Analysis of Determinants of Mineral Water Consumption: The Case of Tehran

Shahram Fattahi
Department of Economics
Faculty of Social Sciences, Razi University
Shahid Beheshti Blvd, Kermanshah, Iran.

Somayeh Alipourfard
Razi University

Hana Habibi
University Putra Malaysia

Abstract

Mineral water is among the products that have important roles in human health; therefore, its consumption is increasing every day. In this paper, the degree of importance of consumers to the quality of mineral water is compared in Tehran for different groups of people in terms of the area, location, education and occupation. The results show that overall quality of mineral water is very important for people with higher education and the higher level of life. We investigated the relationship between independent variables including age, number of household members, education, and education of the head household shopping and the dependent variable, amount of the consumption of mineral water, in Tehran through a logarithmic regression equation. The results showed there is a direct relationship between the consumption of mineral water, education variables and the educational level of people who are responsible for purchasing, but there is a reverse relationship between the number of household members and the amount of mineral water consumption.

Keywords: Mineral Water, Customer Satisfaction, Analysis of Variance, Regression Model

Introduction

Water as the largest chemical solvent is one of the most abundant and most stable components that have been found in the nature. Water is Socio-economic goods in the new international attitude, and is considered as a basic human need. Although water is considered as one of the renewable sources, it is limited and with regard to the growth of population, development of industry, enhancement of public health and welfare renewable sources per capita are decreasing (Tajrishi & Abrishamchi, 2004). Increasing entry of industrial, agriculture and human wastewaters in recent years has caused severe pollution of the current waters. This issue, along with the shortage of water in most regions of the world, has spread the consumption of mineral water among people all of the word including Iran. This caused mineral water to become a fixed component of household food basket. The tendency for packaged drinking water and finding appropriate alternative to replace tape water with packaged drinking water that attracts consumer confidence and trust in terms of quality and integrity in the early 1990's increased dramatically.

Mineral waters are those waters that contain the minimum 1000 mg/kg salt or 250 mg of free Carbonic Anhydride per 1 kg. Mineral waters flow directly from natural springs or digging up the underground layers. The use of safe drinking water is one of the most important factors of water consumption as the origin of nearly 80% of human diseases caused by unhealthy water (Khodadadi et al, 2006). Concurrent with the growth of population and the development of various industries, pollution of drinking water has become one of the most fundamental problems of the world. Separating the water-soluble pollutants requires complex and expensive technologies, such as Reverse Osmosis (RO) although using it for large scale purification of high volume of water is not cost effective. Due to minerals such as calcium, magnesium, sodium and potassium in mineral water, the taste of it is better than tap water and somewhat it can be provide the needs the of body.

According to MBA News of the review conducted by the global market for mineral water consumption in 2009, the United Arab Emirates with 98 percent is the highest consumer of mineral water in the world. According to this report Bahrain and Qatar both with 95% of mineral water consumption are placed in the second rank. A study among the world's countries shows drought and shortage of water reserves in the Persian Gulf member states is one of the reasons for the tendency of people toward the consumption of mineral water. Based on the global statistics in this ranking, Iran is located in category 14 in the table of consumption of mineral water, with 62 percent of consumption of mineral water.

Iran with 113 spas is one of the major manufacturers of mineral water among the countries of the region and a part of its production is exported to the neighboring countries (Ebrahimzadeh, 2003). Statistics show that the consumption of mineral water in Iran is increasing. According to Iran's customs statistics regarding the growth of domestic consumption of mineral water, the amount of the export of this product reaches from 7 million bottles in 2007 exceed to 9 millions in the year 2009. Increase in the amount of the consumption of mineral water in Iran over the next few years will cause the mineral water industry to become one of the most profitable beverage industries of the country. So this issue, along with the low cost of its raw materials, will attract the attention of many investors. (Ghiyasvand, 2010). The purpose of quality improvement methods is to increase market share through customer satisfaction. Customer dissatisfaction has brought remarkable direct and indirect costs for companies. So, poll of costumers provides valuable knowledge to the companies which tend to identify their weaknesses and improve their quality (Han et al, 2001).

Mineral water is not the exclusive product in Iran, so a lot of companies are active in this field. Due to the increase in the consumption of mineral water from the consumer and competitiveness of manufacturing companies in the acquisition of customer satisfaction, quality improvement of mineral water has special importance. This is achieved by implementing the pervasive quality management system in manufacturing companies so manufacturing process quality control can produce high quality mineral water.

The field study method is used. Our statistical community was residents of Tehran which was divided into 5 categories of North, West, East, South and Centre. The sample includes 750 individuals and measuring variables is using the questionnaire method.
Stratified random sampling plan has been implemented and we randomly selected 150 points from the map in each of the 5 multiple regions and the nearest house to the point where we have considered it as a sample unit.

In a study carried out by Grondin et al in 1996, one of the factors associated with the consumption of bottle water was public dissatisfaction from the tap water quality (Grondin et al, 1996).

Levallois et al in the State of Quebec, Canada, stated that 67- 80% of the consumers prefer aesthetic characteristics of water as important factors to encourage the use of packaged waters (Levallois et al, 1999). Some researchers surveyed the difference between waters consumed among the British students and found that mineral waters were preferred to other waters such as the water tap (Fallahee & MacRae, 1995).

The Importance Of Mineral Water From People Point Of View

Using analysis of variance (ANOVA), we want to know whether the observed differences between more than two samples average is random or there are real differences between averages of sampling communities. LSD test performs student t test for all double comparisons between significant groups and does not adjust any values for multiple comparison error rates.

Table 1: One-Sample Test

	Test Value = 0					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
percentage of Importance Quality	44.489	719	.000	21.45102	20.5044	22.3976

The output of Table (1) shows that the probability value for H0 quality hypothesis is equal to zero. Therefore, the hypothesis of being zero of the quality importance is strongly rejected. High confidence interval is expressed that with 95 % confidence limit, the importance of mineral water for the citizens of Tehran is between 20.5 to 22.4 percent.

Comparison of the Importance of Mineral Water for People in Different Areas of Tehran

Table (2) is the output of ANOVA for the average equality tests of the mineral water quality importance in the five multiple regions in Tehran. The probability value for hypothesis of the average equality test of quality importance is equal to zero, so the hypothesis of the average equality test of quality importance in the different regions can be strongly rejected.

Table 2: analysis of variance of the average equality tests of quality importance of the mineral water in the 5 multiple regions in Tehran.

ANOVA

|	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3577.733	4	894.433	5.477	.000
Within Groups	116771.981	715	163.317		
Total	120349.713	719			

Using LSD method and diagram for more accurate comparison, the average importance of quality for mineral water is compared as follows in each couple region. In the following diagrams, abbreviation percentage of I.Q is used instead of the variable percentage of Importance Quality. The sequence of importance of mineral water quality is as below 1. North – 2.Center- 3.South and East - 4. West

Table 3: Importance of mineral water quality in the 5 multiple regions in Tehran

(I) region	(J) region	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
North	West	6.89322[*]	1.49577	.000	3.9566	9.8298
	East	4.18904[*]	1.49577	.005	1.2524	7.1257
	Center	3.60828[*]	1.49577	.016	.6717	6.5449
	South	4.34160[*]	1.51475	.004	1.3677	7.3155
West	North	-6.89322[*]	1.49577	.000	-9.8298	-3.9566
	East	-2.70417	1.50088	.072	-5.6508	.2425
	Center	-3.28494[*]	1.50088	.029	-6.2316	-.3383
	South	-2.55162	1.51980	.094	-5.5354	.4322
East	North	-4.18904[*]	1.49577	.005	-7.1257	-1.2524
	West	2.70417	1.50088	.072	-.2425	5.6508
	Center	-.58076	1.50088	.699	-3.5274	2.3659
	South	.15256	1.51980	.920	-2.8312	3.1364
Center	North	-3.60828[*]	1.49577	.016	-6.5449	-.6717
	West	3.28494[*]	1.50088	.029	.3383	6.2316
	East	.58076	1.50088	.699	-2.3659	3.5274
	South	.73332	1.51980	.630	-2.2505	3.7171
South	North	-4.34160[*]	1.51475	.004	-7.3155	-1.3677
	West	2.55162	1.51980	.094	-.4322	5.5354
	East	-.15256	1.51980	.920	-3.1364	2.8312
	Center	-.73332	1.51980	.630	-3.7171	2.2505

[*]. The mean difference is significant at the 0.05 level.

According to the average equality table, importance of quality in center, south and east can be accepted but this mean has significant difference with the rest in north and west.
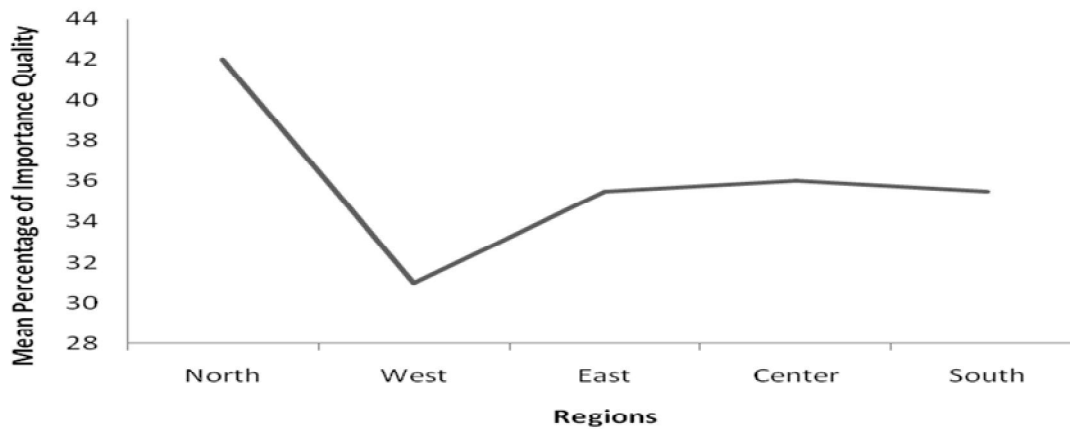
Figure 1: graph of the average percentage of importance to the mineral water quality in Tehran areas

Comparison of Importance of Mineral Water for the Different Education Levels in Tehran

Table (4) is the output of ANOVA for the average equality test of quality importance of the mineral water in the different educational levels of Tehran. The probability value for hypothesis of the average equality quality importance is equal to 0.016.In this case the hypothesis of the average equality of quality importance at different educational levels is not certainly accepted or rejected. The hypothesis of average equality of quality importance was rejected with 95% confidence level and was accepted with 99% confidence level in different educational levels

Table 4: Output variance analysis for importance of mineral water quality at different educational levels in Tehran

| percentage of Importance Quality	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1718.421	3	572.807	3.457	.016
Within Groups	118631.293	716	165.686		
Total	120349.713	719			

Table 5: Importance of mineral water quality in the different educational levels

More accurate analysis was carried out using LSD and diagram methods, average importance of mineral water quality in every couple of educational levels were compared as following.

(I) education	(J) education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Graduate	Diploma	-4.20167[*]	1.30709	.001	-6.7678	-1.6355
	BA	-2.72198[*]	1.37122	.048	-5.4141	-.0299
	higher than BA	-2.44335	1.88777	.196	-6.1496	1.2629
Diploma	Graduate	4.20167[*]	1.30709	.001	1.6355	6.7678
	BA	1.47969	1.15519	.201	-.7883	3.7477
	higher than BA	1.75832	1.73722	.312	-1.6523	5.1690
BA	Graduate	2.72198[*]	1.37122	.048	.0299	5.4141
	Diploma	-1.47969	1.15519	.201	-3.7477	.7883
	higher than BA	.27864	1.78597	.876	-3.2277	3.7850
higher than BA	Graduate	2.44335	1.88777	.196	-1.2629	6.1496
	Diploma	-1.75832	1.73722	.312	-5.1690	1.6523
	BA	-.27864	1.78597	.876	-3.7850	3.2277

*. The mean difference is significant at the 0.05 level.

The sequence of the importance of mineral water quality for educational levels is as below: 1. Diploma 2. BA, MSc & Higher Education 3. Graduate. According to the average equality table, importance of quality can be accepted for Diploma, BA & higher than BA but this average has a significant difference for graduates with diploma and bachelor's degrees.
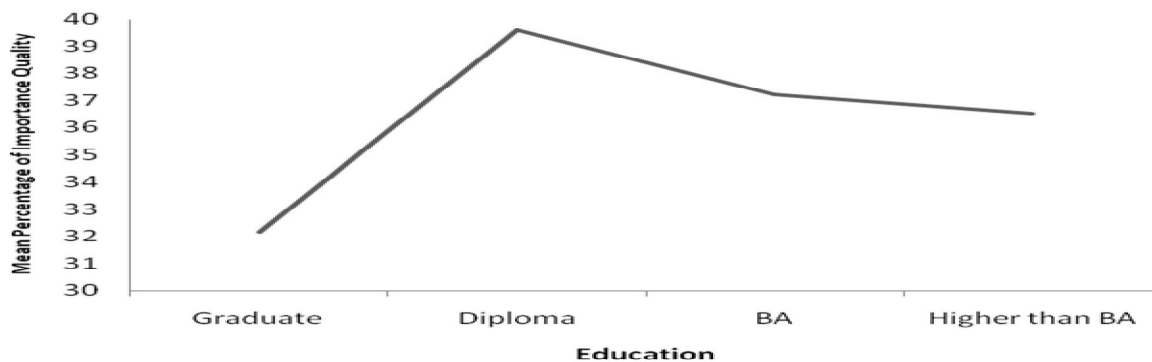
Figure 2: average importance of mineral water quality in the different educational levels

Comparison of the importance of mineral water for various jobs in Tehran

The table (6) shows the output of ANOVA for the average equality test of quality importance of the mineral water for various jobs in Tehran. The probability value for hypothesis is equal to 0.002 so the hypothesis of the average equality of quality importance at different areas is rejected. More accurate analysis is carried out using LSD and diagram methods, average importance of mineral water quality in every couple of jobs were compared as the following.

Table 6: ANOVA for percentage of Importance Quality

Table 6: ANOVA for percentage of Importance Quality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2447.181	3	815.727	4.954	.002
Within Groups	117902.532	716	164.668		
Total	120349.713	719			

Table 7: Average importance of mineral water quality in every couple of jobs

(I) job	(J) job	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Self -	employed	-.17006	1.44610	.906	-3.0092	2.6690
	retired	-1.15005	1.24851	.357	-3.6012	1.3011
	unemployed	6.98021[*]	2.26306	.002	2.5372	11.4232
Self-	employed	.17006	1.44610	.906	-2.6690	3.0092
	retired	-.97999	1.19986	.414	-3.3357	1.3757
	unemployed	7.15027[*]	2.23659	.001	2.7592	11.5413
Self-	employed	1.15005	1.24851	.357	-1.3011	3.6012
	retired	.97999	1.19986	.414	-1.3757	3.3357
	unemployed	8.13026[*]	2.11422	.000	3.9794	12.2811
Self-	employed	-6.98021[*]	2.26306	.002	-11.4232	-2.5372
	retired	-7.15027[*]	2.23659	.001	-11.5413	-2.7592
	unemployed	-8.13026[*]	2.11422	.000	-12.2811	-3.9794

The mean difference is significant at the 0.05 level.

The sequence of importance of mineral water quality for jobs is:
1.self-employed 2.retired & employee 3.unemployed. According to the average equality table, importance of quality is acceptable for self-employed, retired and employees but it has significant difference for unemployed to other. So, that mineral water quality is less important for unemployed people than all practitioners.
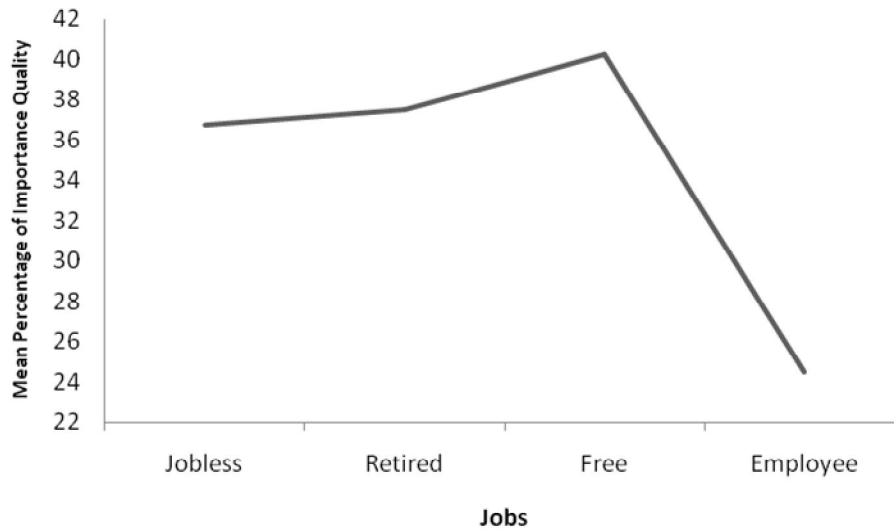
Figure 3: Average importance of mineral water quality for various jobs in Tehran

Comparison of the Importance of Mineral Water for Various Ages in Tehran

The table 8 shows the output of ANOVA for the average quality test for the quality importance of mineral water for different age categories in Tehran. The probability value of hypothesis of the equality of average quality importance is equal to zero. So, this hypothesis within different age categories is strongly denied. More accurate analysis is carried out using LSD and diagram methods, average importance of mineral water quality in every couple of age categories were compared as following.

Anova
Table 8: The average quality importance of mineral water in per couple of age categories.
Percentage of Importance Quality

|	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10829.219	2	5414.610	22.315	.000
Within Groups	72065.698	297	242.645		
Total	82894.917	299			

Multiple Comparisons

Table 9: Dependent Variable: Percentage of Importance Quality LSD

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
15-25	25-35	11.85133(*)	2.29889	.000	7.3271	16.3755
	higher than 35	13.51473(*)	2.14926	.000	9.2850	17.7444
25-35	15-25	-11.85133(*)	2.29889	.000	-16.3755	-7.3271
	higher than 35	1.66340	2.20207	.451	-2.6702	5.9970
higher than 35	15-25	-13.51473(*)	2.14926	.000	-17.7444	-9.2850
	25-35	-1.66340	2.20207	.451	-5.9970	2.6702

* The mean difference is significant at the .05 level.
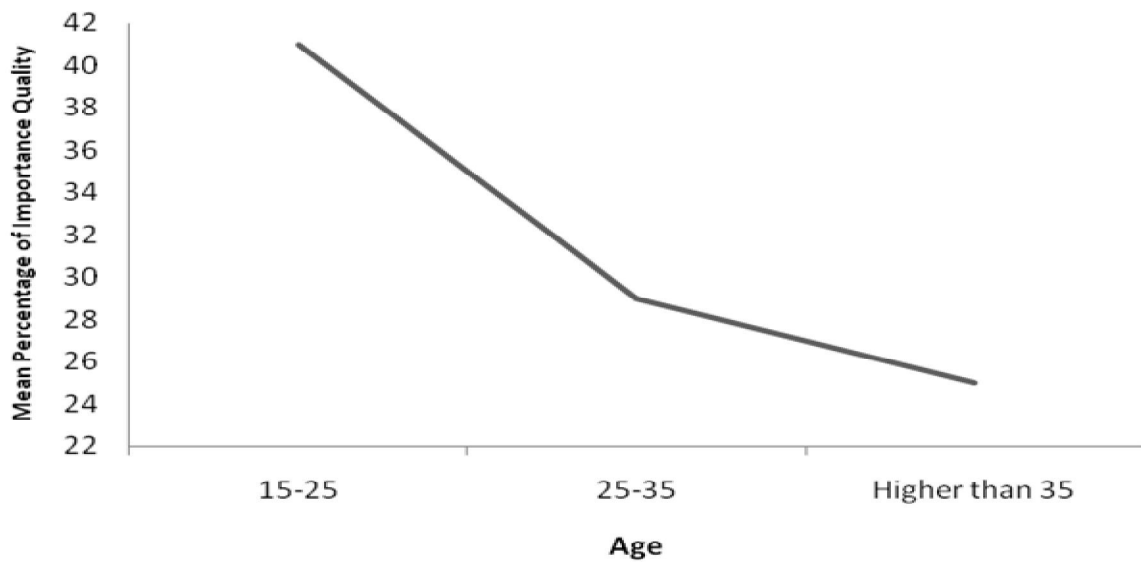
Figure 4: The average quality importance of mineral water for different age categories in Tehran

Comparison of the Importance of Mineral Water for Various Numbers of Household Members in Tehran.

The order of quality importance of mineral water for different age categories is as following: 1. Age group (15-25), 2. Age group (25-35) and 3. Above of 35 years old.

According to the table, the quality average of equality importance for age group (25-35) and above of 35 is acceptable but this average for the group (15-25) has a significant difference with the other. This difference shows that the age group (15-25) cares about the quality of mineral water more than the other groups.

Anova

Table 10: The output of ANOVA for the average equality test of quality importance of mineral water for the different numbers of household members.

Percentage of Importance Quality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6410.530	2	3205.265	12.447	.000
Within Groups	76484.387	297	257.523		
Total	82894.917	299			

More accurate analysis is carried out using LSD and diagram methods, average importance of mineral water quality in every couple of family dimensions were compared as the following the order of quality importance of mineral water for the different numbers of household members is as the follow. 1. The number of members (2-3) 2. The number of members (3-5) 3. More than 5 members. Due to the equality average of quality importance for mineral water table is not acceptable for any of these categories.
Multiple Comparisons

Table 11 : The average of quality importance for mineral water in per couple of the number of household members' categories.

Dependent Variable: Percentage of Importance Quality

LSD

(I) Number of household member	(J) Number of household member	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
2-3	3-5	7.94792(*)	2.21610	.000	3.5867	12.3092
	higher than 5	13.27957(*)	2.73042	.000	7.9062	18.6530
3-5	2-3	-7.94792(*)	2.21610	.000	-12.3092	-3.5867
	higher than 5	5.33165(*)	2.40065	.027	.6072	10.0561
higher than 5	2-3	-13.27957(*)	2.73042	.000	-18.6530	-7.9062
	3-5	-5.33165(*)	2.40065	.027	-10.0561	-.6072

* The mean difference is significant at the .05 level.
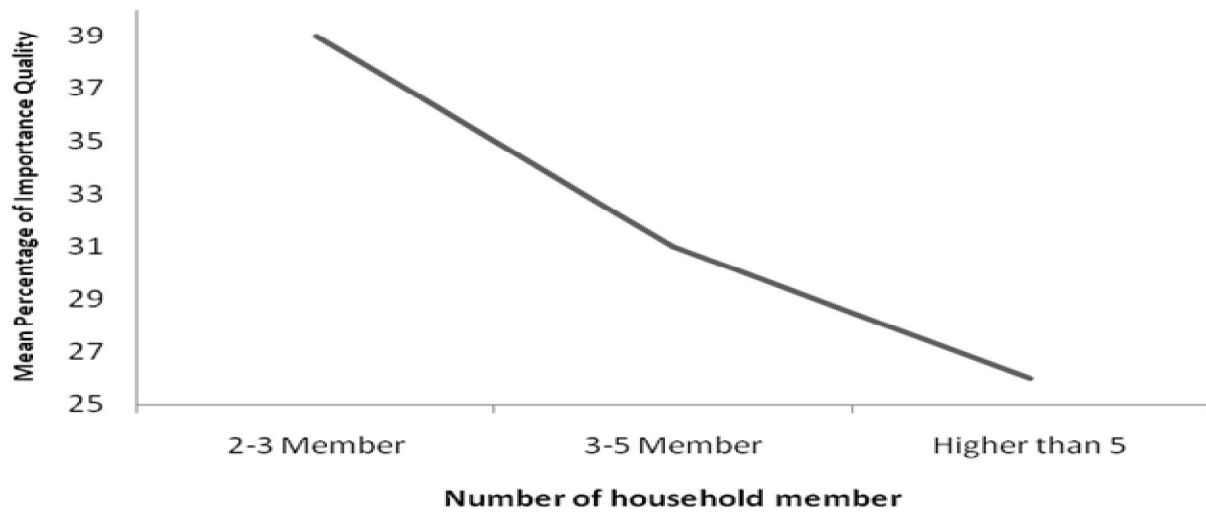
Figure (5): The average of quality importance of mineral water for the different numbers of family members in Tehran.

Comparison of the Importance of Mineral Water for Various Education of Responsible for House Purchase in Tehran

Table (12) is the output of ANOVA for the average equality test of quality importance of mineral water for the different numbers of household members in Tehran. The probability value for hypothesis of the equality average of quality importance is equal to zero. So, the hypothesis of the equality average of the quality importance in different dimensions of households is strongly denied.

Table 12 shows the output of ANOVA for the average equality test of quality importance of mineral water in different educational levels of household purchasing assistant in Tehran. The probability value for hypothesis of equality average of quality importance is equal to zero. So, the hypothesis of the equality of average quality importance is different educational levels of household purchasing assistant is strongly denied.

Table 12: The output of ANOVA for the average equality test of quality importance of mineral water in different educational levels of household purchasing assistant.

Percentage of Importance Quality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9621.401	3	3207.134	12.956	.000
Within Groups	73273.516	296	247.546		
Total	82894.917	299			

More accurate analysis is carried out using LSD and diagram methods, average importance of mineral water in every couple of different educational levels of household purchasing assistant were compared as the following.

The order of quality importance of mineral water for the different educational levels of household purchasing assistant is as the follow: 1. Bachelor 2. Higher than bachelor 3. Diploma 4. Under diploma. Due to the equality average of quality importance for bachelor and higher than bachelor is acceptable also, the equality average for diploma and under diploma is acceptable but there is remarkable difference between these two.

Multiple Comparisons

Table 13: the average of quality importance of mineral water in different educational levels of household purchasing assistant.
Dependent Variable: percentage of Importance Quality
LSD

(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Graduate	Diploma	-5.87935	4.13370	.156	-14.0145	2.2558
	BA	-15.52221(*)	4.03057	.000	-23.4544	-7.5900
	higher than BA	-18.65325(*)	4.59085	.000	-27.6881	-9.6184
Diploma	Graduate	5.87935	4.13370	.156	-2.2558	14.0145
	BA	-9.64286(*)	2.05182	.000	-13.6809	-5.6049
	higher than BA	-12.77390(*)	3.00672	.000	-18.6911	-6.8567
BA	Graduate	15.52221(*)	4.03057	.000	7.5900	23.4544
	Diploma	9.64286(*)	2.05182	.000	5.6049	13.6809
	higher than BA	-3.13104	2.86327	.275	-8.7660	2.5039
higher than BA	Graduate	18.65325(*)	4.59085	.000	9.6184	27.6881
	Diploma	12.77390(*)	3.00672	.000	6.8567	18.6911
	BA	3.13104	2.86327	.275	-2.5039	8.7660

The mean difference is significant at the .05 level.
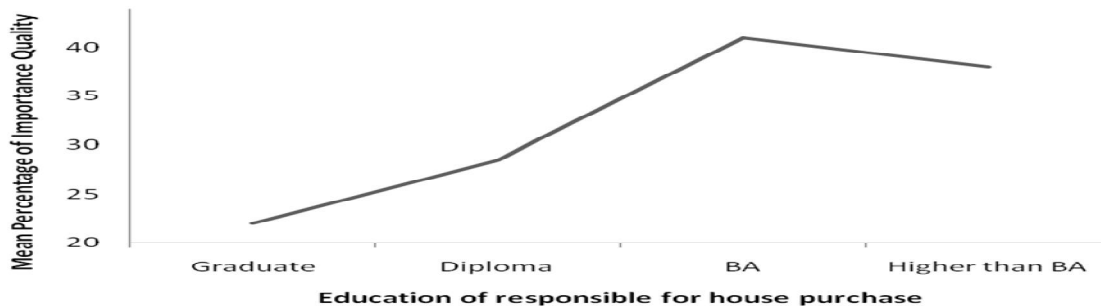
Figure (6): The average of quality importance of mineral water for Various Education of Responsible for House Purchase in Tehran

Logarithmic Regression Model

To determine the correlation between the independent variables (age, the number of household members, education and education of those responsible for household shopping and the amount of consumption of mineral water as dependent variable, statistical analysis is carried out with a statistical software (E-views). Then using a logarithmic regression model, the amount of correlation between these parameters and amount of consumption of mineral water is provided.

Logarithmic model is preferred to simple model because it obtains elasticity coefficients.

Table 14: The matrix correlation coefficients of used variables in the regression equation

	LNX1	LNX2	LNX3	LNX4	LNY
LNX1	1.000000	0.131561	0.017415	-0.174319	-0.146656
LNX2	0.131561	1.000000	-0.204377	-0.269169	-0.199736
LNX3	0.017415	-0.204377	1.000000	0.343848	0.359399
LNX4	-0.174319	-0.269169	0.343848	1.000000	0.307367
LNY	-0.146656	-0.199736	0.359399	0.307367	1.000000

The model is specified as follow

$$Lny = \alpha + \beta_1 Lnx_1 + \beta_2 Lnx_2 + \beta_3 Lnx_3 + \beta_4 Lnx_4$$

Y= dependent variable (amount of consumption of mineral water)
α = intercept
β_i = Parameters that show changes in the dependent variable for one percent change in the independent variables
X_1 = Age, X_2 = Number of household member, X_3 = Education, X_4 = Educational level of people responsible for purchasing.

Estimation Results

Results and descriptions of the regression model are as follows:

$$Lny = 1.88 - 0.19 Lnx_1 - 0.14 \ln x_2 + 0.49 \ln x_3 + 0.25 Lnx_4$$

The estimated intercept is 1.88, which means that in case of being zero of the effect of independent variables, the amount of the consumption of mineral water is equal to 1.88 lit.

Age (X_1) : coefficient of this variable is negative in the above equation. This represents the indirect relationship between amount of the consumption of mineral water and age of people. This coefficient shows the elasticity of consumption respect to age represents that each 1% changes in age variables leads to 19% changes in the consumption of mineral water. Also, the correlation coefficient of this parameter with amount of consumption of mineral water is (-0.14).

The number of household members (X_2): coefficient of this variable is negative in the above equation which means indirect relationship between amount of the consumption of mineral water and number of household members.

This coefficient shows the elasticity of consumption respects to the number of family member represents that each 1% changes in number of household members' variables leads to 14% changes in the consumption of mineral water. Also, the correlation coefficient of this parameter with amount of consumption of mineral water is (-0.19).

Education (X_3): coefficient of this variable is positive in the above equation which means there are direct relationship between amount of the consumption of mineral water and education. This coefficient shows the elasticity of consumption respects to education represents that each 1% changes in number of education level variables, 49% changes in the consumption of mineral water. Also, the correlation coefficient of this parameter with amount of consumption of mineral water is (0.35).

Educational level of people responsible for purchasing (X_4): the coefficient of this variable is positive in the above equation that represents the direct relationship between amount of the consumption of mineral water and education of responsible for household shopping. This coefficient shows the elasticity of consumption respect to education represents that per 1% changes in education of responsible for household shopping variables, 25% changes in the consumption of mineral water. Also the correlation coefficient of this parameter with amount of consumption of mineral water is (0.30).

Conclusion

Results of this research show that the mineral water quality is not very important for consumers in Tehran. This issue removes any competition among the mineral water production companies to improve their product quality. One of the reasons that consumer neglect this issue could be inappropriate informing and training of health ministry and other related organizations. Insignificance intensity in undergraduates group proves this claim. The level of welfare of people also is important in their attitudes to the mineral water quality. The results show that the North of Tehran to the South, Center and East give more importance to the quality of mineral water. West of Tehran has a distinctive condition although the level of welfare of its residents is higher than South and East areas but it has the least importance for the quality of mineral water. The reason of this matter has been clear by an interview with respondents of the West of Tehran when filling the questionnaire. Perfect satisfaction of residents of high quality water plumbing in West of Tehran makes them needless of mandatory consumption of mineral water. Another item that shows the effect of welfare level of people in their attitude is that unemployed workers know the importance of water quality of mineral water less than employed workers.

According to the regression model it can be said that among the used variables, the highest correlation is related to the education of individuals. This issue seems to be logical when considering that, with a high level of education, attention to non-quality of drinking water and knowing that the body needs compounds of mineral water increase. After education, the educational level of people responsible for shopping relatively has high correlation with the consumption of mineral water as the education of those responsible for household shopping increases the necessity of consumption of mineral water and this is caused mineral water to be part of household consumable goods basket.

The variable of number of household members affects consumption of mineral water. In this case, when the number of household members increases the amount of consumption of mineral water is reduced, since the cost of mineral water consumption increases,. Age variable also has a negative correlation with the amount of the mineral water consumption, due to the changing taste and attention to its ingredients among youth and young people.

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