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# *Effects of Sanctions on Food Intake of Urban Households in Razavi Khorasan Province, Iran (2017-2019)*

**Sara Shafaati; MSc[1], Seyyed Reza Sobhani; PhD[1], Elyas Nattagh-Eshtivani; PhD[1,2], Maryam Khosravi; PhD[1,3], Sara Saeedi; MSc[1] & Abdolreza Norouzy; MD. PhD*[1,4]**

*[1] Department of Nutrition, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran; [2] Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran; [3] Department of Public Health, North Khorasan University of Medical Sciences, Bojnurd, Iran; [4] Metabolic Syndrome Research Center, Mashhad University of Medical Sciences, Mashhad, Iran.*

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***Corresponding author:***
norouzya@mums.ac.ir
Nutrition Research Center, School of Medicine, Mashhad University of Medical, Sciences, Mashhad, Iran.

***Postal code:*** 9177948564
***Tel:*** +98 5138002382

***ABSTRACT***

**Background**: Sanctions are a type of forfeit aimed at forcing the subject to obey the desired political will. Since sanctions affect various components of the economic sectors. The purpose of this study is to investigate the effect of sanctions on food intake of households living in Khorasan Razavi province, Iran. **Methods**: To investigate the effect of sanctions on food intake of households living in Khorasan Razavi province, the survey data of the National Statistics Center of Iran (NSCI) on cost and income was used. 2129 households (number of households in 2017: 702, 2018: 726 and 2019: 701) were studied. In the N4 program, macronutrients and micronutrients were calculated. The studied variables were analyzed based on four income categories. In the SPSS software, quantitative variables of 2017 to 2019 were reviewed by ANOVA test and variables in pairs of the same period were reviewed by post hoc Tukey test. **Results**: The analysis showed that by intensifying sanctions, the cost of food has increased more than the average of income, and prices of all food groups spesifically healthy food groups have increased. The diet quality index has decreased significantly. The lower-income classes had the most insufficient dietary intake of micronutrients and the gap between dietary intake of different income classes increased during the study. **Conclusion:** Sanctions have affected the dietary intake due to the rise in the price of food expenditure and as a result people tend to consume cheaper and lower quality food.

**Keywords:** *Sanctions; Food expenditures; Nutrition; Diet quality ndex; Iran*

## Introduction

According to the World Food Summit (1991), food security is defined when everyone has physical and economic access to adequate, healthy, and nutritious food at all times, and food is accessible with diet needs , providing dietary preferences for an active and healthy life. In Iran, the production and supply of food and the possibility of access to adequate, nutritious, and desirable food for all members of society are part of the national development programs (Abdi *et al.*,

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2016). One of the goals of the Millennium Development is to reduce poverty and hunger, and food security is a crucial strategy to combat these issues. About half of Iranians suffer from food insecurity, and the prevalence of this issue has increased for various reasons (Milad Daneshi-Maskooni, 2017). Shocks and disturbances are constantly targeting the economies of countries, and disturbances such as sanctions are exogenous (Heidary, 2018). Sanctions are a leverage to force the subject to obey the desired political will ("National system of definitions and statistical concepts,")(National system of definitions and statistical concepts). Although economic sanctions are a powerful tool in the hands of the countries applying them, their destructive effects on people of the target country are comprehensive and undeniable (Razavi and Zeynodini, 2019). From 2018 and despite the international obligations in the Joint Comprehensive Plan of Action (JCPOA), Iran has been sanctioned again by the United States. With the re-imposition of sanctions and restrictions on international financial exchanges, a significant increase has been observed in the price of all food groups. In short period between the reduction of sanctions in 2016 and their re-imposition in 2018, Iran's economic growth changed from 13% per year to minus 6%. The deepening economic crisis during the re-imposition of the sanctions by the Trump administration increased the poverty rate in Iran from 8.1% in 2017 to 12.1% in 2019. A 4% increase in the poverty rate suggests that another 3.2 million Iranians have fallen below the poverty line within two years (Isfahani, 2021).

From 2017 to 2019, the percentage of urban and rural households in Iran that were prone to food insecurity increased from 8.84% and 25.17% to 11.2% and 29.2%, respectively (Hejazi and Emamgholipour, 2020).

Previous studies in Iran and other countries have investigated the effects of economic sanctions on food prices, hunger, and food insecurity in recent years, while the variable of food intake has not been adequately evaluated. Due to the wide range of new US sanctions against Iran, a study is required on the effect of these sanctions on the food intake of Iranian households.

The present study aimed to investigate the impact of sanctions on the food intake of the households in Razavi Khorasan province, Iran, during 2017-2019.

## Materials and Methods

*Study design*: In this repeated cross-sectional study, we used the data of the National Statistics Center of Iran (NSCI) during 2017, 2018, and 2019. This data was collected from throughout the country. The sample size was optimized with a relative error of less than 10%, so that the average total and partial household costs in various items and cases can be estimated with high accuracy. In this study, two-stage sampling was used. In the first stage, households were selected from among the blocks and in the second stage they were selected from each block.

Eligible participants were the urban households in Razavi Khorasan province during 2017-2019. The household costs and income database provided relevant information in four major sections, including household characteristics, housing facility, household expenses (food and non-food, investments), and income. The data of each household was structured, so that one item could be defined for each variable and a general file could be defined for each household. This was done using coding in the R program environment.

*Measurements:* To assess the changes in the food basket of the Iranian households, the data on the costs of food expenditure during 2017-2019 was used. This data included information about all common household items and their intake.

Food cost data were collected by the food cost questionnaire for the last month consumption, through interviews with heads of households. The data had to be converted into daily data. To obtain the daily values, the amount of each food item was divided into 30 days of the month. Since the data collection unit was a household, it also had to be converted to individual data to review nutrition indicators.

The use of per capita amounts (dividing the total


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amount of household expenditure by the number of the household members) is associated with some limitations depending on the age, gender, and body composition of individuals. To address this issue, the Food and Agriculture Organization (FAO) recommends an index for converting food data from the household level into the individual level (Fiedler *et al.*, 2012, Murphy *et al.*, 2012, United Nations University and World Health Organization, 2004). Furthermore, the Adult Male Equivalent index (AME) is based on the energy value recommended by the FAO and the World Health Organization (WHO) for different age and gender groups. The AME determines the received amount of energy by each family member daily compared to an adult male depending on their age and gender. The AME is equal to one, and other AME values are calculated accordingly. For this purpose, the total AME of the family is calculated primarily, and the share of each AME is calculated separately as an individual AME. Multiplying each individual's AME by the total amount of food items purchased by the family equals the share of each individual (Fiedler *et al.*, 2012, Murphy *et al.*, 2012, Weisell and Dop, 2012). To obtain the daily intake of the family based on the food item per adult male in the present study, the daily intake of the family from each food item was divided by the total amount of the whole intake of the family. A difference was observed from the actual amount received by the individuals, since the purchased food was partially wasted and not consumed. The loss coefficients of various foods in the receiving stage (provided by FAO) for other regions of the world were also selected to obtain more realistic values (Gustafsson *et al.*, 2013). After applying cooking coefficients to the food items during the food process, the levels of macronutrients and micronutrients were also calculated using the updated version of the Nutritionist IV software for Iranian food.

*Ethical concideration*s: The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences (ethics code: IR.MUMS.MEDICAL.REC.1399.273 ).

*Data analysis:* Data analysis was performed in SPSS version 21.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean and standard deviation, and qualitative variables were expressed as frequency (numbers and percentages). To assess the normality of the quantitative variables, the Kolmogorov-Smirnov test was used, and ANOVA was also applied to compare the changes between the study groups. If necessary, post-hoc tests were performed followed by the Tukey multiple comparison test. In all the statistical analyses, $P<0.05$ was considered significant.

## Results

The analysis of net expenses, gross expenses, food expenses, non-food expenses, and household income indicated a significant increase in these values during 2017-2019 ($P<0.01$). The mean income during this period had an upward trend, while it was less than food expenses. In addition, the increase in food expenses in 2019 was more significant in all cases compared to 2017 (**Table 1**).

According to the food price analysis, the prices of all the food groups significantly increased during 2017-2019 ($P<0.01$). The most significant increase was observed in the healthy food group (vegetables), while the least significant effect was denoted in fats, oils, sugar, and sweets in 2019 compared to 2017 (**Table 2**).

According to the analysis of fat-soluble and water-soluble vitamins, lower-income classes had the least significant dietary intake, and higher-income classes had the most significant dietary intake. A significant difference was observed in this regard between fat-soluble vitamins (vitamins A, D, and K) and water-soluble vitamins (vitamins B1, B5, B12, biotin, and vitamin C). Meanwhile, an increase was denoted in the dietary intake of this income class during the study (**Table 3**).

According to the analysis of trace elements, lower-income classes had the least significant dietary intake, and higher-income classes had the most significant dietary intake of Na, K, Zn, and Fe. Furthermore, the diet quality index (DQI) based on income class of the surveyed households


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during 2017-2019 indicated a significant reduction in this regard. In the DQI analysis, the lowest-quality index of diet was observed in the lowest-income class, while the highest-quality index was denoted in the highest-income class. In general, the DQI in lower-income classes of society had a descending trend during the study period. Consequently, the gap between upper- and lower-income classes increased (**Table 4**).

According to the analysis of bread, cereal, rice, and pasta food groups based on four income categories, the share of bread in the total dietary calories was the highest in the lowest-income class and the lowest in the highest-income class. In general, the percentage of this group in the total consumed calories had a rising trend during the study period. Therefore, it could be concluded that the gap between income classes decreased during the study (**Figure 1**).

According to the analysis of fruits, dairy, and meat food groups based on four income classes, the share of fruits, dairy, and meat in the total consumed calorie was the lowest in the lowest-income classes and highest in the highest-income classes. Therefore, it could be concluded that the share of these three food groups in the total consumed calories decreased during the study period, thereby reducing the gap between income classes (**Figures 2-4**).

**Table 1.** Mean (±SD) **of** net expenses, gross expenses, food expenses, non-food expenses, and income in the surveyed households during 2017-2019.

| Vriables | 2017 (n=702) | 2018 (n=726) | 2019 (n=701) | P-value[d] |
|---|---|---|---|---|
| Net cost ( Rials) | 277783378±210117572[a] | 321296725±221044140[b] | 404582824±277702863[c] | <0.01 |
| Gross cost ( Rials) | 284267314±214682897[a] | 336078819±282325961[b] | 416629900±284082352[c] | <0.01 |
| Income ( Rials) | 295621669±245009027[a] | 338194122±239433334[b] | 427084851±283301258[c] | <0.01 |
| Cost of food ( Rials) | 67157580±38926139[a] | 79331009±47646388[b] | 107026116±65099457[c] | <0.01 |
| Cost of non-food | 217109733 ± | 256747810±260162644[b] | 309603783±262008192[c] | <0.01 |

[a]: Significant difference between 2017 and 2018; [b]: Significant difference between 2018 and 2019; [c]: Significant difference between 2019 and 2017; [d]: ANOVA test for quantitative variables, post hoc Tukey test for pairwise comparison of quantitative variables.

**Table 2.** Mean (±SD) of tthe prices of the main food groups during 2017-2019.

| Variables | 2017 (n=702) | 2018 (n=726) | 2019 (n=701) | P value[d] |
|---|---|---|---|---|
| Bread, rice, cereals, and pasta | 137879±75148 | 158297±103867[b] | 267575±165163[c] | <0.01 |
| Vegetables | 225147±133893 | 306448±180006 | 445411±225160 | <0.01 |
| Fruits | 157448±111710[a] | 190462±132966[b] | 259410±215563[c] | <0.01 |
| Dairy | 208325±82876 | 260614±129793 | 342118±162299[c] | 0.02 |
| Red meat, chicken, fish, eggs, legumes, and nuts | 955154±487153[a] | 1100329±621420 | 1460027.27±935675[c] | <0.01 |
| Fats, oils, sugars, and sweets | 554307±367452[a] | 586113±385765 | 735243.47±460818[c] | <0.01 |

[a]: Significant difference between 2017 and 2018; [b]: Significant difference between 2018 and 2019; [c]: Significant difference between 2019 and 2017; [d]: ANOVA test for quantitative variables, post hoc Tukey test for pairwise comparison of quantitative variables.


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**Table 3.** Mean (±SD) of vitamins intake, based on income class of the surveyed households during 2017- 2019.

| Vitamins | Year | First-class | Second class | Third class | Fourth class | P- value[e] |
|---|---|---|---|---|---|---|
| A (RAE) | 2017 | 426.28 ± 389.93 | 450.55 ± 372.97 | 492.57±459.71 | 488.13 ± 361.83 | 0.34 |
| | 2018 | 301.68 ± 351.63[b] | 341.72 ± 278.77 | 399.42 ± 488.78 | 433.13 ± 316.26 | 0.01 |
| | 2019 | 312.66 ± 267.18[b] | 357.57 ± 324.04 | 363.07 ± 280.83 | 422.50 ± 334.31 | 0.01 |
| D (µg) | 2017 | 1.64 ± 1.96 | 1.81 ± 1.52 | 1.88 ± 1.60 | 2.02 ± 1.71 | 0.20 |
| | 2018 | 1.52 ± 1.56[b] | 1.69 ± 1.50 | 1.97 ± 1.66 | 2.33 ± 2.13[c] | 0.01 |
| | 2019 | 1.38 ± 1.50[b] | 1.64 ± 1.75 | 1.60 ± 1.34 | 2.01 ± 2.05 | 0.01 |
| K (µg) | 2017 | 199.51 ± 199.65 | 228.79 ± 271.41 | 232.03 ± 220.59 | 251.74 ± 192.96 | 0.18 |
| | 2018 | 147.81 ± 160.66[b] | 162.93 ± 140.64 | 172.07 ± 146.18 | 207.58 ± 199.48 | 0.01 |
| | 2019 | 170.78 ± 164.50 | 190.76 ± 209.12 | 190.29 ± 183.42 | 217.67 ± 194.75 | 0.14 |
| Pantothenic acid (mg) | 2017 | 5.26 ± 2.50 | 5.48 ± 2.50 | 5.45 ± 2.44 | 5.49 ± 2.20 | 0.78 |
| | 2018 | 4.65 ± 2.23[b] | 4.68 ± 2.08 | 5.27 ± 2.32 | 5.47 ± 2.54[c] | 0.01 |
| | 2019 | 4.76 ± 2.33[b] | 5.12 ± 2.35 | 5.10 ± 2.28 | 5.63 ± 2.61 | 0.01 |
| B12 (µg) | 2017 | 2.62 ± 3.49 | 2.29 ± 1.83 | 2.89 ± 3.24 | 3.25 ± 2.91[c] | 0.02 |
| | 2018 | 2.02 ± 3.13 | 1.98 ± 1.91 | 2.58 ± 4.43 | 2.67 ± 2.63 | 0.07 |
| | 2019 | 1.73 ± 2.14[b] | 1.91 ± 2.02 | 1.91 ± 1.55 | 2.43 ± 2.66 | 0.02 |
| Thiamine (mg) | 2017 | 2.90 ± 1.24[b] | 2.72 ± 0.99 | 2.67 ± 1.11 | 2.45 ± 0.95 | 0.01 |
| | 2018 | 2.75 ± 1.09 | 2.61 ± 1.02 | 2.70 ± 1.00 | 2.66 ± 1.09 | 0.64 |
| | 2019 | 2.91 ± 1.24 | 2.74 ± 1.14 | 2.68 ± 1.06 | 2.72 ± 1.06 | 0.24 |
| Biotin (µg) | 2017 | 32.08 ± 18.98 | 34.23 ± 18.29 | 34.39 ± 20.41 | 33.70 ± 20.01 | 0.67 |
| | 2018 | 26.61 ± 16.26[a, b] | 29.73 ± 17.60 | 31.31 ± 16.38 | 32.16 ± 18.18 | 0.01 |
| | 2019 | 29.21 ± 18.01[b] | 33.33 ± 19.50 | 32.91 ± 18.76 | 34.61 ± 15.87 | 0.04 |
| C (mg) | 2017 | 66.50 ± 57.60[b] | 78.21 ± 59.56 | 80.22 ± 66.03 | 89.39 ± 63.07 | 0.01 |
| | 2018 | 51.22 ± 47.25[a, b] | 60.70 ± 60.69 | 71.24 ± 56.80[d] | 75.80 ± 53.33[c] | 0.01 |
| | 2019 | 55.74 ± 47.02[b] | 67.39 ± 74.72 | 72.69 ± 58.32 | 87.64 ± 75.44[c] | 0.01 |

[a]: Significant difference between the first income class and the third income class; [b]: Significant difference between the first income class and the fourth income class; [c]: Significant difference between the second income class and the fourth income class; [d]: Significant difference between the third income class and the fourth income class; [e]: ANOVA test for quantitative variables, post hoc Tukey test for pairwise comparison of quantitative variables.

**Table 4.** Mean (±SD) of amount of trace elements studied and diet quality index based on the income class of the surveyed households during 2017-2019.

| Variable name | Year | First class | Second-class | Third class | Fourth class | P-value[e] |
|---|---|---|---|---|---|---|
| Sodium (mg) | 2016 | 8826.14 ± 10327.52[b] | 6206.73 ± 7902.96 | 7405.16 ±12416.80 | 5648.84± 9459.68 | 0.02 |
| | 2017 | 8774.97 ±14781.72[b] | 6789.07± 7749.90 | 7506.52± 12081.27 | 5657.43± 8190.10 | 0.06 |
| | 2018 | 7424.57 ± 9394.57 | 6175.42 ±8090.75 | 6192.94 ±9412.32 | 5331.49± 7543.49 | 0.16 |
| Potassium (mg) | 2016 | 2967.46 ± 1428.18 | 3013.54 ± 1476.34 | 2984.08 ± 1323.36 | 3045.23± 1350.96 | 0.96 |
| | 2017 | 2544.51 ± 1220.31[b] | 2608.18 ± 1367.18 | 2770.31 ± 1199.29 | 2892.09 ±1332.37 | 0.04 |
| | 2018 | 2328.32 ± 1211.72[b] | 2629.65 ± 1324.94 | 2662.25 ± 1280.49 | 2771.93 ± 1203.60 | <0.01 |
| Iron (mg) | 2016 | 27.26 ± 11.82[b] | 25.50 ± 9.38 | 25.38 ± 10.43 | 23.51 ± 9.06 | <0.01 |
| | 2017 | 25.27 ± 10.31 | 23.95 ± 9.60 | 24.49 ± 9.10 | 24.12 ± 9.42 | 0.57 |
| | 2018 | 24.79 ± 10.58 | 24.35 ± 10.14 | 23.84 ± 9.19 | 24.11 ±8.66 | 0.82 |
| Zinc (mg) | 2016 | 12.93 ±6.54 | 12.85 ± 5.95 | 12.98 ±6.53 | 12.87 ± 5.48 | 0.99 |
| | 2017 | 11.26 ± 5.54 | 11.42 ± 5.23 | 12.25 ± 5.46 | 12.74 ± 6.26 | 0.04 |
| | 2018 | 11.14 ± 5.62[b] | 12.36 ± 6.03 | 11.95 ± 5.39 | 13.00 ± 5.76 | 0.02 |
| Diet quality index | 2016 | 67.83 ± 7.73[b] | 68.81 ± 7.91 | 69.08 ± 7.57 | 70.78 ± 6.85 | <0.01 |
| | 2017 | 66.16 ± 7.86[a, b] | 67.16 ± 7.32 | 69.03 ± 7.62 | 69.44 ± 7.85[d] | <0.01 |
| | 2018 | 66.74 ± 7.52[a, b] | 67.38 ± 6.97[c] | 70.59 ± 7.89 | 71.64 ± 7.80[d] | <0.01 |

[a]: Significant difference between the first income class and the third income class; [b]: Significant difference between the first income class and the fourth income class; [c]: Significant difference between the second income class and the fourth income class; [d]: Significant difference between the third income class and the fourth income class; [e]: ANOVA test for quantitative variables, post hoc Tukey test for pairwise comparison of quantitative variables.


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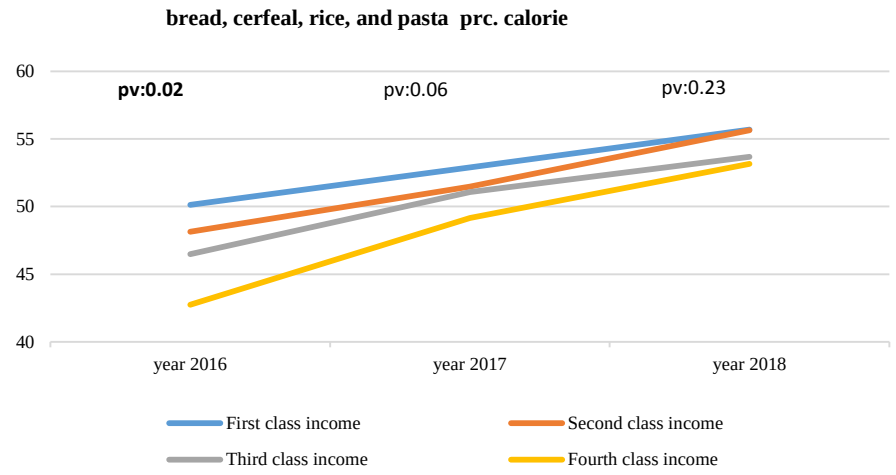


**Figure 1.** Changes in the percentage of bread, cereal, rice and pasta -prc. calorie based on income classes in the surveyed households 2017-2019

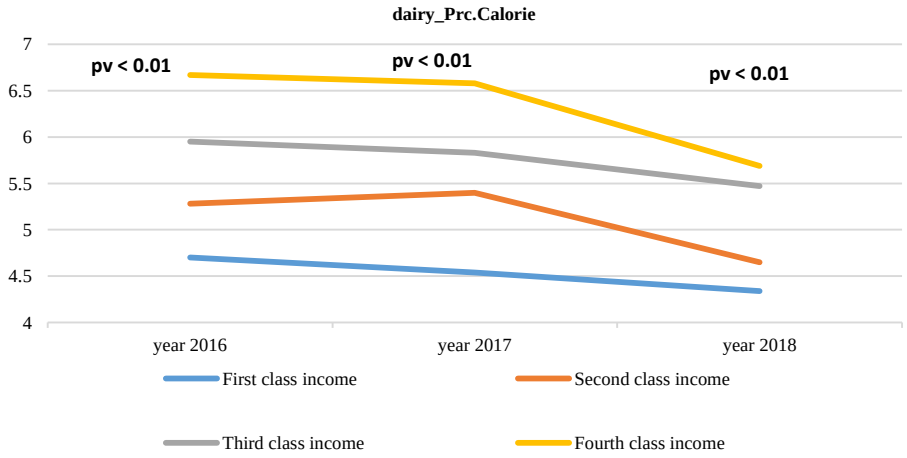


**Figure 2.** Changes in fruits - prc. calorie based on income classes in the surveyed households during 2017- 2019

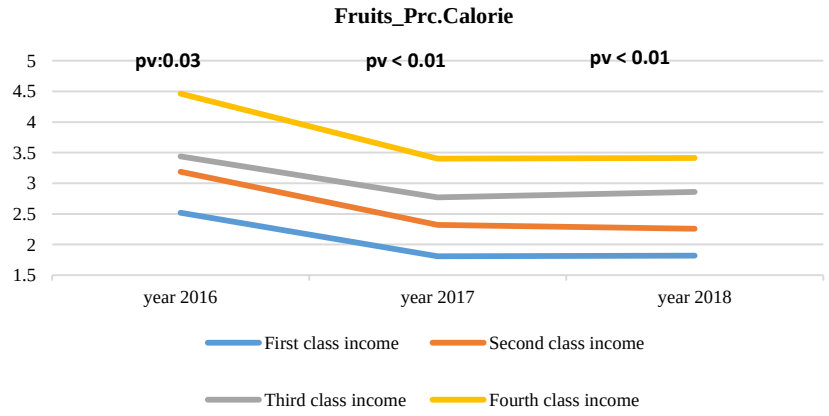


**Figure 3.** Changes in dairy-prc.calorie based on income classes in the surveyed households during 2017-2019







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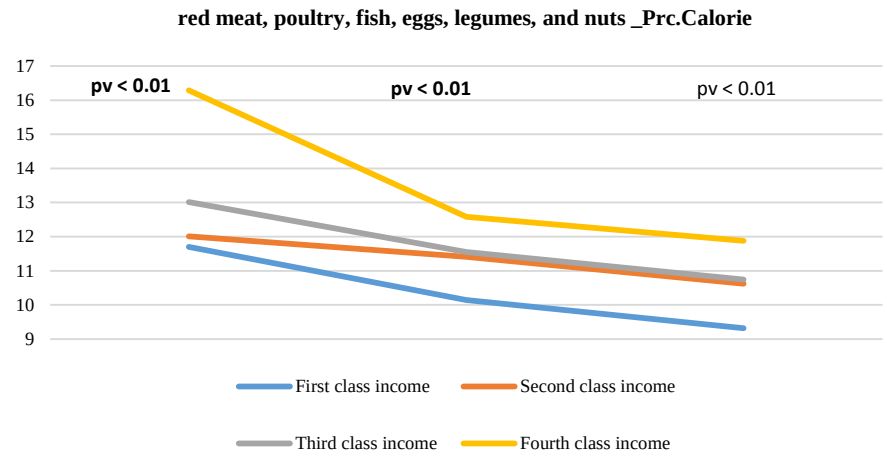


**Figure 4.** Changes in red meat, poultry, fish, eggs, legumes, and nuts -prc.calorie based on income classes in the surveyed households during 2017-2019

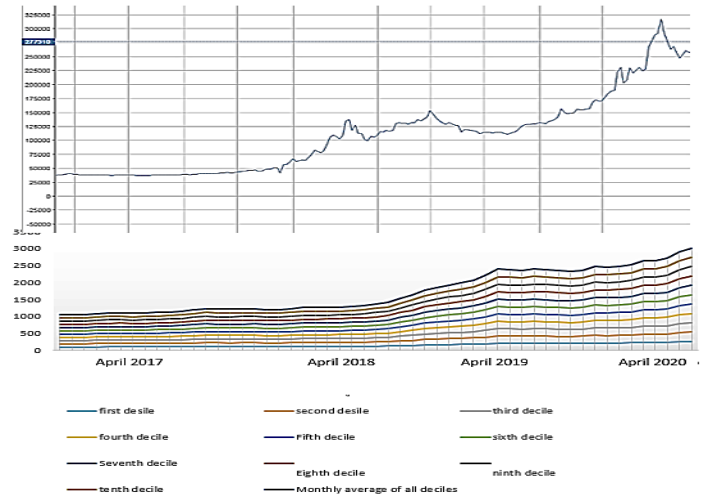


**Figure 5.** Impact of sanctions on the price index of food items of income deciles following the exchange rate from 2017 to 2019.

## Discussion

According to the analysis of the household costs and income in 2019 compared to 2017 in the present study, the net expenses, gross expenses, food expenses, non-food expenses, and income of the surveyed households increased significantly during 2017-2019. Notably, the costs of food increased in an unprecedented manner.

According to the study conducted by Jalal Hejazi and Sara Esmailpour in Iran, the US government's (Trump administration) withdrawal from the JCPOA caused unparalleled inflation in the food market, and Iran's exchange rate loss was estimated at 2.3 of its value following the re-imposition of the US sanctions in 2018 (Hejazi and Emamgholipour, 2020). Another study by Hamid Reza Ghorbani *et al.* suggested that along with the intensity of the sanctions, the financial trade index in the sanctioned country decreased, and the inflation rate increased. Rising inflation causes a significant rise in prices in the long run (Ghorbani Dastgerdi *et al.*, 2018). According to the data of the National Statistics Center of Iran (NSCI), the mean annual inflation rate of the consumer price index (CPI) increased from 12% in 2017 to almost 45% in 2019. The inflation rate of the price of food


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and beverages also increased from 12.1% in 2017 to 46.2% in 2019 (Salehi-Isfahani, 2023)(Salehi-Isfahani, 2023)(Salehi-Isfahani, 2023). Evidently, the percentage of food expenses in the present study was higher than the percentage of food costs of the NSCI due to the urban community (households in Razavi Khorasan province) in our research. **Figure 5** shows that by reconciling the CPI of different deciles of society with the exchange rate chart during 2016-2020, all deciles had a particular gap until April 2017 and were almost equal. Since 2018 and with the increased intensity of the periodic sanctions, the gap between the deciles of society has increased, which further emphasized the effect of sanctions on lower-income deciles ("Technical chart of currency index," ; "Total index of food, beverages and tobacco Prices of goods and consumer services of all households in the country in terms of cost deciles by month,")(total index of food, beverages, and tobacco prices of goods and consumer services of all households in the country in terms of cost deciles by month; technical chart of currency index).

According to the price analysis of food groups in 2019 compared to 2017, the price of the main food groups increased significantly. The most significant price increase was observed in healthy food group (vegetables), while the least significant rise in prices belonged to the fat group. In the study by Jalal Hejazi and Sara Esmailpour, unprecedented inflation in food market and increased CPI led to an increase in the price of all food groups (Hejazi and Emamgholipour, 2020). Consistent with the present study findings, the highest price slope belonged to vegetables in the mentioned study. On the other hand, the lowest price slope belonged to bread, cereals, rice, and pasta.

The findings of Fantunisrane Bachew and Bartminten indicated that different patterns of food groups occurred in Ethiopia during 2007-2016. Due to food inflation and financial expenses from the farm to the consumer, the prices of all macronutrient- and micronutrient-rich food groups increased during this period. The mentioned study concluded that food price inflation has increased the costs of a healthy diet (Bachewe *et al.*, 2019). According to the results of the present study, the intensification of sanctions has led to the most significant price increase in the food and beverage group, and the price increase was more tangible in healthy food groups. In the study conducted by Hejazi, the price of cereal food group was ranked last due to examining the share of imports in food consumption and production. In the present study, direct prices of food groups were evaluated and cereals were ranked second. The increased price of cereals could be due to the increased price of the rice subgroup. According to the price data of the selected food items in urban areas, the price of rice increased by 75% in 2019 compared to 2017 ("Prices of selected food items in urban areas ").

According to the DQI analysis in the study by Mkhawani *et al.*, poor households are more sensitive to changes in food prices, and their dietary quality is adversely affected by rising food prices. High-quality food is associated with higher expenses, and the costs of a healthier diet are higher than the costs of a low-quality diet. Consequently, low-income individuals have limited access to food diversity (Mkhawani *et al.*, 2016). According to the study by Meng T. *et al.*, a higher income allows families to spend more money on high-quality food (Meng *et al.*, 2013). Furthermore, Linh Vu Hoang stated that a household not only increases its calorie intake by increasing income, but it also tends to buy more expensive food with a better quality, better taste, and more nutrients (Hoang, 2009). In the present study, the intensification of sanctions was reflected in the rising exchange rate and CPI, causing low-income classes to shift their food preferences from more expensive sources of calories (higher quality and more nutritious) to cheaper alternatives such as sugar, fat, and bread. As a result, a significant reduction could be observed in their micronutrient intake, especially vitamins. The dietary quality of these individuals decreased during the study period, while the income gap increased.

According to the analysis of the bread and cereal group in the present study, the percentage of this





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food group of total calories increased during 2017-2019. The percentage of fruits, dairy, and meat groups of total calories was the lowest in the lowest-income class and the highest in the highest-income class during 2017-2019, which is consistent with previous findings in this regard. According to the study by Bertazzi Levy *et al*., the effects of the household income were significant on the percentage of most food groups of total calories. In the mentioned study, the percentage of food groups such as milk and its derivatives, fruits, and vegetables was constantly increasing with the level of household income, and carbohydrate intake decreased by increasing income (Levy *et al.*, 2011). In the present study, the most significant price increase was observed in healthy food groups, since foods with lower energy densities and nutrients (e.g., fruits and vegetables) often have higher prices. The price of these food groups increase with the intensification of sanctions. Although the income level increased throughout the sanction period, it is less significant compared to the increase in food expenses. Consequently, economic access to food will decrease, especially in lower-income classes.

According to the analysis of dietary micronutrients in the current research, lower-income classes had the most insufficient dietary intake, and higher-income classes had the highest dietary intake from sources of Na, Fe, K, Zn, and vitamins A, D, C, K, B1, Pantothenic acid (B5), B12, and biotin. Meanwhile, the gap between income classes has increased over the past years. The results of the present study are consistent with the previous findings in this regard. For instance, Iannotti *et al*. reported the inadequacy of micronutrient intake, especially among low-income households (Iannotti *et al.*, 2012). According to the analysis of micronutrient intake in different income deciles and its comparison with the recommended dietary allowance, the intensification of sanctions via increasing food expenses decreased the intake of healthy food groups, especially fruits and vegetables (which are important source of vitamins and minerals). The reduced intake of these micronutrients was more significant in low-income households, since their outcome was not regulated along with inflation. In general, a reduction in micronutrient intake is associated with a lower dietary quality.

The present study has only investigated the effect of sanctions on the food intake of urban households living in Razavi Khorasan province and does not include the investigation of the effect of sanctions on the whole country. The present study is the first study in Iran that has investigated simultaneously the effect of sanctions on food intake, food groups and diet quality during the years 2016, 2017 and 2018, and the effect of sanctions on the above items based on four income classes.

## Conclusion

According to the results, sanctions have increased the CPI and the costs of the household food basket, especially healthy food groups. Furthermore, increased CPI and income up-regulation (especially in lower-income deciles) have reduced economic access to the desired food basket and increased the share of food in households. Food preferences (especially in lower-income deciles) have also been shifted toward higher energy and density and lower quality and the reduction of micronutrient intake (e.g., fat and sugar). The share of healthy food groups (e.g., fruits and vegetables) in the household income has also decreased, especially in lower-income households. The inherent concept of proper food choices refers to the ability to provide physical access to various food products. The quantity and quality of food must meet the nutritional needs of the community, and economic access to adequate food must be ensured. Through Article 21 of the Universal Declaration of Human Rights, member countries have been asked to recognize the right of every person to physical and mental health, which is closely correlated with the right to life and a wide range of socioeconomic and other human rights, including the right to have access to nutritious food. According to the findings, sanctions have deprived people of proper access to safe and healthy food, which is a clear violation of human rights.

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## Authors' contributions

Shafaati S, Sobhani SR, and Norouzy A designed the research; Sobhani SR and Khosravi M conducted the research; Shafaati S and Sobhani SR analyzed the data; and Shafaati, S Saeedi, and Nattagh-Eshtivani E wrote the paper. Norouzy A had primary responsibility for final content. All authors read and approved the final manuscript.

## Conflicts of interest

No conflict of interest is declared.

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