the food and clothing-footwear groups, the household size effects are found to be positive and significant; however, for the furniture and education groups, it is found to be negative and insignificant. The expenditure elasticities of food-drink-tobacco and housing-rent are smaller than one and those goods are found to be necessities. In addition, the expenditure elasticities of furniture, transportation, recreation and culture, and miscellaneous goods and services are greater than unity and these goods are found to be luxuries. The expenditure elasticities of clothing-footwear and health are around unity. In all models except the Log-Share Inverse model, the household size elasticity for food and clothes-footwear shows that there is an economy of scale in these goods.

Şahinli and Fidan (2012) study the food demand in Turkey by using Household Income and Consumption Expenditure Survey for the years 1994 and 2003. The AIDS model is employed to estimate the demand system for six sub-food groups. According to the estimations, the expenditure elasticities for all goods are greater than zero, which means that all goods are normal for these periods. For 1994, the uncompensated price elasticities are inelastic for bread and cereals, milk and dairy products, oil and eggs, various fast food, alcoholic and non-alcoholic beverages, and elastic for meat, fish and poultry, and vegetables and fruits. In addition, the compensated price elasticities are elastic for various fast food and meat, fish and poultry and inelastic for others. For 2003, the uncompensated price elasticities are elastic for only meat, fish and poultry group and inelastic for others. The compensated price elasticities are inelastic for all sub-food groups, except meat, fish, and poultry. Food is found to be a complementary and substitutable good for different goods due to the compensated cross-price elasticities.

Most studies analyze the demand model with household surveys for the year 2003. Akbay (2006) studies the consumption of nine animal products (red meat, poultry, fish, other meat products, butter, fluid milk, cheese, yogurt, eggs) in rural areas by using the 2003 data sets and uses Chi-square test, F-test and t-test. The income groups are

created from households in rural areas. According to the findings, the expenditure share of food is found to be high in the low-income group compared to the high-income group. On the other hand, the expenditure shares of animal products in total food expenditure increase from low-income group to the high-income group; in addition, the consumption of each animal products varies within the income groups. For example, the expenditure share of meat and meat products (in the expenditure of total animal products) increases as income increases. The socio-demographic properties strongly affect household consumption of animal products.

Akbay and Boz (2007) examine the household food consumption by using Turkish Household Expenditure Survey for the year 2003 and apply a Linearly Approximated Almost Ideal Demand System (LA-AIDS) and a two-stage estimation technique in the study. All the household size coefficients are found to be statistically significant and six of them are found to be positive. The labor force participation of housewife has a significant impact on nine food budget shares; a negative impact on bread, meat, vegetables and fruits, and positive impact on cereals, dairy, jam-honey-chocolate, coffee and tea, and non-alcoholic beverages. In all categories, education has a negative impact on bread and cereals, oils and fats, vegetables, and coffee and tea, however, a positive effect on meat, dairy, fruits, and non-alcoholic beverages. Most regional dummies are found to be statistically significant and affect household consumption. The expenditure elasticities of bread, coffee, and tea are small, and the demands for meat and meat products, oils and fats, and jam, honey, chocolate groups are expenditure-elastic. Akbay and Boz (2007) state with the results that the food consumption patterns of Turkish households cannot be entirely explained by price and income changes.

Akbay, Bilgiç, and Miran (2008) analyze the demand elasticities of major food products in Turkey using the 2003 Turkish Household Expenditure Survey. In the study, the most consumed products (42 goods) in Turkey are considered and the Heckman two-stage demand model is applied. Among the products consumed by households, bread, eggs, and tomatoes consumptions are found to be high and these are followed by fresh milk, cheese, sugar, potatoes, and tea, respectively. As the number of individuals in the household increases, the consumption of goods such as beef, bananas, hazelnuts decreases while the consumption of vegetables, rice, macaroni, milk, eggs, and sugar increases. The other factors, which are age, gender,

and marital status, have different impacts on consumption. Education is statistically significant for almost all goods. In addition, since the regional differences are effective on the demand for food, dummy variables are added in each model and most of the coefficients are found to be statistically significant. The income elasticities are found to be positive and statistically significant.

Tiryaki and Akbay (2010) analyze the behaviour of households for consuming fluid milk in urban areas. The Chi-square test of independence and multinomial logit model is used to analyze two products which are unprocessed fluid milk and processed fluid milk. A large majority (83%) of households consume one of them, at the same time, a large proportion (66.3%) of these households consume unprocessed milk. The socioeconomic and demographic characteristics of consumers consuming two products show differences, the large families consume more unprocessed milk while the small families consume more processed milk. The number of children also has a significant impact on the consumption decision of households.

Bilgiç and Yen (2013) use a two-step demand system approach to analyze food demand. In this study, The Turkish Household Expenditure Survey Data for the year 2003 is used and it differs from earlier studies because they consider a large system of 16 food products at a disaggregated level (cereals as bread, rice, macaroni, dough product, other cereals, meats as bovine, mutton, poultry, giblets and fish, and dairy products such as milk, yogurt, cheese and curds, eggs, fats and oils). Consistent with the economic theory, all the expenditure elasticities are found to be positive, all the uncompensated and compensated own-price elasticities are found to be negative, and they are statistically significant. The head of household age has positive impacts on most food items except other cereals, giblets, and eggs. Bilgiç and Yen (2013) found that other cereals, bovine, mutton, giblets, milk, yogurt, and bread commodities are expenditure elastic.

Bilgiç and Yen (2014) study on the demand for meat and dairy products and use Turkish Household Expenditure Survey Data for the year 2003. The demand analysis is based on twelve food items which are bovine, mutton, poultry, giblets, fish, milk, yogurt, cheese, eggs, fats, oils, and cereals. They estimate the demand model using the Linearly Approximated Almost Ideal Demand System (LAIDS) with the Tobit (censored) linear equation system procedure of Amemiya. All the estimated uncompensated own-price elasticities are found to be negative and significant, and

they are high for rural areas. Cereals are the most cross-price-elastic for both rural and urban households. Bovine, mutton, and milk are the second most cross-price-elastic for rural households, while dairy products (cheese, milk, and yogurt) are the second most elastic for urban households. The compensated own-price elasticities are found to be negative and significant for all goods. Households generally consume normal commodities and rarely luxurious commodities in rural areas. Household consumption in rural areas is determined by the prices of goods and the income of households rather than by the sociodemographic factors.

Çağlayan and Astar (2012) analyze the consumption of food and clothing using Household Consumption Expenditure Survey Data Set for the year 2009 with nine different functional forms. All the coefficients of food and clothing expenditures are found to be statistically significant. The elasticities of food expenditure are 0.33 (Least Absolute Deviation) and 0.34 (Least Trimmed Squares and M), and elasticities for clothing expenditure are 0.76 (Least Absolute Deviation), 0.73 (M) and 0.78 (Least Trimmed Squares). These results show that both food and clothing are compulsory goods for households. The income elasticities of food and clothing expenditures are found to be positive, smaller than one and statistically significant.

2.2.3. Nutrient Demand Studies

Akinleye and Radhi (2007) analyze nutrient elasticities for Nigeria by using the indirect method. First, they estimate the price and income elasticities with the Linearly Approximated Almost Ideal Demand System (LAAIDS) approach using the years 1996/97 National Consumer Survey data set. After obtaining the elasticities from the demand system, they use the method developed by Huang in order to estimate nutrient elasticities. The estimation of elasticities is made for three income groups; low-income, middle-income, and high-income. The results show that for low-income groups, rice and yam are luxury goods, bean is a complementary good for all other goods, except yam. Millet and maize are the substitute goods for most goods. For middle-income groups, rice, yam, and millet are luxury goods, and garri and bean are inferior goods; moreover, garri, bean, and maize are inferior goods for high-income groups. On the other hand, guinea corn is found to be price elastic, and the other goods are inelastic. The estimation results of nutrient elasticity for the middle-income group show that millet and guinea corn are dangerous goods because an increase in the price

of these goods decreases the nutrient intake for this group. Finally, an increase in income for the high-income group decreases their nutrient intake because households in this group prefer fast food and exotic meals that have fewer nutrients compared to other food groups.

Alderman and Timmer (1980) investigate food demand to see which food policy improves nutrient intake. They use the Socio-Demographic Survey Data for the year 1976 for Indonesia. Rice, fresh cassava, and total calorie intake are included in the analysis to estimate the demand model. The double-log quadratic model is employed in this study for different twenty-four cities (plus Jakarta) and twelve income groups. According to the results, the income elasticities of rice and fresh cassava are high for the low-income group, and rice is a luxury good for them. In addition, the income elasticity of total calories is found a value between the income elasticities of rice and fresh cassava. They state that the income elasticity of total calorie is low because egg, fish, meat, and milk are not included to compute total calorie intake. As a result, poor households are affected by price changes more than rich households.

Gibson and Kim (2013) estimate the price elasticity of calorie elasticity by adding and removing quality substitution effect. The Vietnam Household Standards Survey data set for the year 2010 is used to analyze the different demand systems. They note that 10 percent increases in relative rice prices decrease the consumption of calories by 2 percent, when ceteris paribus, with adding the quality substitution effect in the demand system. However, the results of estimation without the quality substitution effect is specified to be higher compared to the quality effect.

Huang (1996) aims to improve an approach for estimating an elasticity of nutrient intake. For this purpose, he uses the data set for the years between 1953-1990 for the United States. The analysis includes thirty-five food commodities. The response of beef prices is found to be positive when the prices of pork and chicken change; in other words, pork and chicken are substitutable goods for beef. The own-price elasticities for most of the substantial food commodities are statistically significant, however, the own-price elasticities for rice and fish are found to be positive but not statistically significant. Thus, this does not show that they are inferior goods. On the other hand, Huang (1996) states that this demand system is reliable for estimating nutrient elasticities because most of the estimated demand elasticities are statistically significant.

Huang and Lin (2000) estimate the AIDS demand system in order to compute the nutrient elasticities for households in the US. In the analysis, they use thirteen aggregated food groups, the households socio-demographic properties, and three income groups; low, middle, and high. The demand equation of fish is removed from the demand system for solving the singularity problem. The fish equation is chosen because most households in the US do not consume fish more than once a week. The first step of estimation nutrient elasticities is to obtain the price and income elasticities from the demand system. Then, those price and income elasticities and the nutrient values of food are used to calculate the nutrient elasticities for each nutrient. The results show that the quality of food has an essential impact on food consumption for households in low-income groups, and the quality elasticity is lower than middle- and high-income groups. Lastly, Huang and Lin state that the expenditure and own-price elasticities do not show any changes between income groups systematically.

Ecker and Qaim (2008) use the QUAIDS model to estimate food demand and nutrient elasticities. The process of estimating nutrient elasticity consists of three stages. In the first stage, they use the Working-Leser model to see how households separate their budget on the consumption of food and non-food commodities. In the second stage, they calculate the budget share of five sub-food groups, and in the last stage, they estimate the price and income elasticities for twenty-three aggregated food commodities using the QUAIDS model. The results show that expenditure elasticity for food is 0,87 and this shows that households increase food expenditure when their total food expenditure increases. Moreover, the highest expenditure elasticity is computed for the animal-sourced food group. The expenditure elasticities for most of the nutrients are found to be high, for instance, when household income increases, the intakes of protein and vitamin-B12 increase higher proportion than the calorie intake, however, the intake of vitamin-A and vitamin-C increase lower proportion than calorie intake. They state that there are substitution effects in household consumption.

Behrman and Deolalikar (1987) examine the expenditure effects on nutrient intake, likewise, they research whether the total expenditure affects food consumption. The 1976-77 and 1977-78 panel data set including 240 households selected from three different agroclimatic is used in this analysis. They use Ordinary Least Square (OLS) to estimate the expenditure elasticity for food and nutrients. According to the estimation results, the expenditure elasticities for all food are found to be positive and

statistically significant. They also find that an increase in total expenditure or income increases nutrient intake.

Mojduszka, Caswell, and Harris (2001) study on frozen prepared food after government regulation of nutrition labeling started to be mandatory in the US. They use the data set for the years 1993-1998 and the Logit model, Multinomial Logit model, and Random Coefficients Discrete Choice model. The results of the logit estimation are not statistically significant, however, they obtained significant results from the random coefficient model. Some information about nutrients in food affects positively household consumption. In addition, the interactions with demographic variables are significant which shows that when income and household size increases, consumption of calorie, fat, meat and ethnic food increases. Authors state that there is not a big effect on frozen prepared food consumption after labeling nutrition information and instead of this, food prices and advertisements are more effective.

Biao (2011) estimates the income elasticity for calories directly. He uses the 2007-2008 data set including one-day consumption information of 8,337 respondents and three different models for estimation; parametric, nonparametric and semiparametric. According to the parametric estimation results, the majority of explanatory variables are found to be statistically significant and an increase in income increases calorie intake. The results of nonparametric and semiparametric are similar, they show that the income elasticity for calorie is higher for poor respondents than rich respondents. Finally, Biao points out that an increase in income does increase household calorie intake, but this is not a significant increase.

Vecchi and Coppola (2006) analyze changes in the undernourishment ratio and nutrient elasticity for Italy between 1861 and 1911 years. They employ the Fogel method to estimate the undernourishment ratio and results indicate that this ratio decreases during this period. On the other hand, they used only the 1901-year data set for estimating nutrient elasticities. For undernourished households, when their budget changes, their reaction to nutrient intake changes more than other households. In general, increases in income improve nutrient intake and they substitute quality for quantity. They find that an average Italian household is adequately nourished during this period.

3. EMPIRICAL METHODOLOGY

This chapter introduces empirical methodology of the demand model and nutrient elasticity estimation. First, a demand system is specified. The second section represents The Almost Ideal Demand System and its suitability for demand systems. In the third section, Quadratic Almost Demand System is indicated which is usen in this study to estimate the food demand system. The final section represents empirical implementation and estimation of the price and expenditure nutrient elasticities.

3.1. Demand System

The study of households on budgets dates back to the 18th century, but in 1857, Ernst Engel's work on the budget of households was accepted as the first study. Engel examined the relationship between households' budget and consumption and deduced that a decrease in income increases the expenditure share of food in total expenditure which is called the Engel's Law. Engel indicated another relationship that if the household income is high, the expenditure share of food decreases in total expenditure.

Demand models were first analyzed as Engel curves. Then, this system was developed, and demand models were started to be estimated with different approaches. These are the Linear Expenditure System (LES), the Indirect Addilog Model (IAD), the Rotterdam Model, the Transcendental Logarithmic Demand System, the Generalized Addilog Demand System, the Almost Ideal Demand System (AIDS), and the Quadratic Almost Ideal Demand System (QUAIDS). The model that provided the best requirements and constraints on demand theory was AIDS. However, the QUAIDS model was developed by including the quadratic term of income in the AIDS model.

3.2. Almost Ideal Demand System

Deaton and Muellbauer (1980) have developed the Almost Ideal Demand System (AIDS). They note that the AIDS ensures an arbitrary first order estimation. However, it is a model that fulfills the preference axioms in the economy. It is a model that can

be applied easily to household budget data. Homogeneity, symmetry and adding-up constraints are provided, and their tests can be performed.

Deaton and Muellbauer (1980) formed the AIDS model through cost and expenditure functions. In equantion (3) the PIGLOG class function given as

$$\log c(u, \mathbf{p}) = (1-u)\log\{a(\mathbf{p})\} + u\log\{b(\mathbf{p})\} \tag{3}$$

where

a(**p**) is the cost of subsistence,

b(**p**) is the cost of bliss;

P is the price vector of goods

u takes values from 0 to 1 (which are related with subsistence and bliss, respectively).

a(**p**) and b(**p**) are functions that are positive and linearly homogeneous in **p**. These functions are shown in equation (4) and equation (5)

$$\log a(\mathbf{p}) = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij}^* \log p_i \log p_j, \tag{4}$$

$$\log b(\mathbf{p}) = \log a(\mathbf{p}) + \beta_0 \prod_i p_i^{\beta_i}, \tag{5}$$

and the cost function is in equation (6)

$$\log c(u, \mathbf{p}) = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2}\sum_i \sum_j \gamma_{ij}^* \log p_i \log p_j + u\beta_0 \prod_i p_i^{\beta_i} \tag{6}$$

where α_i, β_i, and γ_{ij}^* are parameters and c(u,**p**) is linearly homogeneous in price. This cost function ensures adding-up, symmetry and homogeneity.

The demand functions are derived from the AIDS cost function in equation (6). First, Deaton and Muellbauer (1980) specified the budget share of *i*th good in equation (7),

$$w_i = \frac{p_i q_i}{c(u, \mathbf{p})} = \frac{\partial \log c(u, \mathbf{p})}{\partial \log p_i}. \tag{7}$$

When the logarithmic derivative of equation (6) is obtained, it gives a budget share function based on price and utility.

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i u \beta_0 \prod p_k^{\beta_k} \tag{8}$$

where

$$\gamma_{ij} = \frac{1}{2}\left(\gamma_{ij}^* + \gamma_{ij}^*\right). \tag{9}$$

The total expenditure (x) is equal to the cost function in equation (3). Indirect utility function related to price and total expenditure is also derived from this equality. Equation (6) and equation (8) are used to obtain budget shares based on price and total expenditures. These budget shares in equation (10) refer to the AIDS demand system.

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log\{m/\mathbf{P}\} \tag{10}$$

where w_i is expenditure share of *i*th good,

p_j is the price of *j*th good,

α_i, γ_{ij} and $\beta_i$are the estimated parameters,

m is total expenditure,

P is the price index which is shown in equation (11);

$$\log\mathbf{P} = \alpha_0 + \sum_i \alpha_i \log p_k + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \log p_i \log p_{j.} \tag{11}$$

The restrictions of adding up, homogeneity, and Slutsky symmetry which must be hold by AIDS are given in equation (12), equation (13) and equation (14).

$$\sum_{i=1}^{n} \alpha_i = 1 \qquad \sum_{i=1}^{n} \gamma_{ij} = 0 \qquad \sum_{i=1}^{n} \beta_i = 0 \tag{12}$$

$$\sum_j \gamma_{ij} = 0 \tag{13}$$

$$\gamma_{ij} = \gamma_{ji} \tag{14}$$

3.3. Quadratic Almost Ideal Demand System

The AIDS is one of the most widely used approaches in the literature, especially for analyzing households' consumption. The AIDS model provides better estimation results than other approaches since demand systems are not linear all the time and was developed for estimating nonlinear demand systems. For estimating AIDS model linearly, Deaton and Muellbauer (1980) extended demand system by using Stone Price Index in their estimation. However, Banks, Blundell, and Lewbel (1997) showed that AIDS model was linear in logarithmic budget and requires generalization, hence, their purpose is to establish a system similar to the AIDS which is appropriate for the more general Engel Curves found in their study. Banks et al. (1997) stated that the AIDS model does not provide flexibility in income. Therefore, they added a quadratic term in the AIDS model to provide income flexibility. The Quadratic Almost Ideal Demand System (QUAIDS) is based on the indirect utility function, and in this model, the indirect utility function is the inverse of $[\ln m - \ln a(\boldsymbol{p})]/b(\boldsymbol{p})$ with λ. Quadratic budget share system is shown in equation (15) having indirect utility functions of the form:

$$\ln V = \left[\left(\frac{\ln m - \ln a(\mathbf{p})}{b(\mathbf{p})}\right)^{-1} + \lambda(\mathbf{p})\right]^{-1} \tag{15}$$

Quadratic budget share system ($\ln V$) has indirect utility function ($[\ln m - \ln a(\boldsymbol{p})]/ b(\boldsymbol{p})$). λ is a homogeneous and differentiable function that represented in equation (16).

$$\lambda(\mathbf{p}) = \sum_{i=1}^{n} \lambda_i ln\, p_i, \quad \text{for} \quad \sum_i \lambda_i = 0 \tag{16}$$

In addition, $\ln a(\mathbf{p})$, has the translog form, and $\ln b(\mathbf{p})$ is the Cobb-Douglas price aggregator that are shown in equation (17) and equation (18), respectively.

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} ln\, p_i ln p_j \tag{17}$$

$$b(\mathbf{p}) = \prod_{i=1}^{n} p_i^{\beta_i}. \tag{18}$$

They are all defining QUAIDS as a function of expenditure share for *i*th good.

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij \ln} p_j + \beta_{i \ln} \left[\frac{m}{a(\mathbf{p})}\right] + \frac{\lambda_i}{b(\mathbf{p})} \left[\ln\left(\frac{m}{a(\mathbf{p})}\right)\right]^2 \tag{19}$$

The expenditure share equation, equation (19), is differentiated for estimating QUAIDS.

$$\mu_i \equiv \frac{\partial w_i}{\partial \ln m} = \beta_i + \frac{2\lambda_i}{b(\mathbf{p})} \ln \frac{m}{a(\mathbf{p})} \tag{20}$$

$$\mu_{ij} \equiv \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i \left(\alpha_j + \sum_k \gamma_{jk \ln} p_k\right) - \frac{\lambda_i \beta_j}{b(\mathbf{p})} \left[\ln \frac{m}{a(\mathbf{p})}\right]^2 \tag{21}$$

The expenditure elasticities and uncompensated price elasticities are estimated by using equation (22) and equation (23), respectively;

$$e_i = (\mu_i / w_i) + 1 \tag{22}$$

$$e_{ij}^u = \left(\mu_{ij} / w_i\right) - \delta_{ij} \tag{23}$$

where δ_{ij} is the Kronecker delta. In addition, to estimate compensated price elasticities, e_{ij}^c, the Slutsky equation can be used.

$$e_{ij}^c = e_{ij}^u + e_i w_j \tag{24}$$

3.4. Econometric Model

In this study, Quadratic Almost Ideal Demand System, which was developed by Banks, Blundell and Lewbel (1997), is used to analyze demand system by Poi (2012)'s approach adapted for STATA. This approach is based on nonlinear seemingly unrelated regression (NLSUR). Poi's approach incorporates demographics by using the scaling technique introduced by Ray (1983). In equation (25), the expenditure function from Ray's procedure is given as

$$e(\mathbf{p}, \mathbf{z}, u) = m_0(\mathbf{p}, \mathbf{z}, u) \times e^R(\mathbf{p}, u) \tag{25}$$

where

$e(\mathbf{p}, \mathbf{z}, u)$ is the expenditure function,

p is the vector of prices, and

z is the vector of characteristics which can be seen as the household's size.

Ray introduces a function that scales the expenditure function. This scale function includes household characteristics;

$$m_0(\mathbf{p}, \mathbf{z}, u) = \overline{m}_0(\mathbf{z}) \times \phi(\mathbf{p}, \mathbf{z}, u) \tag{26}$$

where $\overline{m}_0(\mathbf{z})$ is a measurement function of **z** that calculates the changes in households expenditure. For doing this, the changes from consumption model are not included. $\phi(\mathbf{p}, \mathbf{z}, u)$ controls the changes in goods consumed by households and relative prices. In equation (27) and equation (28), $\overline{m}_0(\mathbf{z})$ and $\phi(\mathbf{p}, \mathbf{z}, u)$ are shown, respectively.

$$\overline{m}_0(\mathbf{z}) = 1 + \boldsymbol{\rho}'\boldsymbol{z} \tag{27}$$

$$\ln\phi(\mathbf{p}, \mathbf{z}, u) = \frac{\prod_{j=1}^{n} p_j^{\beta_j} \left(\prod_{j=1}^{n} p_j^{\boldsymbol{\eta}_j'\mathbf{z}} - 1 \right)}{\frac{1}{u} - \sum_{j=1}^{n} \lambda_{i\ln} p_j} \tag{28}$$

where $\boldsymbol{\rho}$ is a vector of parameters, and $\boldsymbol{\eta_j}$ is the *j*th colum of s × n parameter matrix $\boldsymbol{\eta}$ and s is the number of characteristics, in other words the number of a household member.

The equation of expenditure share for *i*th good is shown in equation (29);

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij\ln} p_j + (\beta_i + \boldsymbol{\eta_i'}\mathbf{z})\ln\frac{m}{\overline{m}_0(\mathbf{z})a(\mathbf{p})} + \frac{\lambda_i}{b(\mathbf{p})c(\mathbf{p},\mathbf{z})}\left[\ln\frac{m}{\overline{m}_0(\mathbf{z})a(\mathbf{p})}\right]^2 \quad (29)$$

$$i = 1,2,\ldots.,n$$

where

w_i represents the budget share of *i*th good,

m is the total food expenditure,

p_j is the price of *j*th good,

α_i, β_i and λ_i are parameters, and

$c(\mathbf{p},\mathbf{z}) = \prod_{j=1}^{n} p_j^{\boldsymbol{\eta_j'}\mathbf{z}}$.

The homogeneity, adding-up and Slutsky symmetry requirements are implemented in this model.

3.4.1. Estimation of Demand Elasticities

The formulation of elasticities presented in Poi (2012)'s article. The equation of uncompensated price elasticity is shown in equation (30).

$$\epsilon_{ij} = -\delta_{ij} + \frac{1}{w_i}\left(\gamma_{ij} - \left[\beta_i + \boldsymbol{\eta_i'}\mathbf{z} + \frac{2\lambda_i}{b(\mathbf{p})c(\mathbf{p},\mathbf{z})}\ln\frac{m}{\overline{m}_0(\mathbf{z})a(\mathbf{p})}\right] \times\left(\alpha_j + \sum_l \gamma_{jl}\, lnp_l\right) - \frac{(\beta_j + \boldsymbol{\eta_j'}\mathbf{z})\lambda_i}{b(\mathbf{p})c(\mathbf{p},\mathbf{z})}\left[\ln\frac{m}{\overline{m}_0(\mathbf{z})a(\mathbf{p})}\right]^2\right) \quad (30)$$

where ϵ_{ij} is uncompensated price elasticity for *i*th good when the price of *j*th good changes. The expenditure (income) elasticity for *i*th good is represented in equation (31).

$$\mu_i = 1 + \frac{1}{w_i}\left[\beta_i + \boldsymbol{\eta_i'}\boldsymbol{z} + \frac{2\lambda_i}{b(\mathbf{p})c(\mathbf{p},\mathbf{z})}\ln\frac{m}{\overline{m}_0(\mathbf{z})a(\mathbf{p})}\right] \quad (31)$$

After obtaining the expenditure and uncompensated price elasticities, the Slutsky equation is used to obtain the compensated price elasticities.

$$\epsilon_{ij}^{C} = \epsilon_{ij} + \mu_i w_j. \quad (32)$$

3.4.2. Estimation of Nutrient Elasticities

Nutrient elasticities are values that show how changes in income or food prices affect nutrient intake. Nutrient elasticities can be calculated as demand elasticities in terms of both price and income. In order to calculate nutritional elasticities, a demand model must be established on food and the demand elasticities of food must be estimated. Then, the nutritional values of the food consumed are calculated. Using these values and demand elasticities, food elasticities can be calculated. The total quantity of nutrient in food is shown as $\emptyset_k$, which can be calculated as;

$$\emptyset_k = \sum_i a_{ki} E(Y_i) \quad (33)$$

where a_{ki} is the quantity of kth nutrient in food i, and E(Y_i) is mean ith food consumption. In 1966, Lancaster published one study and he presented "consumption technology". $\emptyset_k$ is called consumption technology in food demand system.

Food price – nutrient elasticities are calculated with using uncompensated price elasticities and nutrient values.

$$\Phi_{kj} = \frac{\sum_i a_{ki}\, e_{ij} E(Y_i)}{\sum_i a_{ki}\, E(Y_i)} \quad (34)$$

where

Φ_{kj} the food price-nutrient elasticity,

a_{ki} is the quantity of kth nutrient in ith food,

e_{ij} is uncompensated own- and cross-price elasticities,

$E(Y_i)$ is mean consumption of *i*th food.

Food prices-nutrient elasticities can be calculated with compensated price elasticities. They are calculated using compensated price elasticities instead of uncompensated price elasticites in equation (34).

In equation (35), income – nutrient elasticities are shown. These elasticities indicate how changes in income affect nutrient intake. For estimating income – nutrient elasticities, income elasticities of food and nutrient values are used. In the literature, total food expenditures are used instead of income as a proxy variable.

$$\Phi_{kx} = \frac{\sum_i a_{ki}\, e_{ix} E(Y_i)}{\sum_i a_{ki}\, E(Y_i)} \tag{35}$$

where

Φ_{kx} is the expenditure elasticity of *k*th nutrient,

x is the total food expenditure

e_{ix} is the expenditure elasticity.

4. DATA

In this study, two data sets are used to estimate nutrient elasticities. First, the food demand model is analyzed by using Turkey Household Survey Data Set for the year 2003. Second, the nutrient values of food are compiled from Türkomp National Food Composition Database in order to estimate nutrient elasticities.

4.1. Turkey's Household Survey Data (2003)

In this study, Turkey's Household Budget Survey Data for the year 2003 published by the Turkish Statistical Institute (TurkStat) is used in order to find expenditure and price elasticities. The reason for using the year 2003 data is that it includes information about consumption amount and total consumption values for each food. Thus, unit values are obtained instead of food prices for use in the demand system. Information about amounts of every food type is classified according to the ten-digit classification of individual consumption by purpose (COICOP). The ten-digit classification shows that food commodities are not aggregated as a food group, in this way, food commodities and nutrient values can be matched in order to estimate nutrient elasticities. However, this data is used to estimate food demand with the QUAIDS model. For estimating food demand, those food commodities are aggregated into twelve food groups which are cereals, bread, meat and fish, milk and dairy products, eggs, oils, fruits, vegetables, sugar, tea and coffee, non-alcohol beverages, and other food.

There are 25,764 households completed in the survey. For 17 households, there is no information about food consumption, and they are excluded from the analysis. There are 1,408 food items in household budget survey data set. For estimating nutrient elasticities, the nutrient values are compiled and matched with each food item consumed by households. As a consequence, the nutrient values are only matched with 597 food items and other food items are excluded. Lastly, zero consumption of food are not included in the analysis. After organizing data set, there are 6,048 households left to estimate the demand system. In addition, demoghraphic variables such as

household size, maritual status, income-level and work status are included in the analysis.

Table 3: Household Socio-Demographic Characteristics (2003)

	Turkey	**Rural**	**Urban**
Number of Households	25747	7480	18267
Number of Households (%)	**100**	29.1	70.9
***Head of Households' characteristics**			
*Gender (Male) (%)	90.5	93.2	89.4
*Employment Status (Working) (%)	70	80	65.8
*Marital (Married, %)	89.1	90.6	88.5
*Illiterate (%)	6.9	9.9	5.6
*Primary School (%)	56.4	71.4	50.2
*Secondary and High School (%)	27.4	15.3	32.4
*University (%)	9.3	3.4	11.8
***Total (%)**	**100**	**100**	**100**
*29 Years and Younger (%)	8.4	5.6	9.6
*Between 30 and 49 Years (%)	52.6	47.8	54.5
*50 Years and Older (%)	39	46.6	35.9
***Total (%)**	**100**	**100**	**100**
Employment Status for Wife (Working) (%)	22.7	48.6	11.8
***Households' Types**			
* Nuclear Family with 1 Child	16.8	12.5	18.6
* Nuclear Familiy with 2 or More Children	41.6	36.5	43.7
*Nuclear Familiy-No Child	12.9	15.4	11.9
*Patriarchal or Extended Family-No Child	2.3	3.2	2
*Patriarchal or Extended Family	17	25	13.7
*Single Adult Family-No Child	4	3.4	4.2
*Single Adult Family with Children	4.8	3.7	5.2
*Students and Other People (Living Together)	0.2	0.04	0.3
*Relatives (Living Together)	0.4	0.26	0.5
***Total (%)**	**100**	**100**	**100**

Own calculations using data from the Turkish Statistical Institute, 2003 Turkish Household Budget Survey.

Therefore, as the summary information for households are shown in Table 3, there are socio-demographic properties of 25,747 households. The majority of households with a 71 percent share, lives in urban areas. The 90.5 percent of the head of household are male, while the remaining are female. The other characteristics of the head of households are in similar proportions with some exceptions such as the ratio of university graduates in rural areas is around 3.5 percent while it is 11.8 percent in urban regions. The biggest difference is in the rate of primary school graduates between urban and rural areas, around 21.2 percent, and it is higher in rural areas. In addition, the ratio of working women is low in urban areas (11.8%) compared to rural areas (48.6%). This situation can be explained as women in rural areas work mainly in agriculture.

Table 3 shows households types and the households are mostly the nuclear family with two or more children, around 41.6 percent. The patriarchal or extended family has the second big proportion in household types and this rate is higher in rural areas than urban areas while are 25 percent and 13.5 percent, respectively. The ratios of relatives, students and other people who are living together are the lowest in all, and the ratios of the single adult with and without child family are also low in Turkey with respect to these results.

There are 6,048 households included in the analysis. Table 4 and Table 5 represent descriptions of variables used in the demand system. In Table 4, prices of food groups show that the mean of unit values which are aggregated from each food. The head of household characteristics is included in the analysis as demographic variables because the household consumption is affected mostly by the head of household characteristics. The household size, the number of children and income levels are also included in the analysis. Regional properties are included as urban-rural, and 26 NUTS-II[6] regions. Households live mostly in urban areas, 81 percent, and according to the level 2 region, 16 percent of households live in Istanbul.

[6] 26 regions according to the criterion of Nomenclature of Territorial Units for Statistics (NUTS) are listed in Table 21.

Table 4: Descriptions of Variables Used in QUAIDS Model

Variables	Mean	Standard Deviation
Price of Cereals (TL/kg)	1.44	1.05
Price of Bread (TL/kg)	1.08	0.25
Price of Meat&Fish (TL/kg)	6.90	2.81
Price of Milk&Dairy P. (TL/kg)	2.71	1.34
Price of Eggs (TL/kg)	0.12	0.02
Price of Fats&Oils (TL/kg)	2.80	1.13
Price of Fruits (TL/kg)	1.45	0.94
Price of Vegetables (TL/kg)	1.33	0.56
Price of Sugar (TL/kg)	2.88	2.05
Price of Tea&Coffee (TL/kg)	6.78	5.45
Price of Non-alcohol Beverages (NAB) (TL/kg)	1.66	0.85
Price of Other Food (TL/kg)	1.65	2.02
Total Food Consumption (TL/monthly)	232.43	120.14
Head of household's age	46.25	12.36
Head of household's gender	0.92	0.27
Head of household's maritul status (=1 is married)	0.92	0.28
Head of househod's education (year)	1.95	5.20
Head of household's working status (=1 is working)	0.70	0.46
Household size	4.22	1.79
Number of children	1.87	1.38
I.%20 Income level (if households =1)	0.20	0.40
II.%20 Income level (if households =1)	0.20	0.40
III.%20 Income level (if households =1)	0.20	0.40
IV.%20 Income level (if households =1)	0.20	0.40
V.%20 Income level (if households =1)	0.20	0.40
Urban (if households =1)	0.81	0.39
İstanbul (if households =1)	0.16	0.36
Ağrı (if households =1)	0.01	0.09
Malatya (if households =1)	0.03	0.16
Van (if households =1)	0.01	0.11
Gaziantep (if households =1)	0.02	0.13
Şanlıurfa (if households =1)	0.02	0.15
Mardin (if households =1)	0.01	0.10

Table 5: Descriptions of Variables Used in QUAIDS Model

Variables	Mean	Standard Deviation
Tekirdağ (if households =1)	0.04	0.19
Balıkesir (if households =1)	0.04	0.20
İzmir (if households =1)	0.08	0.28
Aydın (if households =1)	0.03	0.18
Manisa (if households =1)	0.04	0.20
Bursa (if households =1)	0.06	0.24
Kocaeli (if households =1)	0.03	0.18
Ankara (if households =1)	0.06	0.24
Konya (if households =1)	0.03	0.18
Antalya (if households =1)	0.04	0.19
Hatay (if households =1)	0.03	0.16
Adana (if households =1)	0.07	0.25
Kırıkkale (if households =1)	0.02	0.14
Kayseri (if households =1)	0.04	0.19
Zonguldak (if households =1)	0.04	0.19
Kastamonu (if households =1)	0.02	0.14
Samsun (if households =1)	0.02	0.15
Trabzon (if households =1)	0.04	0.19

Table 6 shows total expenditure of households on food and nonfood commodities. The expenditure share of food and non-alcoholic beverages is the highest proportion (34.2%) in total household expenditure. In rural areas, households allocate 43.4 percent of their budget for consuming food and nonalcoholic beverages. In urban areas, the highest expenditure share, 32.5 percent, for households is for housing, water, electricity, gas and other services, which is followed by food and nonalcoholic beverages with 30.5 percent. In rural areas, this is the opposite, households allocate 43.4 percent of their budget for food and non-alcoholic beverages and 23.7 percent of their budget for housing, water, electricity, gas and other fuels. Furthermore, the expenditure share of educational services is the lowest proportion and this ratio is 0.4 percent for rural areas and 1.1 percent for urban areas.

Table 6: Share of Goods and Services in Total Expenditure (Average) (2003)

	Turkey	Rural	Urban
Food and Non-Alcoholic Beverages	34.2	43.4	30.5
Alcoholic Beverages, Cigarettes and Tobacco	4.9	5.4	4.7
Clothing and Footwear	5.3	5.3	5.3
Housing, Water, Electricity, Gas and Other Fuels	30	23.7	32.5
Furniture, Home Appliances and Home Care Services	4.6	4.5	4.7
Health	1.7	2	1.6
Transportation	6.6	6	6.9
Communication	4.1	3.7	4.3
Entertainment and Culture	1.4	1	1.5
Educational Services	0.9	0.4	1.1
Restaurant, Catering and Hotels	3.6	2.6	4
Various Goods and Services	2.7	2	2.9
Total (%)	**100**	**100**	**100**

Own calculations using data from the Turkish Statistical Institute, 2003 Turkish Household Budget Survey.

Table 7: Share of Goods and Services in Total Expenditure by Income Groups (Average) (2003)

	I. %20	II. %20	III. %20	IV. %20	V. %20
Food and Non-Alcoholic Beverages	41.6	37.6	35	31.1	25.8
Alcoholic Beverages, Cigarettes and Tobacco	5.1	5	5	5	4.3
Clothing and Footwear	3.7	4.6	5.4	6	6.7
Housing, Water, Electricity, Gas and Other Fuels	33.1	32.1	29.7	28.5	26.5
Furniture, Home Appliances and Home Care Services	3.3	4	4.7	5.3	5.9
Health	1.7	1.6	1.6	1.7	1.9
Transportation	3.5	4.8	6.3	7.8	10.9
Communication	3	3.7	4	4.6	5.2
Entertainment and Culture	0.7	0.9	1.2	1.6	2.3
Educational Services	0.2	0.5	0.7	1.2	2
Restaurant, Catering and Hotels	2.3	3.1	3.8	4.2	4.6
Various Goods and Services	1.8	2.1	2.6	3	3.9
Total (%)	**100**	**100**	**100**	**100**	**100**

Own calculations using data from the Turkish Statistical Institute, 2003 Turkish Household Budget Survey.

Table 7 shows the allocation of the household budget on goods and services according to income levels. In the lowest income group, households allocate 41.6 percent of their

budget on food and non-alcoholic beverages. Likewise, the expenditure share of food and non-alcoholic beverages is higher in the other income levels, except in the largest income group that the highest expenditure share (26.5%) is housing, water, electricity, gas, and other fuels. As income increases, the expenditure share of food, non-alcoholic beverages and housing, water, electricity, gas, and other fuels decrease, but the expenditure share of transportation, clothing and footwear, furniture, home appliances and home care services, communication, entertainment and culture, and educational services increase.

In Table 8, there are expenditure shares of twelve aggregated food groups in the total food expenditure. The expenditure share of vegetable is the highest share of total food expenditure and it is not different in rural or urban areas. The second highest expenditure share is bread and the third expenditure share is meat and fish. This ranking is different in rural and urban areas. In rural areas, the second highest expenditure share is cereals and the third one is milk and dairy products; however, the second highest expenditure share is bread and the third one is meat and fish in urban areas. The high expenditure share of cereals in rural areas can be indicated that households make their bread themselves by using cereals.

Table 8: Shares of Food Groups in Total Food Expenditure (Average) (2003)

	Turkey	**Rural**	**Urban**
Cereals	10.4	14.4	8.7
Bread	14.4	9.9	16.3
Meat and Fish	13.7	11.8	14.5
Milk and Dairy Products	11.6	12.3	11.4
Eggs	2.8	2.6	2.8
Fats and Oils	6.4	7.4	5.9
Fruit	9.1	8.3	9.4
Vegetable	16.9	17.8	16.5
Sugar	7.9	9	7.4
Tea and Coffee	3	3.8	2.7
Non-alcohol Beverages	2.7	1.7	3.2
Other Food	1.1	1	1.2
Toplam (%)	**100**	**100**	**100**

Own calculations using data from the Turkish Statistical Institute, 2003 Turkish Household Budget Survey.

Table 9: Share of Food Groups in Total Food Expenditure by Income Groups (Average) (2003)

	I. %20	II. %20	III. %20	IV. %20	V. %20
Cereals	12.1	10.5	10.1	9.7	9.4
Bread	15.9	16.2	15.2	13.9	10.8
Meat and Fish	9.5	11.4	13.2	15.5	18.8
Milk and Dairy Products	11.6	11.6	11.4	11.5	12.1
Eggs	3.3	3	2.8	2.6	2.2
Fats and Oils	6.9	6.9	6.5	6	5.6
Fruit	7.7	8.3	9	9.6	10.8
Vegetable	18.3	17.6	17.2	16.3	15.1
Sugar	8.4	7.9	7.9	7.7	7.5
Tea and Coffee	3.8	3.3	2.9	2.7	2.4
Non-alcohol Beverages (NAB)	1.6	2.2	2.6	3.2	4
Other Food	0.9	1.1	1.2	1.3	1.3
Total (%)	**100**	**100**	**100**	**100**	**100**

Own calculations using data from the Turkish Statistical Institute, 2003 Turkish Household Budget Survey. Own calculations using data from the Turkish Statistical Institute, 2003 Turkish Household Budget Survey.

Table 9 shows the expenditure shares of food groups in total food expenditure by five income groups. It is seen that for the lower four income groups, the expenditure share of vegetable is the highest in total food expenditure. However, for the largest 20% income group, the expenditure share of meat and fish (18.8%) is the largest share, and the expenditure of vegetable (15.1%) is the second largest share. The expenditure share of bread is the highest share in the first four 20% income groups, then expenditure shares of other food groups change by income levels. In the low-income level, cereals are consumed more than the other income levels. As income increases, the expenditure shares of bread, cereals and vegetable decreases, but consumption of fruit, meat and fish increases. The expenditure share of milk and dairy products is almost the same in all income groups except the largest income group which has a larger share. In addition, the expenditure shares of eggs, fat and oil, sugar, and tea and coffee decrease as income increases and the expenditure shares of NAB and other food groups increase.

The expenditure shares of food groups by regions is given in Table 22 and Table 23. The expenditure share of vegetable in 10 regions is high in almost all regions. Only the expenditure share of meat and fish group is higher in Northeast Anatolia region,

and the expenditure share of bread is higher in Eastern Anatolia. Lastly, in the Central Anatolia region, the expenditure shares of three food groups are almost at the same level; these are vegetables (15.9 percent), meat and fish (15.8 percent) and bread (15.2 percent).

Table 24 and Table 25 show the expenditure shares of food groups for different types of households. The expenditure share of vegetable is high for most household types. For instance, nuclear family with one child, nuclear family with 2 children, nuclear family with 3 or more children, nuclear family without a child, patriarchal or extended family, and patriarchal or extended family without child have the highest expenditure share of vegetable. As it is expected, students, employees, and relatives, who are living together, have a high expenditure share of bread. As a result, in general, households allocate their budget mostly on vegetable, bread, cereals, and meat and fish.

4.2. Data for Nutrient Values

In order to estimate nutrient elasticities, nutrients values of food groups are used which is published by the TürKomp National Food Composition Database. There are 21 types of nutrient which are calorie, protein, fats, carbohydrate, cholesterol, calcium, phosphor, sodium, potassium, iron, glucose, thiamin, niacin, riboflavin, vitamin C, vitamin A, vitamin B6, vitamin B12, magnesium, iodine, and zinc. First, each of the food commodity consumed by households is examined and there are 1.408 food commodities. Then, the nutrient values could be obtained only for 597 food commodities from the Türkomp database. The other food commodities, which could not be obtained their nutrient values, are excluded from the analysis.

The shares of 21 nutrients in twelve aggregated food groups should be computed to use in the analysis. First, the nutrient values in twelve food groups are computed by weighting the nutrient values of 597 food commodities with the consumption amount of these food commodities. Likewise, the nutrient shares in each food group are computed by dividing each nutrient values of food groups by total nutrient values of food groups.

As seen in Table 10, Table 11, and Table 12, the consumption of bread is a major source of calorie (26.3%), protein (30.6%), carbohydrate (34.7%), thiamin (36%), and zinc (31%). Eggs provide the highest level of cholesterol (53.2%), and other sources

of cholesterol are meat and fish (27.4%), milk and dairy products (16.5%), and oils (2.9%). Iron is mostly provided by vegetables (32.4%) and bread (20.9%), but it is less provided by meat and fish (5.7%). Vegetables is also a major source of potassium (41.2%), vitamin A (51.2%), vitamin C (69.6%), vitamin B6 (37.9%), and magnesium (31.7%).

Table 10: Nutrient Shares in Food Groups Consumed by Households (Average, %)

Goods	Calo.	Prot.	Fat	Carb.	Chol.	Ca.	Phos.
Cereals	18	15.4	4.1	26	0	5.9	14.6
Bread	26.3	30.6	10.9	34.7	0	25	18.5
Meat&Fish	4.5	16.8	8.2	0.2	27.4	1.3	11
Milk&Dairy P.	7.4	14.2	15.6	2.7	16.5	27.9	20.4
Eggs	1.3	4.2	3	0	53.2	1.2	4.1
Fats&Oils	15.5	0	45.9	0	2.9	0	0.1
Fruits	5.7	3.1	4.2	7.2	0	5.3	7
Vegetables	9.1	11.8	5.1	10.2	0	17.4	19.6
Sugar	9.2	0.4	1.9	15.5	0	0.2	1
Tea&Coffee	1.2	3.2	0.1	0.8	0	4.7	2.5
N.A.B.	1.3	0	0.1	2.3	0	10.4	0.7
Other Food	0.5	0.3	0.9	0.4	0	0.7	0.5
Total	100	100	100	100	100	100	100

Calo (calorie), Prot (protein), Carb (carbohydrate), Chol (Cholesterol), Ca (calcium), Phos (phosphor). Own calculation using the data from Turkish Statistical Institute, 2003 Turkish Household Budget Survey and Türkomp, National Food Composition Database.

Table 11: Nutrient Shares in Food Groups Consumed by Households (Average, %)

Goods	Iron	Gluc.	Pot.	Sod.	Vit. A	Thi.	Rib.
Cereals	12.9	4	8.2	2.5	0	18.9	6.9
Bread	20.9	0	10.5	28.8	0	36	12.1
Meat&Fish	5.7	0	7.4	2.8	4	6.2	10.5
Milk&Dairy P.	1.1	0.1	10.2	13.2	21.7	7.1	34.1
Eggs	3.5	0	1.1	1.3	9.5	1.6	10.4
Fats&Oils	0	0	0	0	6.7	0	0.1
Fruits	7	40.3	14.6	0.4	6.7	4.9	5.8
Vegetables	32.4	31.6	41.2	6.9	51.2	24.6	19.9
Sugar	0.9	4.5	0.6	0.3	0	0.5	0.1
Tea&Coffee	14.4	1.4	5.9	0.2	0	0	0
N.A.B.	0.1	17.8	0.1	0.1	0	0	0
Other Food	1.1	0.3	0.2	43.5	0.2	0.2	0.1
Total	100	100	100	100	100	100	100

Note: Gluc (glucose), Pot (potassium), Sod (sodium), Vit. A (vitamin A), Thi (thiamin), Rib (riboflavin). Own calculation using the data from Turkish Statistical Institute, 2003 Turkish Household Budget Survey and Türkomp, National Food Composition Database.

Table 12: Nutrient Shares in Food Groups Consumed by Households (Average, %)

Goods	Nia.	V.C	V.B6	V.B12	Mag.	Iod.	Zinc
Cereals	22	0.2	6.4	0.1	14.2	0	23.2
Bread	16.4	0	19.1	0	20.1	0	31
Meat&Fish	28.3	0	15.3	44	4.9	27.1	10.4
Milk&Dairy P.	1.2	0	5.3	46.8	7	0	12
Eggs	0.1	0	1.5	8.8	1	0	2
Oils	0	0	0	0.3	0	0	0
Fruits	6.3	30	14.5	0	12.9	0	4.6
Vegetables	25.5	69.6	37.9	0	31.7	0.1	13.6
Sugar	0.1	0	0	0	0.2	0	0.1
Tea&Coffee	0	0	0	0	7.2	0	1.8
N.A.B.	0	0	0	0	0	0	0.1
Other Food	0.1	0.2	0	0	0.8	72.8	1.2
Total	100	100	100	100	100	100	100

Nia (niacin), V.C (vitamin C), V.B6 (vitamin B6), V.V12 (vitamin B12), Mag (magnessium), Iod (iodine). Own calculation using the data from Turkish Statistical Institute, 2003 Turkish Household Budget Survey and Türkomp, National Food Composition Database.

The consumption of milk and dairy products gives the highest level of calcium (27.9%), phosphor (20.4%), riboflavin (34.1%), and vitamin B12 (46.8%). The main sources of iodine are other food (72.8%), meat and fish (27.1%), and vegetables (0.1%). Moreover, the consumption of fruits and vegetables provides major glucose (respectively 40.3% and 31.6%). Generally, households provide their nutrient requirements by bread and vegetable consumption.

In terms of income groups, households in the low-income group have the highest expenditure share for vegetables and bread. Therefore, the consumption of vegetables gives the highest level of iron (31.5%), potassium (41.7%), vitamin A (51.7%), niacin (26.2%), vitamin C (71.5%), vitamin B6 (38.6%), and magnesium (31.2%). Moreover, bread is a major source of calorie (28.6%), protein (33.8%), carbohydrate (37.1), calcium (27.5%), phosphor (20.6%), thiamin (38.5%), and zinc (34.4%). As it is observed, households in low-income group satisfy fourteen nutrients by consuming vegetables and bread.

Table 13: Reference Values for Daily Nutrient Intake and Individual Nutrient Intake in Turkey (Average)

Nutrients	Reference Values	Individual's[(a)] Nutrient Intake
Calorie (energy) (kcal)	2100-3600 kcal (adult men) and 1750-2700 kcal (adult women)	2409.53 kcal
Protein (g)	13 g (children aged 1-3), 19 g (children aged 4-8),34 g (children aged 9-13), 56 g (adult men) and 46 g (adult women)	69.27 g
Total Fat (g)	Not Defined	76.78 g
Carbohydrate (g)	130 g	343.69 g
Cholesterol (mg)	Less than 300 mg	128.01 mg
Calcium (mg)	1000 mg (adults), 800 mg (children), 1300 mg (young people)	966.46 mg
Phosphor (mg)	800 mg (children aged 1-10), 1200 mg (people aged 11-24), 800 mg (people aged 24 and more)	982.98 mg
Iron (mg)	10 mg (adult men) and 15-18 mg (adult women)	11.71 mg
Glucose (g)	-	12.22 g
Potassium (mg)	2-4 g (adults)	2600.47 (mg)
Sodium (mg)	2-3 g (adults)	3816.86 (mg)
Vitamin A (Retinol Equivalent – RE)	375 mcg (baby months 0-12), 400 mcg (children aged 1-3), 700 mcg (children aged 7-10), 800 mcg (children aged 11-14), 1000 mcg RE (people aged 15-18), 1000 mcg (adult men) and 800 mcg (adult women)	493.69 $mcg^{(b)}$
Thiamin (mg)	0.4 mg (appropriate amount for each 1000 calories intake)	1.28 mg
Riboflavin (mg)	0.6 mg (appropriate amount for each 1000 calories intake)	1.28 mg
Niacin (mg)	6.6 mg (appropriate amount for each 1000 calories intake)	13.72 mg
Vitamin C (mg)	75-90 mg	140.53 mg
Vitamin B6 (mg)	1.5-2 mg	1.26 mg
Vitamin B12 (mcg)	2 mcg	2.40 mcg
Magnesium (mg)	80 mg (1-3), 120 mg (children aged 4-6), 170 mg (children 7-10) and 320-400 mg (adults)	291.26 mg
Iodine (mcg)	90 mcg (children) and 150 mcg (young and adult people)	45.43 mcg
Zinc (mg)	10 mg (children aged 1-10), 12 mg (adult women) and 15 mg (adult men)	15.62 mg

(a) Individuals within households. Own calculation using the data from Turkish Statistical Institute, 2003 Turkish Household Budget Survey and Türkomp, National Food Composition Database.
(b) Microgram.

For the high-income group, the expenditure share of meat and fish is the largest share and the second is vegetables. Meat and fish provide 50.6 percent of vitamin B12 and vegetable is the major source of iron (34%), potassium (40.1%), vitamin A (51.2%), vitamin C (36.5%), and magnesium (32%). In addition, bread provides 21.9 percent of calorie, 24.9 percent of protein, 30.1 percent of carbohydrate, 17.4 percent of iron, 30.9 percent of thiamin, and 25.4 percent of zinc. However, there is no big difference in the way of nutrient intake between the low-income group and the higher-income groups.

Table 13 shows a daily requirement of nutritional values. These values were obtained from the Republic of Turkey Ministry of Health and FAO publications. Reference values are the values that an adult should take daily. In addition, the total nutrient consumption of the surveyed households is calculated by using the data used in the estimation of food elasticity and those values are added in Table 13. Since the consumption values in this data are the monthly total amount, this amount has been converted to the daily amount and the consumption amounts of the individuals are calculated according to the number of individuals in the household. It is assumed that every individual in the household makes an equal intake of nutrients.

In accordance with this information, calorie, cholesterol, calcium, phosphorus, potassium, riboflavin, niacin and zinc intake, as it is observed in Table 14, are within or near the reference values. However, vitamin A and iodine intake are lower than the reference values. In addition, vitamin B6, iron and magnesium intake are lower but close to the reference values. On the other hand, protein, carbohydrate, sodium and vitamin B12 intakes are slightly higher than reference values. According to these results, a significant nutrient deficiency is not found in those households.

Table 26 contains information on nutrient sources, and it provides to make a comparison between the households' food consumption and the nutrient intake. According to the information in Table 10, Table 11, and Table 12, households spend high budget share on vegetable; thus, they provide most of the nutrient requirement by the vegetables. Especially green leafy vegetables are good sources of nutrients. Moreover, the expenditure shares of bread, meat and fish, and milk and dairy products are high in household budget. These food groups are a major source of nutrients for households.

According to all these tables, except for iodine, individuals can meet their nutritional requirements at reference values or around. However, iodine intake is provided as half of the reference values. Iodine-intensive food commodities are fish and seafood. In addition, iodine is added to salt, water, and bread for providing iodine to people. It is seen that individuals do not get enough iodine by consuming those food commodities. As a result, households may not consume fish and seafood much and the consumption of other iodized food commodities may not provide daily iodine requirement.

The distribution of calorie intake by food according to income levels of households is given in Figure 2. The relationship between income and calorie intake is an important indicator to show nutritional status.

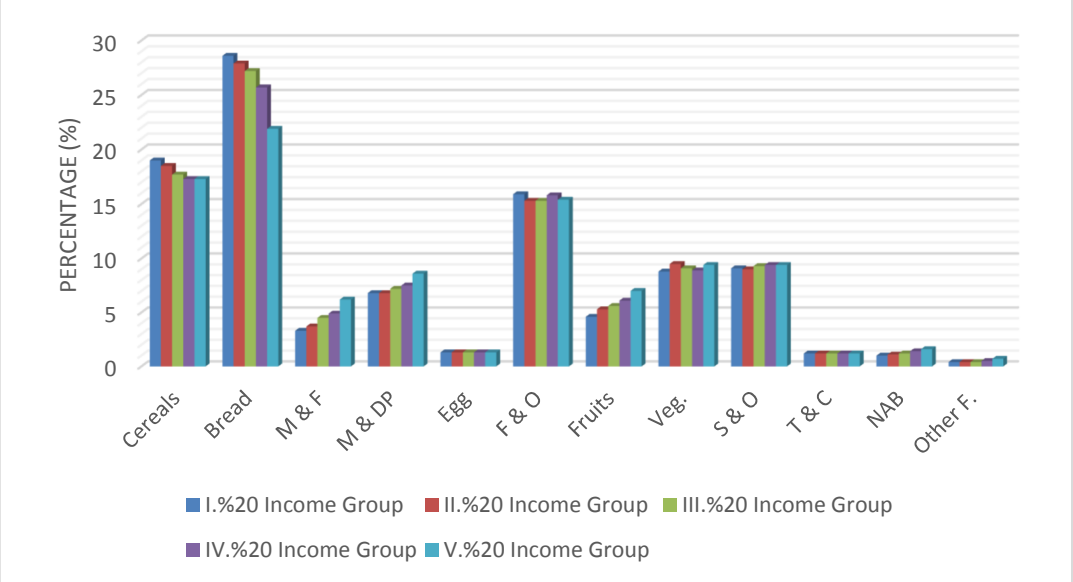

Figure 2: Calorie Intake by Income Groups (2003)

This figure is adapted from Turkish Statistical Institute, 2003 Household Budget Survey and Türkomp, National Food Composition Database.

First of all, all income groups provide calorie intake mostly by bread. However, this ratio is higher for low-income households than the other income levels. The second-high source of calorie is provided by cereals for all income groups. On the other hand, high-income households take more calories from meat and fish than the other income groups. Likewise, milk and milk products and fruit provide more calorie for high-income households than the others. Egg, fats and oils, vegetable, sugar, tea and coffee,

NAB and other food groups provide calorie to households at similar levels in each food groups.

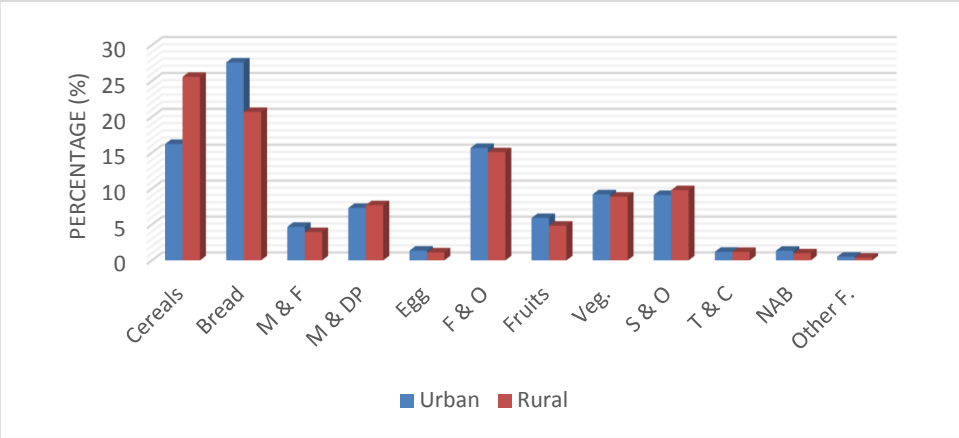

Figure 3: Calorie Intake by Urban-Rural Areas (2003)

This figure is adapted from Turkish Statistical Institute, 2003 Turkish Household Budget Survey and Türkomp, National Food Composition Database.

The differences in calorie intake by food groups between urban and rural areas are shown in Figure 2. The largest difference is observed for bread and cereals. Calorie intakeby bread is higher in urban than rural areas and calorie intake by cereals is higher in rural than urban areas. The reason for these two situations may be said that in rural areas, households can produce their own bread themselves; hence, they consume flour or similar goods more in the cereal group. In urban areas, households consume more prepared food; therefore, bread consumption is higher than rural areas. Calorie intakeby the other food groups is at similar levels, although there are small differences.

The distribution of protein intake, which is one of the important nutrients, according to income groups is given in Figure 3. Households provide the most protein intake by bread. The low-income households provide the majority of protein intake by bread and cereals. The protein taken by cereals and bread is called poor quality or incomplete protein because it does not contain some amino acids. In the case of high-income households, the majority of protein intake is obtained by bread; however, there is also a high percentage of protein intake by meat and fish. Moreover, protein intake by milk and dairy products is also high for the higher income group.

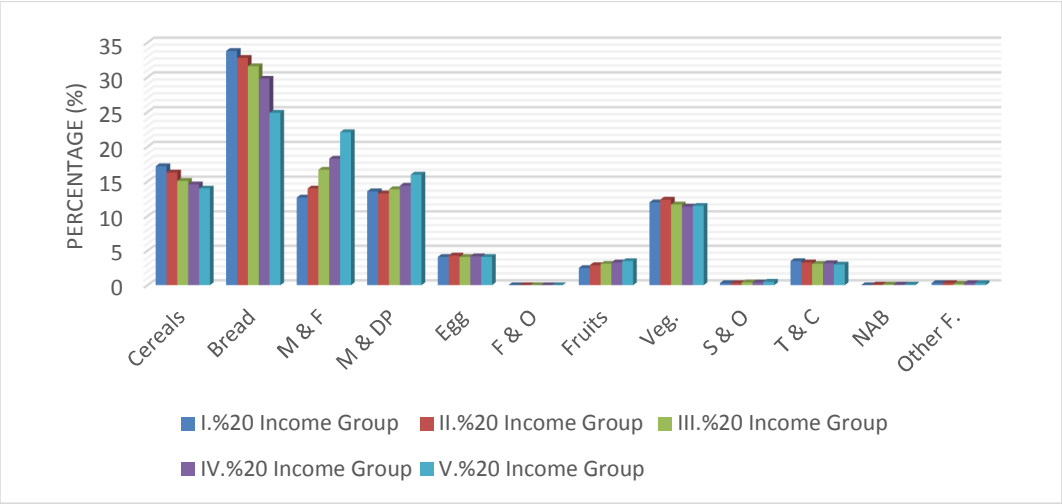

Figure 4: Protein Intake by Income Groups (2003)

This figure is adapted from Turkish Statistical Institute, 2003 Turkish Household Budget Survey and Türkomp, National Food Composition Database.

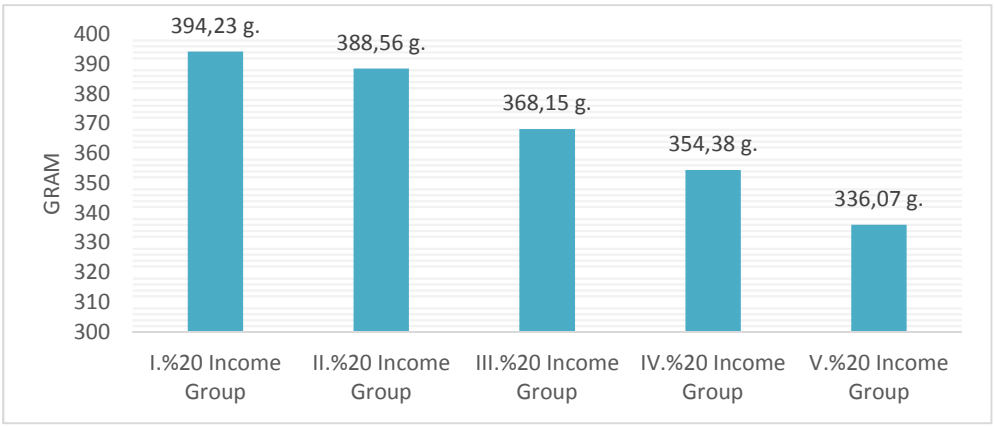

Figure 5: Individual Carbohydrate Intake by Income Groups (2003)

This figure is adapted from Turkish Statistical Institute, 2003 Turkish Household Budget Survey and Türkomp, National Food Composition Database.

Figure 4 shows the average carbohydrate intake of individuals in households is given in grams according to income groups and carbohydrate intake is found higher than the reference values for each income level. The daily reference value of carbohydrate intake is 130 grams for a person. As it can be seen in Figure 4, in all income groups, carbohydrate consumption is much higher than this amount. As expected, the consumption of individuals in the low-income group is higher than the other income groups. Amount of carbohydrate intake falls as income level increases.

5. EMPIRICAL RESULTS

In this chapter, the results of demand elasticities and nutrient elasticities are presented. The first section reports the results of expenditure and own-price elasticities for 12 food groups estimated with Quadratic Almost Ideal Demand System (QUAIDS). The second section reports the results of nutrient elasticities for 21 different nutrient types.

5.1. Results of Food Demand

This section submits estimation results from the food demand model. Table 15 summarizes expenditure, uncompensated and compensated price elasticities for 12 food groups. Considering the calculated elasticities and standard errors, demand elasticities are found to be statistically significant. The estimated expenditure elasticities show that the consumption of each food group increases as total expenditure increases. The most affected food group by total expenditure increases is meat and fish with 1.69 expenditure elasticity. This shows that households increase the expenditure of meat and fish more compared to other food groups when they increase their total food expenditure through income growth.

The expenditure elasticity of bread is found to be low as expected but high for cereals. The expenditure elasticity of vegetables, which has the largest share in total food expenditures, shows that households do not change their consumption decisions on vegetables much. In addition, expenditure share of milk and dairy products is also high and its expenditure elasticity, around 0.82, shows that households continue to consume milk and dairy products even though their income increased. The expenditure elasticities of fats and oils, fruit and sugar (1.07, 0.93, and 1.04 respectively) are around unity. Lastly, eggs, NAB, other food, and tea and coffee are found to be expenditure inelastic in addition to bread.

Table 14: Demand Elasticities

	Uncompensated Own-Price Elasticities	Compensated Own-Price Elasticities	Expenditure Elasticities
Cereals	-0.9880 (0.0186)	-0.8918 (0.0186)	1.1718 (0.0243)
Bread	-0.5310 (0.0247)	-0.4467 (0.0244)	0.6052 (0.0180)
Meat&Fish	-0.6468 (0.0201)	-0.3832 (0.0194)	1.6921 (0.0238)
Milk&Dairy P.	-0.8154 (0.0129)	-0.7175 (0.0129)	0.8198 (0.0167)
Eggs	-0.4088 (0.0333)	-0.3918 (0.0332)	0.5929 (0.0208)
Fats&Oils	-0.8182 (0.0281)	-0.7432 (0.0280)	1.0701 (0.0252)
Fruits	-0.8289 (0.0137)	-0.7433 (0.0137)	0.9330 (0.0186)
Vegetables	-0.9241 (0.0131)	-0.7643 (0.0130)	0.9515 (0.0135)
Sugar	-0.6469 (0.0150)	-0.5722 (0.0143)	1.0389 (0.0230)
Tea&Coffee	-0.7216 (0.0210)	-0.6987 (0.0209)	0.7048 (0.0234)
NAB	-0.6518 (0.0251)	-0.6356 (0.0250)	0.5750 (0.0282)
Other Food	-0.5020 (0.0109)	-0.4952 (0.0108)	0.5470 (0.0289)

Values in parentheses are standard errors. The estimation results of the Quadratic Almost Ideal Demand System for food groups..

The own-price elasticities are found to be negative for each food group, which is consistent with the economic theory that increases in food prices decrease their demand. The negative results of uncompensated own-price elasticities indicate that 12 aggregated food groups are normal goods. The findings show that cereals and vegetables have the highest own-price elasticities, 0.99 and 0.92 respectively. As it is mentioned before, these food groups have a large expenditure share in total food expenditure; therefore, since the increase in these food prices decreases largely their consumption, households may switch more easily their consumption to other food groups.

It is expected that an increase in the prices of the meat and fish group, specifically red meat price, decrease their consumption largely; however, the own-price elasticity of meat and fish is found to be low. This can be attributed to the fact that an increase in the price of one food item in meat and fish group may cause to switch household consumption to other food items in this group because there are various food items in this group such as red meat, chicken, and fish. The own-price elasticity of bread is found to be low as expected. Bread, meat and fish, egg, sugar, NAB, tea and coffee,

and other food groups are price inelastic, milk and dairy products, fats and oils, and fruits are also price inelastic, but their price elasticities are higher than other price inelastic goods. Lastly, the price elasticity of any food group is no higher than 1, but that of cereals and vegetables is close to 1, especially cereals; therefore, these food groups can be called price elastic.

The compensated (Hicksian) price elasticities are reported in Table 31 and Table 32. The results show that all the own-price elasticities are found to be negative and except seven cross-price elasticities, all the cross-price elasticities are found to be positive. Positive cross-price elasticities show that most food groups are net substitutes; however, only seven results negative which shows they are net complementarity.

5.2. Results of Nutrient Elasticities

This section submits the estimation results of nutrient elasticities. Two different nutrient elasticities are estimated for 21 nutrients. The first one is expenditure-nutrient elasticities which show that the changes in total food expenditure effects on 21 nutrients intake. The second one is food price-nutrient elasticities that shows the changes in food price effects on 21 nutrients intake. As it is mentioned before, estimated nutrient elasticities are accepted to be statistically significant because the expenditure and price elasticities, which are used to compute nutrient elasticities, are statistically significant.

Table 15 summarizes the expenditure-nutrient elasticities for 21 nutrients. The results of expenditure-nutrient elasticities, which are all positive, are interpreted as an increase in income increases nutrient intakes. For instance, a 1 percent increase in the total food expenditure increases calorie intake by 0.93 percent and protein intake by 0.96 percent. The highest expenditure-nutrient elasticity is computed 1.28 for vitamin B12 and the lowest elasticity is computed 0.41 for sodium.

The daily nutritional requirements for individuals and the daily individual nutrient intake in Turkey are reported in Table 13. According to this table, individuals' vitamin A and iodine intakes are very low compared to reference values. Considering the expenditure elasticities of these two nutrients, vitamin A intake increase by 0.92 percent and iodine intake increase by 0.50 percent when the total food expenditure increases by 1 percent. It is known that the most common sources of iodine are fish

and seafood, and if individuals do not consume enough of these food commodities, it may cause a low iodine intake. Therefore, since the expenditure share of meat and fish does not show the consumption amount of fish and seafood, it cannot be interpreted that individuals consume fish and seafood less, but the results also show that the consumption of these products cannot ensure individuals to receive sufficient iodine. In addition to this, Table 12 reports the nutrient shares in food groups and it can be seen that individuals provide 72.8 percent of iodine from the other food group because the iodized food items are included in this group, but they do not provide adequate iodine to individuals. Overall, the expenditure elasticity for iodine intake shows that increases in total food expenditure through income growth also cannot increase iodine intake sufficiently.

Table 15: Expenditure – Nutrient Elasticities

Nutrients	Elasticity
Calorie (Energy-kcal)	0.9270
Protein	0.9580
Fat	1.0101
Carbohydrate	0.8725
Cholesterol	0.9418
Calcium	0.7706
Phosphor	0.9480
Iron	0.8751
Glucose	0.8717
Potassium	0.9461
Sodium	0.4061
Vitamin A	0.9187
Thiamin	0.8764
Riboflavin	0.9087
Niacin	1.1890
Vitamin C	0.9364
Vitamin B6	1.0000
Vitamin B12	1.2748
Magnesium	0.9041
Iodine	0.5019
Zinc	0.9205

Nutrient-expenditure elasticities for 21 nutrients are calculated by using 21 nutrient shares and expenditure elasticities of 12 food groups.

Considering the findings in Table 13, individual protein, carbohydrate, and sodium intakes are calculated higher compared to the reference values, especially for

carbohydrate intake. Therefore, the expenditure elasticities for those nutrients are become more important to consider because other nutrients intakes are in the reference values interval or around it. First, the amount of carbohydrate intake is two-and-a-half times the reference values and this consumption level shows individuals consuming carbohydrate-dense foods can affect their health. The result of expenditure elasticity for carbohydrate intake indicates that individuals increase carbohydrate consumption by 0.87 percent when their total food expenditure increases by 1 percent. This increase can interpret to be high by reason of individuals provide carbohydrates mostly from bread and cereals, as it is mentioned before, those food groups consumption also increases by an increase in total food expenditure, especially cereals increases largely.

Protein intake is found to be higher than the reference values, but this high protein intake is not provided mostly from meat and fish group, only 16.8 percent, as seen in Table 10. The highest protein source for individuals is bread with 30.6 percent, thus it can be a reason for the high protein intake. Considering these findings and the expenditure elasticity for protein intake, a 1 percent increase in total food expenditure increases protein intake by 0.96 percent, it can be said that this high increase may come from increases in bread consumption. Lastly, other nutrients intakes also increase as the total food expenditure increases.

Table 16: Food Price - Nutrient Elasticities

Goods	Calo.	Prot.	Fat	Carb.	Chol.	Ca.	Phos.
Cereals	-0.1598	-0.1421	-0.0554	-0.2194	-0.0345	-0.0217	-0.1351
Bread	-0.1759	-0.2038	-0.1482	-0.1876	-0.1104	-0.1409	-0.1306
Meat&Fish	-0.1185	-0.1709	-0.1275	-0.1095	-0.2218	-0.0559	-0.1237
Milk&Dairy P.	-0.0672	-0.1365	-0.1252	-0.0317	-0.1915	-0.2204	-0.1827
Eggs	-0.0191	-0.0319	-0.0350	-0.0101	-0.1645	-0.0167	-0.0292
Oils	-0.1416	-0.0211	-0.3737	-0.0181	-0.0741	0.0046	-0.0065
Fruits	-0.0543	-0.0581	-0.0197	-0.0740	-0.0336	-0.0604	-0.0831
Vegetables	-0.0667	-0.1041	-0.0290	-0.0743	-0.0041	-0.1361	-0.1788
Sugar	-0.0805	-0.0364	-0.0465	-0.1110	-0.0329	-0.0178	-0.0297
Tea&Coffee	-0.0170	-0.0352	-0.0143	-0.0110	-0.0227	-0.0269	-0.0258
NAB	-0.0168	-0.0084	-0.0196	-0.0191	-0.0371	-0.0710	-0.0124
Other Food	-0.0096	-0.0097	-0.0161	-0.0067	-0.0146	-0.0075	-0.0104

Calo (calorie), Prot (protein), Carb (carbohydrate), Chol (Cholesterol), Ca (calcium), Phos (phosphor). Food price-nutrient elasticities for 21 nutrients are calculated by using 21 nutrient shares and uncompensated price elasticities of 12 food groups.

Table 16, Table 17, and Table 18 present food price-nutrient elasticities which shows the changes in food prices impacts on 21 nutrients intake. The values in the tables are interpreted for calorie intake as follows; a 1 percent increase in bread prices reduces calorie intake by 0.18 percent. These food price-nutrient elasticities should be interpreted by looking at Table 10, Table 11, and Table 12 because it is important to know that individual nutrients intake is provided by what food groups. For instance, individuals provide protein intake mostly from bread, then meat and fish. In this situation, bread prices are also important for protein intake as much as meat and fish prices. As mentioned before, carbohydrate intake is high, and the most influential among food prices is the price of cereals and bread while they do not affect strongly carbohydrate intake.

Table 17: Food Price - Nutrient Elasticities

Goods	Iron	Gluc.	Pot.	Sod.	Vit. A	Thi.	Rib.
Cereals	-0.1047	-0.0029	-0.0679	0.0011	0.0060	-0.1525	-0.0642
Bread	-0.1271	-0.0666	-0.0874	-0.1891	-0.0243	-0.1865	-0.0961
Meat&Fish	-0.1067	-0.0145	-0.0886	-0.0931	-0.0669	-0.1256	-0.1126
Milk&Dairy P.	-0.0188	-0.0123	-0.0950	-0.1377	-0.1786	-0.0621	-0.2865
Eggs	-0.0210	-0.0155	-0.0137	-0.0331	-0.0419	-0.0153	-0.0507
Oils	-0.0033	00250	0.0103	-0.0325	-0.0305	-0.0092	0.0012
Fruits	-0.0871	-0.3230	-0.1480	0.0255	-0.0802	-0.0735	-0.0718
Vegetables	-0.2736	-0.3324	-0.3826	-0.0095	-0.4616	-0.2041	-0.1781
Sugar	-0.0237	-0.0219	-0.0181	0.0247	-0.0142	-0.0274	-0.0198
Tea&Coffee	-0.1029	0.0057	-0.0438	0.0145	0.0004	-0.0047	-0.0081
N.A.B.	0.0014	-0.1100	-0.0060	-0.0253	-0.0193	-0.0080	-0.0134
Other Food	-0.0078	-0.0034	-0.0053	0.0484	-0.0077	-0.0076	-0.0084

Gluc (glucose), Pot (potassium), Sod (sodium), Vit. A (vitamin A), Thi (thiamin), Rib (riboflavin). Food price-nutrient elasticities for 21 nutrients are calculated by using 21 nutrient shares and uncompensated price elasticities of 12 food groups.

Individuals consume vitamin A less than the daily requirements (in Table 13) and the expenditure nutrient elasticity for vitamin A is found to be positive and close to unity. Therefore, individuals get vitamin A mostly from vegetables, then milk and dairy products, and those food groups prices are important for vitamin A intake. According to the food price-nutrient elasticities for vitamin A, it is seen that vegetable prices effects on vitamin A intake is higher than other food groups. This means that a 1 percent increase in vegetable prices decreases vitamin A intake by 0.46 percent. The

second highest food price-vitamin A elasticity is for milk and dairy products (-0.18), as expected.

In terms of the effects of food prices on iodine intake, a 1 percent increase in bread prices decreases iodine intake by 0.21 percent, meat and fish by 0.14 percent and milk and dairy products by 0.12 percent. However, iodine intake increases by 0.14 percent when the price of other food is increased. There is a wide range of diversity for food commodities in the other food group and it may cause this positive price elasticity for iodine intake because an increase in the other food price is not only influenced by iodine-contained food but also by the prices of other food.

Table 18: Food Price - Nutrient Elasticities

Goods	Nia.	V.C	V.B6	V.B12	Mag.	Iod.	Zinc
Cereals	-0.2352	0.0224	-0.0536	-0.0683	-0.1177	-0.0560	-0.2087
Bread	-0.1692	-0.0334	-0.1563	-0.1590	-0.1240	-0.2078	-0.1836
Meat&Fish	-0.2164	-0.0213	-0.1332	-0.2354	-0.0917	-0.1415	-0.1459
Milk&Dairy P.	-0.0575	-0.0062	-0.0625	-0.4430	-0.0665	-0.1185	-0.1109
Eggs	-0.0236	-0.0047	-0.0195	-0.0728	-0.0131	-0.0659	-0.0202
Oils	-0.0316	0.0408	-0.0018	-0.0419	0.0033	-0.0909	-0.0141
Fruits	-0.0915	-0.2679	-0.1553	-0.0411	-0.1330	0.0639	-0.0648
Vegetables	-0.2788	-0.6619	-0.3674	-0.0748	-0.2804	-0.0227	-0.1107
Sugar	-0.0462	0.0052	-0.0242	-0.0659	-0.0169	0.0324	-0.0253
Tea&Coffee	-0.0179	0.0049	-0.0074	-0.0332	-0.0532	0.0101	-0.0209
N.A.B.	-0.0115	-0.0116	-0.0130	-0.0244	-0.0018	-0.0466	-0.0055
Other Food	-0.0096	-0.0027	-0.0060	-0.0150	-0.0092	0.1418	-0.0100

Nia (niacin), V.C (vitamin C), V.B6 (vitamin B6), V.V12 (vitamin B12), Mag (magnessium), Iod (iodine). Food price-nutrient elasticities for 21 nutrients are calculated by using 21 nutrient shares and uncompensated price elasticities of 12 food groups.

Calorie consumption is one of the most important factors to describe individual nutritional status in empirical studies. Individuals provide calorie intake from cereals by 18 percent, from bread by 26.3 percent, from fats and oils by 15.5 percent, from sugar by 9.2 percent, and from vegetables by 9.1 percent. It is seen that the highest portion is provided from carbohydrate-dense food groups. Expenditure elasticity for calorie intake is around 0.93 which is closed to unity and the prices of cereals, bread, meat and fish, and fats and oils affect calorie intake more than other food groups but not strongly.

Overall, the food price-nutrient elasticities table shows that changes in prices of cereals, bread, meat and fish, milk and dairy products, vegetables, and fruits affect 21 nutrients intake significantly. These effects can be seen consistent with the expenditure shares of food groups because their expenditure shares are high in total food expenditure; therefore, an increase in their prices decreases most nutrient intakes through decreases in consumption amount.

6. CONCLUSION

Nutritional studies have become significant over the years as malnutrition affects not only human life and health but also the societies, countries, and economies. Regardless of whether a developed or developing country, each country suffers at least one type of malnutrition. Most developing countries generally have malnutrition such as underweight, stunting and wasting, while developed countries generally have obesity and overweight problems. According to the statistics published by FAO and WHO, there is a decrease in underweight and stunting, while an increase in overweight and obesity. The Global Nutrition Report 2018 presented 141 countries having malnutrition and the majority of them including Turkey suffer from two types of malnutrition at the same time which are mainly overweight and anemia.

Due to malnutrition, human productivity decreases, health expenses increase, and sustainable development is prevented. Malnutrition affects human life to a large extent; especially individuals, who had nutritional problems when they are children, face health problems easier compared to other people. In addition, nutritional problems affect individual's work and social lives, and economic situations; for instance, because of a decrease in human productivity, malnutrition negatively affects human potential in work-life and existing unproductive people in countries also badly affect economies. For these reasons, the necessity of examining malnutrition from an economic point of view has emerged.

Nutrient demand is now being made in the field of economic analysis and most studies examine the relationship between calorie and income for different countries. The reason to investigate the relationship between income and calorie is it determines human health and nutritional status. However, there is one crucial problem has emerged that adequate calorie intake and nutrient intake are not the same because higher consumption of calorie-dense food does not show that this food provides other nutrient types at the same level. In general, calorie-dense food have low nutrient values; thus, the relationship between other nutrients intake and income should be examined in addition to income and calorie intake. In the literature on nutrient demand,

there are studies such as Huang (1996) and Huang and Lin (2000) examine the relationship between income and different nutrients and moreover food prices and different nutrients. In economic theory, individuals decide to consume food considering food prices with respect to their limited budget and both the limited budget and food prices affect their nutritional status.

In this study, effects of total expenditure (instead of income) and food prices on nutrient intake are examined by estimating the Quadratic Almost Ideal Demand System for 12 aggregated food groups using 2003 Household Budget Survey Data, and the expenditure and price elasticities are estimated. The data for the year 2003 is chosen because current data do not have the information about the amount of consumption for food and some characteristics of households.

The results of expenditure elasticities show that most food expenditure elasticities are closed to unity, which are milk and dairy products, fats and oils, fruits, vegetables, sugar. Bread, eggs, NAB, coffee and tea, and the other food groups have the small expenditure elasticities (smaller than unity). The expenditure elasticities of cereals and meat and fish are higher than unity indicating that they are more expenditure elastic. The own-price elasticities are found to be negative for each food groups and this is consistent with the economic theory that increases in food prices decrease their demand. According to the uncompensated own-price elasticities, 12 aggregated food groups are found to be normal goods, while cereals and vegetable are price elastic compared to other food groups. Finally, compensated own-price elasticities are found to be negative for 12 aggregated food and statistically significant. All the compensated cross-price elasticities are estimated positive, except eight elasticities, and these show that most food groups are substitutable.

In the second part of the analysis, to identify the effects of total food expenditure and food prices on nutrient intake, nutrient elasticities are calculated using uncompensated price elasticities and expenditure elasticities. These nutrient elasticities are accepted as being significant because they derived from demand elasticities that are all statistically significant. First, all the expenditure – nutrient elasticities are found to be positive; this implies that an increase in total food expenditure increases 21 different nutrients intake. According to the results, vitamin A and iodine intakes do not reach to the reference values. Considering the expenditure – nutrient elasticities of these two nutrients, the intake of vitamin A increases by 0.92 percent and iodine increases by

0.50 percent when expenditure increases 1 percent. The expenditure-nutrient elasticity for iodine intake is lower compared to vitamin A and an increase in expenditure affects more vitamin A intake than iodine. It is known that the most common source of iodine is fish and seafood, and if households do not consume enough of these food commodities, it may cause low iodine intake. Moreover, it is understandable that the consumption of other food group containing iodine does not provide the daily iodine needs to individuals.

Protein, carbohydrate, and sodium intakes are higher than reference values for households. Expenditure shares of bread and cereals show that households consume more carbohydrate-dense food, for this reason, there is a high level of carbohydrate intake. The food price-nutrient elasticity for carbohydrate indicates that an increase in all the food prices decreasing carbohydrate intake. According to the findings, households mostly get carbohydrate by bread by 34.7 percent, by cereals by 26 percent and by sugar by 15.5 percent. Therefore, those food prices impact on carbohydrate intake are higher than the other food prices.

Furthermore, if household income is increased by subsidies or some aid programs and improvements are made for food prices, they may help to increase their nutrient intakes. However, household food consumption is not just affected by income and food price changes, there are many factors such as preferences, geographical conditions, accessing clean water and health services, socio-demographic properties. Therefore, if policymakers move only by considering certain issues, they cannot produce effective policies, and the interventions for nutrition may not be sufficient.

All of these indicates that it is important to understand the effects of household income and food prices changes on household consumption decisions. This relationship between food consumption, food prices, and income define household nutritional status. In addition to this, other factors such as food availability, preferences, culture, and geographic location have important effects on nutritional status. Thus, if the household nutritional status is understood clearly, it proves good information to policymakers for regulating policies on nutrition, however, if these are not well understood, policies and programs for nutrition may implement on certain malnutrition, other malnutrition types may be ignored.

It is difficult to design a policy or an intervention for nutrition because interventions on malnutrition may not provide always desired results. Akinleye and Rahji (2007) state that increases in income may increase nutrition-dense food consumption, at the same time increase low-nutrition food such as fast food. Using income as a tool for nutrition programs could be inefficient at the end. The same results can be seen by using food prices as a tool. Therefore, it is wrong to consider only income and food prices for making nutrition policies and programs as it is mentioned before. There are various factors affecting the nutritional status of people and they should be considered as well.

In addition to the effect on human beings, malnutrition has economic and social impacts, not only to individuals but also to societies and countries. Some of the effects of malnutrition on humans are mortality, morbidity, illness, impair development and the social effects are seen mostly in children and women. If children are stunting and this problem continues a long time, they could have less education and it may cause to become less talented adults. Malnutrition may not be seen as a big problem; however, malnutrition causes many economic consequences and they affect most countries and all around the world. Some economic consequences could be listed as follows; high losses of human capital, high health insurance costs, high losses of economic output, poverty cycles. In addition, it may prevent economic development and cause high losses of income because of illness. Those impacts affect countries and global economies significantly.

All types of malnutrition impacts on the global economy per year in 2013 are around 3.5 trillion dollars, in other words, 5 percent of global income (Global Panel). The reasons for this cost are such as the failure to sustain economic development, high losses of human capital, losses of labor productivity. In Turkey, the statistics indicate that health expenditures are 4.5 percent of gross domestic products (GDP) and 78 percent of these health expenditures are supplied by the Turkish government (TurkStat). Furthermore, Bulletin of Sustainable Development Indicators published by TurkStat between 2010 and 2017 years presents that relative poverty rate decreased by 3.4 percent, 10.9 percent of children under five are overweight, maternal and under-five child mortality rates decreased, and the share of net official development aids in GDP increased by 0.95 percent. In Turkey, it can be visible that there are three types

of malnutrition, which are overweight, obesity, and anemia. Therefore, nutritional policies should be appropriately prepared and implemented.

The whole of the findings is considered, this analysis could be made using the year 2003 Turkish Household Budget Survey Data Set, it cannot be estimated using the current data sets. In this case, there is a lack of data to analyze the effects of food prices and income on nutrient intake. This data deficiency should be eliminated because the income level in 2003 and the current income level are different, in addition, the food inflation shows food prices changed over the years. The cost of malnutrition should also be examined attentively. There are some statistics about health expenses for Turkey, but it does not show the share of expenses for malnutrition. Elimination of these deficiencies is important for the continuity of nutrition studies. Moreover, Turkish Health Minister publishes the recommendations about adequate nutrition, appropriate nutrition for each age or nutrition for schooled children, but there is no information about how they affect people and the progress of those recommendations.

The results of the analysis show that individual vitamin A and iodine intakes are insufficient, and their carbohydrate and sodium intakes are higher. The most common policy is consumer subsidies or to improve income, therefore, an increase in income increases nutrients intake, and the policy on income is seen appropriate. However, increases in income do not increase the intake of all nutrients at the same level. As mentioned before, a 1 percent increase in income increases the vitamin A intake by 0.92 percent but the iodine intake by 0.50 percent for Turkish individuals. The improvements in income may be effective for vitamin A intake, however, it is seen that the increase in income may be less effective for iodine intake compared to vitamin A. The nutritional habits are important as much as food demand; in addition, to understand household nutritional habits could help to design an appropriate policy for nutrition.

The findings also show that the household carbohydrate and sodium intakes are higher than the normal level; particularly the carbohydrate intake is higher compared to the others. This result is consistent with the increases in the percentages of obesity and overweight in Turkey. According to the expenditure-nutrient elasticities, a 1 percent increase in income increases the carbohydrate intake by 0.87 percent and as it is seen that the effects of household nutritional habits are substantial. Households do not change their consumption decisions from carbohydrate-dense food to nutrient-dense

food much when their income increases. In this situation, the nutritional policy on income may not be effective to achieve the targets of nutrition such as decrease overnutrition or nutrient deficiencies because households also increase their carbohydrate intake at the same time.

The other method of designing nutritional policy is food prices; the low-nutrient-dense food prices may be increased by taxation and the high-nutrient-dense food prices may be decreased by subsidies. In this way, the aim is to steer households to high-nutrient-dense food. Likewise, the household nutrition habits and consumption decisions should be considered as well while the food price policies are implemented.

As a result, the nutritional policies should not be depended on only food prices and income. The food availability for households is one of the important factors to be adequate nutrition and the food availability depends on production, food transportation, consumer purchasing power, and market and trade systems and they should be considered. The improvements in those factors could help to increase food availability and this may help to reach adequate nutrition for households.

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APPENDIX

Appendix 1. Tables of Some Countries with Malnutrition

Table 19: Countries With Malnutrition

Malnutrition	Countries			
Overweight (Only)	Argentina Australia Brunei	Darussalam Chile Costa Rica	Germany Mexico Mongolia	Nicaragua Peru USA
Anemia (Only)	China Japan	Republic of Korea	Singapore	Sri Lanka
Stunting (Only)	Philippines			
Overweight and Anemia	Algeria Armenia Azerbaijan Barbados Belarus Belize Bolivia Bosnia and Herzegovina Brazil Bulgaria Colombia Cuba Czechia Dominican Republic	El Salvador Fiji Gabon Georgia Ghana Guyana Iran Jamaica Jordan Kazakhstan Kuwait Kyrgyzstan Lebanon Montenegro Venezuela	Morocco Oman Panama Paraguay Moldova Romania Saint Lucia Samoa Sao Tome and Principe Saudi Arabia Senegal Serbia Seychelles Uruguay	State of Palestine Suriname Thailand The former Yugoslav Republic of Macedonia Tonga Trinidad and Tobago Tunisia Turkey Turkmenistan Ukraine Uzbekistan
Overweight and Stunting	Ecuador	Guatemala	Honduras	
Anemia and Stunting	Afghanistan Bangladesh Bhutan Burkina Faso Burundi Cambodia Central African Republic	Chad Democratic People's Republic of Korea Democratic Republic of the Congo Eritrea	Lao People's Democratic Republic Madagascar Malawi Mozambique Myanmar Nepal Ethiopia	Niger Pakistan Rwanda Timor-Leste Uganda Viet Nam India Indonesia

Development Initiatives, **Global Nutrition Report 2018Report: Shining a light to spur action on nutrition** (Bristol, 2018).

Table 20: Countries With Malnutrition

Malnutrition	Countries			
Overweight, Anemia and Stunting	Albania	Gambia	Maldives	Sudan
	Angola	Guinea	Mali	Swaziland
	Benin	Guinea-Bissau	Mauritania	Syrian Arab Republic
	Botswana	Haiti	Namibia	
	Cameroon	Iraq	Nigeria	Tajikistan
	Comoros	Kenya	Papua New Guinea	Togo
	Congo	Lesotho	Sierra Leone	United Republic of Tanzania
	Côte d'Ivoire	Liberia	Solomon Islands	
	Djibouti	Libya	Somalia	Vanuatu
	Egypt	Malaysia	South Africa	Yemen
	Equatorial Guinea			Zambia
				Zimbabwe

Development Initiatives, **Global Nutrition Report 2018Report: Shining a light to spur action on nutrition** (Bristol, 2018)

Appendix 2. Tables Adapted from Household Budget Survey Data Set

Table 21: NUTS-II Regions

Regions and Region Codes			
TR10	İstanbul	TR71	Kırıkkale
TR21	Tekirdağ	TR72	Kayseri
TR22	Balıkesir	TR81	Zonguldak
TR31	İzmir	TR82	Kastamonu
TR32	Aydın	TR83	Samsun
TR33	Manisa	TR90	Trabzon
TR41	Bursa	TRA1	Erzurum
TR42	Kocaeli	TRA2	Ağrı
TR51	Ankara	TRB1	Malatya
TR52	Konya	TRB2	Van
TR61	Antalya	TRC1	Gaziantep
TR62	Adana	TRC2	Şanlıurfa
TR63	Hatay	TRC3	Mardin

Turkish Statistical Institute, 2003 Household Budget Survey.

Table 22: Shares of Food in Total Food Expenditure by Regions (Average) (2003)

	İstanbul	Western Marmara	Aegean	Eastern Anatolia	Western Anatolia	Mediterranean
Cereals	8,3	9,5	10,2	9,2	8,8	10
Bread	14,7	14,4	14,3	17	14,7	15,3
M & F	15,1	14,7	13,2	13,5	14,4	13
M & DP	13,3	12,6	12,2	11,5	11,7	10,9
Eggs	2,7	2,7	2,7	3	2,9	2,8
F & O	5,2	5,9	6,1	5,6	5,7	6,5
Fruits	9,3	9,7	9,8	9,1	10,4	8,9
Veg.	16,7	15,9	16,7	15,9	16,1	17,3
Sugar	6,6	7,6	7,5	7,7	8,2	8,2
T & C	2,4	2,5	3	2,5	3	3,3
NAB	4,4	3,1	3,2	3,8	2,9	2,7
Other F.	1,3	1,4	1,1	1,2	1,2	1,1
Total	100	100	100	100	100	100

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food). Own calculations using from Turkish Statistical Institution, 2003 Household Budget Survey.

Table 23: Shares of Food in Total Food Expenditure By Regions (Average) (2003)

	Central Anatolia	Western Black Sea	Eastern Black Sea	Northeastern Anatolia	Middle East Anatolia	Southeastern Anatolia
Cereals	9	12,6	10,8	14,7	11,3	14,1
Bread	15,2	12,6	16,9	14,8	15,2	10,3
M & F	13,7	11,8	12,5	16,7	15,8	13,3
M & DP	11,2	11,6	10,4	8,7	10,1	11,5
Eggs	3,1	2,9	2,8	2,4	2,5	2,5
F & O	6,7	7,8	7,8	7,6	7,1	6,7
Fruits	9,6	8,7	8,1	7,5	8,2	7,3
Veg.	16,8	18,4	18,2	14,6	15,9	18,4
Sugar	8,4	7,9	7,8	8	8,8	8,9
T & C	3,2	3,2	2,2	2,8	2,6	4,5
NAB	2	1,5	1,6	1,5	1,7	1,5
Other F.	1,1	1	0,9	0,7	0,8	1
Total	100	100	100	100	100	100

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food). Own calculations using from Turkish Statistical Institution, 2003 Household Budget Survey.

Table 24: Shares of Food in Total Food Expenditure By Types of Household (Average)(2003)

	Nuclear Family With One Child	Nuclear Family With Two Children	Nuclear Familiy With Three or More Children	Nuclear Family – Without Children	Patriarchal or Extended Family – Without Children
Cereals	9,5	9,3	11,9	9,3	10,2
Bread	13,9	14,7	16	12,1	14,2
M & F	14,6	14,2	11,7	15,7	13,9
M & DP	12	11,4	10,9	11,8	11,4
Eggs	2,7	2,9	2,9	2,5	2,6
F & O	6	6	6,5	6,9	6,8
Fruits	9,9	9,4	7,9	10,2	9,1
Veg.	16,4	16,2	17,3	17,3	17,5
Sugar	7,5	7,7	8,4	7,5	7,7
T & C	2,8	2,7	3,3	3,1	3,2
NAB	3,4	3,3	2,1	2,5	2,4
Other F.	1,3	1,2	1,1	1,1	1
Total	100	100	100	100	100

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food). Own calculations using from Turkish Statistical Institution, 2003 Household Budget Survey.

Table 25: Shares of Food in Total Food Expenditure By Types of Household (Average)(2003)

	Patriarchal or Extended Family	Family With one Adult - Without Children	Family With One Adult	Student, Worker, etc. (People Living Together)	Relatives Living Together
Cereals	12,5	8,4	9,8	8,7	7,4
Bread	13,4	12,3	15,4	16,1	16,3
M & F	13	14,5	12,5	10,3	14,3
M & DP	11,9	13,5	11,8	11,8	11,3
Eggs	2,7	2,6	3	3,9	3,3
F & O	6,7	6,3	6,1	4,1	6,6
Fruits	8,2	10,5	8,5	10,4	9,8
Veg.	17	17,3	17,7	15,2	15,8
Sugar	8,4	7,3	7,9	7,3	6,8
T & C	3,2	3,4	3,2	3,1	3,3
NAB	2	3	2,9	7,4	3,9
Other F.	1	0,9	1,2	1,7	1,2
Total	100	100	100	100	100

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food). Own calculations using from Turkish Statistical Institution, 2003 Household Budget Survey.

Appendix 3. Tables Related to Nutrients

Table 26: Sources of Nutrients

Nutrients	Sources
Protein	Proteins from animal sources, such as meat, poultry, fish, eggss, milk, cheese, and yogurt are called "complete proteins[7]". Proteins from plants, legumes, grains, nuts, seeds, and vegetables are called "incomplete proteins[8]".
Total Fat	Butter, margarine, vegetable oils, whole milk, visible fat on meat and poultry products, invisible fat in fish, shellfish, some plant products such as seeds and nuts, and bakery products.
Carbohydrate	Starch and sugar are the major types of carbohydrates. Grains and vegetables (corn, pasta, rice, potatoes, breads) are sources of starch. Natural sugars are found in fruits and juices. Sources of added sugars are soft drinks, candy, fruit drinks, and desserts.
Cholesterol	Sources of cholesterol include liver, eggss, and food that contain eggss such as cheesecake and custard pies.
Calcium	Milk and dairy products (yoghurt, cheese, ice cream, etc.) are the best source of calcium. Eggs yolk, cereals, dry legumes and oil seeds are also good sources of calcium. The absorption of calcium in green leafy vegetables and cereals is low.
Phosphor	Protein-rich food have a high phosphorus content. Milk and dairy products, meat and meat products, chicken, fish, eggss, cereals, dried legumes and oil seeds are important sources of phosphorus.
Iron	Meat and meat products, eggss, green leafy vegetables and cereals are the source of iron. Molasses and dried fruits are also a good source of iron.

This table is adapted from Gülhan Samur, **Vitaminler, Minareller ve Sağlığımız** (Hacettepe Üniversitesi-Sağlık Bilimleri Fakültesi Beslenme ve Diyetetik Bölümü, 2008), and Institute of Medicine of The National Academies, **Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids** (2005).

[7] Complete proteins contain all of the essential amino acids in adequate amounts (Institute of Medicine of The National Academies, 2005).
[8] Incomplete proteins are missing, or do not have enough of, one or more of the essential amino acids, making the protein imbalanced (Institute of Medicine of The National Academies, 2005).

Table 27: Sources of Nutrients

Nutrients	Sources
Glucose	Glucose is found in the natural structure of milk and dairy products, bread, cereals, legumes, fruits and vegetables. In addition, added sugar, sucrose, also known as tea sugar, obtained from sources such sugar cane and sugar beet, is commonly added to food and beverages for flavor or protective purposes during the production phase. Some food prepared with extra sugar and frequently consumed; cola-carbonated drinks, prepared vegetable, juices, candies, chocolate, waffles and bars, ice cream, pastries such as cakes, cookies, biscuits, jam, marmalade, chocolate cream.
Potassium	Milk, meat, cereals, fresh vegetables and fruits.
Sodium	The main source of sodium and chlorine is salt. In addition, each nutrient contains sodium in certain proportions. The sodium content in fruits is very low. There is a high proportion of salt in brined food and some processed food.
Vitamin A	Vitamin A is provided in two ways. Vitamin A is taken in Retinol form from animal-derived liver, fish oil, milk, butter, eggss. From plant sources vitamin A is taken from carotenoids such as beta carotene and turn them into vitamin A. The sources of carotenoids (vitamin A precursor) are many dark green leafy vegetables with red and yellow oranges. Vitamin A is found mostly in yellow-orange vegetables (carrot, winter squash, etc.), dark green leafy vegetables and yellow and orange fruit (apricot, peach, etc.).
Thiamin	Liver and other organ meats, meat, milk, dried legumes, cereals (wheat, corn, rice), walnuts, hazelnuts, eggss.
Riboflavin	Liver, meat, milk and products, eggss, cheese, fish, green leafy vegetables and cereals.
Niacin	Meat, fish, poultry, liver, yeast, cereals, legumes and green leafy vegetables.

This table is adapted from Gülhan Samur, **Vitaminler, Minareller ve Sağlığımız** (Hacettepe Üniversitesi-Sağlık Bilimleri Fakültesi Beslenme ve Diyetetik Bölümü, 2008), and Institute of Medicine of The National Academies, **Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids** (2005).

Table 28: Sources of Nutrients

Nutrients	Sources
Vitamin C	Citrus fruits such as lemon, orange, tangerine, strawberry, blackberry, rosehip, tomato, cabbage, potatoes and green leafy vegetables such as spinach, lettuce, green pepper, vine leaf.
Vitamin B6	Meat, liver, kidney, cereals and legumes.
Vitamin B12	Meat, milk, cheese, eggss and fish. Vitamin B12 is not found in plant food.
Magnesium	Dried legumes, oilseeds, unrefined cereals and dark green leafy vegetables are important sources of magnesium.
Iodine	Seafood is a source of iodine, especially fish. Food grown in iodized soil provide enough iodine. In addition, iodine is added to salt, water and bread in countries where iodine deficiency diseases are seen.
Zinc	Meat, liver, eggss and seafood are the best sources of zinc. Milk and products, dried legumes, oil seeds and grains contain enough zinc. The amount of zinc in the highly purified flour decreases.

This table is adapted from Gülhan Samur, **Vitaminler, Minareller ve Sağlığımız** (Hacettepe Üniversitesi-Sağlık Bilimleri Fakültesi Beslenme ve Diyetetik Bölümü, 2008), and Institute of Medicine of The National Academies, **Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids** (2005).

Appendix 4. Calculated Demand Elasticity Tables

Table 29: Uncompensated Own- and Cross-Price Elasticities

	Cereals	Bread	M & F	M & DP	Eggs	F & O
Cereals	**-0.9880**	0.0571	-0.1370	-0.0430	-0.0131	-0.0329
Bread	0.0806	**-0.5310**	-0.1158	0.0287	-0.0062	-0.0268
M & F	-0.1153	-0.2558	**-0.6468**	-0.1175	-0.0517	-0.0912
M & DP	-0.0006	0.0040	-0.0177	**-0.8154**	-0.0129	0.0326
Eggs	0.0102	-0.0275	-0.1110	-0.0267	**-0.4088**	-0.0361
F & O	-0.0303	-0.1180	-0.1061	0.0258	-0.0284	**-0.8182**
Fruits	0.0221	-0.1178	0.0110	-0.0182	-0.0157	0.0525
Veg.	0.0200	0.0139	-0.0305	0.0012	0.0016	0.0266
Sugar	-0.0096	-0.1297	-0.1219	-0.0417	-0.0088	-0.0404
T & C	0.0057	-0.0469	-0.0741	-0.0100	-0.0077	-0.0047
NAB	0.1000	-0.0542	0.0230	0.0008	-0.0376	-0.0295
Other F.	-0.0029	-0.0555	-0.0236	-0.0375	-0.0233	-0.0280

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food).

Table 30: Uncompensated Own- and Cross-Price Elasticities

	Fruits	Veg.	Sugar	T & C	NAB	Other F.
Cereals	0.0029	0.0038	-0.0179	-0.0129	0.0175	-0.0082
Bread	-0.0479	0.0747	-0.0358	-0.0079	-0.0121	-0.0058
M & F	-0.0628	-0.1571	-0.1032	-0.0474	-0.0272	-0.0161
M & DP	-0.0037	0.0237	-0.0093	-0.0065	-0.0067	-0.0073
Eggs	-0.0193	0.0698	0.0100	-0.0051	-0.0377	-0.0107
F & O	0.0563	0.0438	-0.0437	-0.0140	-0.0258	-0.0115
Fruits	**-0.8289**	-0.0712	0.0364	-0.0115	0.0059	0.0024
Veg.	-0.0406	**-0.9241**	-0.0107	0.0116	-0.0174	-0.0030
Sugar	0.0368	-0.0397	**-0.6469**	-0.0181	-0.0209	0.0017
T & C	-0.0118	0.1015	-0.0160	**-0.7216**	0.0752	0.0054
NAB	0.0518	-0.0401	-0.0198	0.0908	**-0.6518**	-0.0085
Other F.	0.0527	0.0269	0.0454	0.0193	-0.0185	**-0.5020**

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food).

Table 31: Compensated Own- and Cross-Price Elasticities

	Cereals	Bread	M & F	M & DP	Eggs	F & O
Cereals	**-0.8918**	0.2203	0.0456	0.0970	0.0204	0.0492
Bread	0.1303	**-0.4467**	-0.0215	0.1009	0.0111	0.0156
M & F	0.0236	-0.0202	**-0.3832**	0.0846	-0.0033	0.0273
M & DP	0.0667	0.1181	0.1100	**-0.7175**	0.0106	0.0900
Eggs	0.0588	0.0550	-0.0186	0.0441	**-0.3918**	0.0055
F & O	0.0576	0.0310	0.0606	0.1536	0.0023	**-0.7432**
Fruits	0.0987	0.0121	0.1564	0.0932	0.0110	0.1178
Veg.	0.0981	0.1464	0.1178	0.1148	0.0289	0.0932
Sugar	0.0758	0.0149	0.0400	0.0824	0.0209	0.0324
T & C	0.0636	0.0512	0.0357	0.0742	0.0125	0.0447
NAB	0.1472	0.0259	0.1126	0.0695	-0.0211	0.0108
Other F.	0.0420	0.0206	0.0617	0.0279	-0.0077	0.0103

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food).

Table 32: Compensated Own- and Cross-Price Elasticities

	Fruits	Veg.	Sugar	T & C	NAB	Other F.
Cereals	0.1104	0.2005	0.0664	0.0251	0.0506	0.0064
Bread	0.0076	0.1763	0.0078	0.0118	0.0050	0.0018
M & F	0.0925	0.1270	0.0185	0.0076	0.0206	0.0050
M & DP	0.0715	0.1614	0.0496	0.0202	0.0164	0.0029
Eggs	0.0352	0.1693	0.0526	0.0142	-0.0209	-0.0034
F & O	0.1545	0.2235	0.0332	0.0207	0.0044	0.0019
Fruits	**-0.7433**	0.0855	0.1035	0.0188	0.0323	0.0140
Veg.	0.0467	**-0.7643**	0.0577	0.0426	0.0095	0.0088
Sugar	0.1322	0.1347	**-0.5722**	0.0157	0.0085	0.0147
T & C	0.0529	0.2199	0.0347	**-0.6987**	0.0951	0.0142
NAB	0.1046	0.0565	0.0216	0.1095	**-0.6356**	-0.0013
Other F.	0.1029	0.1187	0.0847	0.0370	-0.0031	**-0.4952**

M & F (Meat&Fish), M & DP (Milk&Dairy Products), F & O (Fats&Oils), Veg. (Vegetables), T & C (Tea&Coffee), NAB (Non-Alcohol Beverages), Other F. (Other Food).

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