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RESEARCH ARTICLE

Analyses of food supplements intake behaviour in peri-pandemic period*

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Abstract

The aim of this study is to analyse "food supplements intake behaviour" in Turkey. To do this, we aimed to identify the behaviours and the motivations of supplementary food intakes in the pre and the peri-pandemic periods. In addition, we revealed income effects on food supplements intake behaviour in the pre-, and the peri-pandemic periods.

The data of the study consists of 311 individuals living in Turkey who were selected by snowball sampling. Data were collected via a virtual environment between May - June 2021. Descriptive statistics, parametric tests and concentration analyses were employed to reveal the potential motivations of the increase in food supplements intake in the peri-pandemic period. Parametric tests, concentration analysis, and logistic regressions were further performed to identify income effects on (i) food supplements taking behaviour and (ii) the increase in food supplements intake in the peri-pandemic period, respectively.

We found that almost half of the respondents took food supplements. In addition, health anxiety and Covid-19 fear levels were revealed to be increasingly effective on the intake of food supplements intake in the peri-pandemic period. Furthermore, income was identified as a determinant of food supplement intake in the pre-pandemic period while no income effects were observed on the increase of food supplement intakes in the peri-pandemic period. This might imply that food supplements could be considered as compulsory food during the pandemic. To clarify this issue, further research investigating income effects on the demand of food supplements in inflationary environment in peri-pandemic period is required.

Keywords: Food Supplementation, Peri-Pandemic Period, Health Anxiety, Fear of Covid-19, Covid-19

JEL codes: C01, C19, I10, I12

* This study was previously presented as an abstract at the 14th National Congress on Health and Hospital, 14-17 October, 2021.

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1. INTRODUCTION

There has been an increase in food supplements intake in the last two decades in developed countries (Mishra & Potischman 2021). Several reasons for this increase have been reported so far including adopting a healthy lifestyle (Bailey et al. 2013), increasing elderly population (Cowan et al. 2018), and the tendency to self-medicate (Egan et al. 2011). It is widely suggested that individuals prefer to consume food supplements for various purposes such as strengthening immunity, being fit, improving health, relieving chronic pain and maintaining weight control (Kanak et al. 2021; Kaufman et al. 2002; Lee et al. 2000). It is understood that in addition to the use of food supplements for supporting dietary intake, they are also used with the motive of healing from a disease (Lordan 2021). Bailey et al. (2013) confirm that the main motivation of individuals using food supplements is to improve their general health status rather than supporting their nutrition.

The increase in the prevalence of food supplements intake in recent years (Cowan et al. 2018; Barnes et al. 2016) and the jump in their use during the Covid-19 pandemic have had an important impact on the sector (Food Supplementation and Nutrition Association 2020). Such increases have brought about the growth of the market as a consequence. The U.S. earned almost $345 million from sales of food supplements in 2019. This amount enormously increased in 2020 since $435 million worth food supplements sales were executed only in the first quarter of 2020 (Grebow 2021). This increase is also observed for Turkey. The total number of food supplements in Turkish market has increased by 34.3% to 80 million boxes where their value has reached to 2.87 billion Turkish Liras with 56.6% increase in 2020 (PIEA 2020). Due to this market size and growth, it is interesting to analyse food supplements intake behaviour in Turkey.

Increasing anxiety and fear during the Covid-19 pandemic has caused persistent changes to our daily lives. The change in nutritional habits and food preferences of individuals is counted as one of the important changes (Kaya et al. 2021). Increased anxiety in the lack of treatments for Covid-19 (WHO 2020; Colgecen and Colgecen 2020; Baykal 2020) led to attempts for protective and preventive measures with the aim to prevent the spread or mitigating the effects of the infection (Lake 2020; Salathé et al. 2020; WHO 2020). Owing to the concrete assessments towards the food supplements (Celik et al. 2021; de Faria Coelho-Ravagnani et al. 2021), it was identified that individuals had turned to food supplements to improve their immunity and/or to reduce the potential effects of the disease in case of infection in the peri-pandemic period (Hamulka et al. 2021).

On the other hand, the debates about healing effects of food supplements still continue. Some clinical studies (Bae et al. 2022; Pedrosa et al. 2022) reported improving effects of food supplements on the severity of the disease and the length of hospital stays, while others (Chen et al. 2021; Rawat et al. 2021) did not observe any affirmative effects about either the Covid-19 infection or the healing process. Their definitive effects on Covid-19 have still been controversial, (Bae et al. 2022; Chen et al. 2021; Hamulka et al. 2021) therefore, studies that are more clinical are needed. Despite these controversial findings, it is clear that the use of food supplements has significantly increased for healing or preventing purposes in the peri-pandemic period (Mukattash et al. 2022). In the report published by the Food Supplementation and Nutrition Association (2020) in Turkey revealed that food supplements intake increased in the peri-pandemic period when vitamins C and D had the highest increase with the motivation of improving immunity. In addition, according to this report, 60% of the participants took food supplements. Hamulka et al. (2021) confirmed that there was an interest especially in vitamins C and D in the peri-pandemic period based on the analysis of the internet search engine data. In a study conducted in Sweden, Norway and Holland, half of the respondents revealed that they used supplements. Accordingly, frequently preferred supplements were Omega 3, 6 or 9 vitamin D and multivitamins (Kristoffersen et al. 2021). In another multinational Middle Eastern study, Mukattash et al. (2022) defined that 46.6% of the participants had supplements intake and the most preferred supplements were vitamin D (55.7%), vitamin C (77.8%) and zinc (42.9%). Kristoffersen et al. (2021) emphasized that the half of the participants were in middle-income while Mukattash et al. (2022) stated that 40.4% of the participants were employed individuals and 39.8% were students.

This study aims to analyse food supplements intake behaviour in Turkey. In this context, the behaviours and the motivations for supplementary food intakes in the pre-, and the peri-pandemic periods were identified. Such an identification is important since it is of great importance for public health that individuals consciously take food supplements and access them from reliable sources. In addition, we aim to reveal income effects on food supplements intake behaviour in the pre-, and the peri-pandemic periods. Revealing the income effects are crucial in contributing and understanding the discussion of whether supplements are luxury goods before the pandemic, but whether they then turn into compulsory goods during the pandemic period.

The second part of the study presents methodology and data. In the third part of the study, research findings are included. In the fourth and fifth sections of the study, the discussion and conclusion sections are reported respectively.

2. DATA AND METHODOLOGY

2.1. Data

The data of 311 individuals living in Turkey were exploited. The data were collected through a virtual survey according to snowball sampling between May-June 2021 and contained information on food supplements intake of individuals in the pre-, and the peri-pandemic periods. In addition, health anxiety, fear of Covid-19, and attitudes of health nutrition of the individuals were questioned. To do this, the scales of health anxiety (Aydemir et al. 2013), the fear of Covid-19 (Bakioglu et al. 2020) and attitude scale of healthy nutrition (Tekkursun Demir et al. 2019) were employed respectively.

The Health Anxiety Scale is generated by Salkovskis et al. (2002) and validated by Aydemir et al. (2013). It consists of eighteen questions. It could take the values between 0 and 54 where the higher scores of the scale indicate higher levels of anxiety. The scale of Covid-19 fear is introduced by Ahorsu et al. (2020) and validated by Bakioglu et al. (2020). It consists of seven questions and can take the values between 7 and 35 where the higher scores of the scale indicate higher levels of anxiety. The Attitude Scale of Healthy Nutrition is introduced and validated by Tekkursun Demir and Cicioglu (2019) and the scale includes 21 questions taking the values between 21 and 105. The higher scores of the scale indicate higher levels of attitude towards healthy nutrition.

2.2. Methodology

Food supplements taking behaviours of individuals in the pre-, and the peri-pandemic periods were investigated in the study. While doing this, we further identified motivations of the increase in food supplements intake in the peri-pandemic period. To do these, descriptive statistics were initially presented. Subsequently, parametric tests and concentration analysis were employed in order to reveal the potential motivations of the increase in food supplements intake in the peri-pandemic period. Finally, parametric tests, concentration analysis, and logistic regressions were performed to identify income effects on (i) food supplements taking behaviour and (ii) the increase in food supplements intake in the peri-pandemic period.

The concentration index (CI) measures the magnitude of inequality. The CI ranges between -1 and 1; a negative value denotes the pro-poor inequality; whereas, a positive value indicates the opposite (pro-rich inequality). A zero value represents perfect equality (O'Donnell et al. 2006). In addition to the CI, the study exploits the logistic regression design. The logit model with a cumulative distribution function could be calculated as following (Gujarati 2004: 595):

$$P_i = E(Y = 1 \mid X_i) = \vartheta(Z_i) = \frac{1}{1+e^{-Z_i}} \quad (1)$$

In Equation 1, the probability value for observation i when $Y = 1$ is defined as P_i (P_i is defined as the probability of food supplement taking behaviour *(FSTB)*, i.e. Y_{FSTB}=1). $E(Y = 1 \mid X_i)$ represents the expected value of $Y_i = 1$ which is conditional on explanatory variable X_i. ϑ shown in Equation 1 refers to the cumulative logistic distribution function.

$$Z_i = X\beta \quad (2)$$

Z_i ranges from to ranges from 0 to 1. Furthermore, P_i is nonlinearly related to Z_i .The probability value for observation when the person is not taking food supplement $(Y = 0)$ could be expressed as below:

$$1 - P_i = E(Y = 0 \mid X_i) = \frac{1}{1+e^{Z_i}} \tag{3}$$

where $1 - P_i$ represents the probability of Y_{FSTB}=0. The odds ratio could be derived from the ratio of Equations (1) and (3) in favour of food supplement taking behaviour.

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \tag{4}$$

Taking the natural logarithm of Equation (4), it is obtained the log of odds ratio. The natural logarithm of Equation 4 could simply be expressed:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = X\beta + u_i \tag{5}$$

In this way, the linear function of food supplement taking behaviour is achieved.

3. RESULTS

3.1. Descriptive statistics

Table 1 reports descriptive statistics for the variables used in the study. Table 1 suggests that 45% of the respondents took food supplements in the peri-pandemic period. It was identified that regular food supplements taking rate was 32% in the pre-pandemic period (Table 1). This implies that food supplements taking behaviour has increased after the Covid-19 pandemic existed. This was confirmed since 34% of the respondents stated that their food supplements expenses increased during the pandemic. Almost 30% of the respondents spent up to 100 Turkish Liras for their food supplement intakes while approximately 30% spent more than 100 Turkish Liras on monthly basis. Vitamins were reported as the most taken food supplement since approximately 45% of the respondents state their intake. Further, D (45%) and C (37%) vitamins were the most taken vitamins, respectively. Besides, it was revealed that the intakes of D (32%) and C (27%) vitamins had the greatest increase in the peri-pandemic period.

Based on Table 1, one could clearly see that food supplements were mostly bought from pharmacies (65%) and e-commerce websites (35%). The participants mostly preferred the supplements if their practitioner (62%) and pharmacist (31%) recommend taking them. The respondents taking food supplements stated that they mostly took them for strengthening their immune systems (55%) or being more energetic (31%). As for the ones not taking food supplements, they reported that they did not use them mostly because (i) they were not in need (45%) or (ii) they tried to have a better dietary intake instead (35%). Almost half of the participants believed that food supplements could be harmful for their health. Interestingly, almost 70% of the participants did not know the licensing and supervisory authority for food supplements in Turkey.

Table 1. Descriptive Statistics

Variable	n	%	Variable	n	%	Variable	n	%
Taking food supplements in pre-pandemic period	99	31.8	Having the most expenditure in peri-pandemic period on			Reasons of taking food supplements		
Taking food supplements in peri-pandemic period	142	45.6	*Vitamin C*	86	27.6	*Strengthening the immune system*	169	54.3
Having more food supplements expenses in peri-pandemic period	108	34.7	*Vitamin D*	101	32.4	*Increasing the nutritional intake*	77	24.7
Average monthly expenditure on food supplements			*Omega 3-6-9*	43	13.8	*Preventing the diseases*	87	27.9
None	143	45.9	*Herbal tablets*	43	13.8	*Recovering faster*	68	21.8
Up to 100 TL	83	27.4	Places to buy food supplements			*Being more energetic*	97	31.1
More than 100 TL	85	27.3	*Pharmacies*	204	65.5	*Increasing intellectual performance*	52	16.7
Types of food supplements taken			*Markets*	35	11.2	Reasons of not taking food supplements		
Vitamins	148	47.5	*E-commerce websites*	110	35.3	*Not in need*	82	45.8
Minerals	62	20	*Cosmeceutical markets*	12	3.8	*Trying to have better dietary intake instead*	65	35.2
Herbal tablets	51	16.4	*Herbalists*	96	30.8	*Unable to afford*	24	13.4
Probiotics	36	11.5	Factors playing role on the preference			Believes food supplements can be harmful	161	51.7
Bee products	44	14.1	*Advertisements*	21	6.7	Licensing and supervisory authority		
Types of vitamins taken			*Recommendation of a friend*	85	27.3	*Ministry of Agriculture and Forestry*	98	31.5
Vitamin A	45	14.4	*Previous experiences*	114	36.6	*Ministry of Health*	172	55.3
Vitamin B	83	26.7	*Recommendation of the practitioner*	194	62.3	*Do not know*	39	12.5
Vitamin C	117	37.6	*Recommendation of the pharmacist*	97	31.1			
Vitamin D	151	48.5	*Price*	46	14.7			
Vitamin E	47	15.1						
Vitamin K	32	10.2						

3.2. Motivations of the increase in the peri-pandemic period

As it is previously mentioned, food supplements intake had increased in the peri-pandemic period. In this section, the motivations of such increase were examined. In this context, we endeavoured to figure out the effects of health anxiety, the fear of Covid-19 and healthier nutrition.

i. Reliabilities and Correlations of the Scales

Before investigating the motivations for increased food supplements intake in the peri-pandemic period, the reliabilities and the correlations of the scales employed in the study were tested. Accordingly, Cronbach's Alpha scores which are a measure of internal consistency related to a set of items were calculated as 0.86, 0.88, 0.83 for Health Anxiety Scale-HAS (Aydemir et al. 2013), The Fear of Covid-19 Scale-SCF (Bakioğlu et al. 2020) and Attitude Scale for Healthy Nutrition-ASHN (Demir & Cicioğlu 2019), respectively. Accordingly, it was understood that all the scales employed were reliable as a reliability coefficient of 0.70 or higher is considered "acceptable" in most social science research situations. Additionally, the correlations between the scales were calculated and there appeared no strong correlations between the scales.

Table 2. Cronbach's Alphas and Correlation Coefficients

Scales	Cronbach's Alpha	HAS	SCF	ASHN
HAS	0.86	1		
SCF	0.88	0.469 (0.00)	1	
ASHN	0.83	-0.101 (0.090)	-0.209 (0.000)	1

Note: p values are in parentheses.

ii. Health anxiety effect

To explore the potential effect of health anxiety on the increase in food supplements intake in the peri-pandemic period, the health anxiety levels of the individuals (i) those take food supplements on regular basis in the pre-, and the peri-pandemic periods and (ii) those had never taken food supplements with (iii) those took food supplements in the peri-pandemic period were compared. Accordingly, health anxiety levels of the individuals were on food supplements in the peri-pandemic period were higher than (i) those taking supplements on regular basis in the pre-, and peri-pandemic period and (ii) those never took food supplements. The findings are presented in Table 3. As recommended by Greene (2018, 261), the skewness and kurtosis values were compared to 0.0 and 3.0, respectively, for the normal distribution. As a result of the normality control, it was determined that the dependent variable had a normal distribution, thus t test was performed.

In addition, we identified the concentration of the individuals who started to take food supplements in the peri-pandemic period among the participants ranked according to their level of health anxiety. Positive value of the concentration coefficient (0.112) suggested that those individuals started to take food supplements in peri-pandemic period are more concentrated among those with higher health anxiety levels. The magnitude of the coefficient reflects the skewness of their distribution among the participants. On the other hand, no skewed distributions of those taking food supplements in the pre- and the peri- pandemic periods (-0.041) and those never take food supplements (-0.047). The findings imply that increased food supplements intake in peri-pandemic period may be related to higher anxiety levels of the individuals those started to take food supplements in peri-pandemic period.

Table 3. Results of t-tests and Concentration Coefficients for Health Anxiety

Health Anxiety Comparison	The individuals taking food supplements regularly in pre and peri-pandemic period			The individuals started to take food supplements in peri-pandemic period			The individuals never take food supplements				
	n	Mean	SD	n	Mean	SD	n	Mean	SD	df	t
1.	81	15.240	6.519	61	16.942	8.107	-	-	-	140	-1.386 (0.084)
2.	-	-	-	61	16.942	8.107	151	15.431	7.285	210	-1.323 (0.093)
Concentration Coefficients		-0.041 (0.450)			0.112 (0.099)			-0.047 (0.152)			

Note: p values are in parentheses. n donates number of observations; SD refers to standard deviation.

t represents t statistic and df is the degree of freedom.

iii. The fear of Covid-19 effect

For identifying the potential effects of the fear of Covid-19, the fear levels of the individuals (i) those took food supplements on regular basis in the pre-, and peri-pandemic period and (ii) those had never taken food supplements with (iii) those started to take food supplements in peri-pandemic period were compared. Accordingly, the fear levels of those started to take food supplements in the peri-pandemic period were higher than those already taking food supplements regularly in the pre-, and peri-pandemic period. On the other hand, there seems no statistical differences between the fear levels of the individuals who started to take food supplements in the peri-pandemic period and those never take food supplements.

In addition, to reveal the concentration of the individuals who started to take food supplements in the peri-pandemic period among the participants ranked according to their level of Covid-19 fear. Accordingly, a positive value of concentration coefficient depicts that the individuals started to take food supplements in the peri-pandemic period were more concentrated among the individuals with higher levels of Covid-19 fear. These might imply that increased food supplement intake in the peri-pandemic period may be related to higher levels of Covid-19 fear of the individuals started to take food supplements in the peri-pandemic period.

Apart from these, we checked whether the individuals taking food supplements regularly in the pre-, and the peri-pandemic periods were not afraid of the spread. To understand this, the distributions of those taking food supplements regularly in the pre-, and peri-pandemic periods among the participants who were already ranked according to their levels of the Covid-19 fear were examined. Accordingly, no statistically significant results were observed.

Table 4. Results of t tests and Concentration Coefficients for the Fear of Covid-19

Fear of Covid-19 Comparison	The individuals taking food supplements regularly in pre and peri-pandemic period			The individuals started to take food supplements in peri-pandemic period			The individuals never take food supplements				
	n	Mean	SD	n	Mean	SD	n	Mean	SD	df	t
1.	81	13.654	6.283	61	15.901	6.697	-	-	-	140	-2.050 (0.021)
2.	-	-	-	61	15.901	6.697	151	14.642	6.690	210	-1.240 (0.108)
Concentration Coefficients		-0.066 (0.239)			0.140 (0.042)			0.011 (0.659)			

Note: p values are in parentheses. n donates number of observations; SD refers to standard deviation.

t represents t statistic and df is the degree of freedom.

iv. Healthier nutrition effect

As for distinguishing the potential effects of the attitudes of healthier nutrition, we compared the health nutrition scores of the individuals (i) those take food supplements on regular basis in the pre- and the peri-pandemic periods and (ii) those never had taken food supplements with (iii) those started to take food supplements in the peri-pandemic period. Accordingly, healthy nutrition scores of those started to take food supplements in the peri-pandemic period were lower than those taking food supplements regularly in the pre-, and the peri-pandemic periods. In contrast, their healthy nutrition scores were higher compared to those who have never taken any food supplements.

Additionally, the concentration analysis suggests that the individuals taking food supplements on regular basis in the pre-, and peri-pandemic-periods were more concentrated among the individuals with higher healthy nutrition scores when the participants were ranked according to their healthy nutrition scores. On the contrary, the individuals who have never taken food supplements were more concentrated among the individuals with lower healthy nutrition scores in the same ranking. Unfortunately, no significant results were observed for the individuals starting to take food supplements in the peri-pandemic period. This might imply that those individuals who started to take food supplements in the peri-pandemic period may not be concentrated among certain parts of the participants ranked according to their healthy nutritional scores.

Although the concentration coefficient is lack of its statistical significance, the increased in food supplement intake in the peri-pandemic period might relate to healthy nutrition knowledge of individuals who started to take food supplements in the peri-pandemic period. Owing to their level of knowledge regarding healthy nutrition, they might desire to have healthier dietary intakes than they used to have in the pre-pandemic period in order to strengthen their immune systems. Therefore, their desire to have healthier nutrition may explain the increases in food supplement intakes in the peri-pandemic period.

Table 5. t-tests' Results and Concentration Coefficients for Healthy Nutrition Scores

Healthy Nutrition Score Comparison	**The individuals taking food supplements regularly in pre and peri-pandemic period**			**The individuals started to take food supplements in peri-pandemic period**			**The individuals never take food supplements**				
	n	Mean	SD	n	Mean	SD	n	Mean	SD	df	t
1.	81	80.074	10.574	61	76.524	9.895	-	-	-	140	2.035 (0.021)
2.	-	-	-	61	76.524	9.895	151	72.649	12.183	210	2.206 (0.028)
Concentration Coefficients		0.201 (0.000)			0.010 (0.914)			-0.145 (0.000)			

Note: p values are in parentheses. n donates number of observations; SD refers to standard deviation.

t represents t statistic and df is the degree of freedom.

3.3. Income effect on food supplements intake

The income effect on food supplements taking behaviour was further examined. To do this, the income levels of those taking food supplements regularly in the pre-, and peri-pandemic periods and of those never had taken food supplements were compared. Then, the concentration analysis was employed to identify where they were concentrated among the participants ranked according to their income levels. Finally, logistic regressions were performed to reveal the income effect on food supplement intake behaviour.

Income levels of the individuals taking food supplements regularly in the pre-, and peri-pandemic periods had significantly higher levels of monthly income than those never take food supplements (Table 7). The concentration analysis confirmed that the individuals taking food supplements regularly in the pre-, and peri-pandemic periods were more concentrated among the participants with higher income levels whereas the individuals never had taken food supplements were concentrated among the participants with relatively low-income levels. The findings implied that there might be some impacts of income on food supplements taking behaviour. To identify the effect a binary logit model where the outcome variable is binary indicating whether the individual takes food supplements regularly in the pre-, and peri-pandemic periods was established. Then the marginal effects of the income on the status of regular food supplements intake was calculated. The results suggest that one unit increase of 'Income/1000 TL' variable implies 1000 TL increase in the monthly income of the family. The estimation results depict that ₺ 1000 TL increase in monthly income is associated with almost 2% increase in food supplements taking behaviour on regular basis. This result confirms that the individuals with higher level of income have higher probability of taking food supplements on regular basis and income may play a role on food supplements taking behaviour.

Table 6. t-test Result and Concentration Coefficients for Income – Food Supplement Taking Behaviour

Income	The individuals taking food supplements regularly in pre and peri-pandemic period			The individuals started to take food supplements in peri-pandemic period			The individuals never take food supplements				
	n	Mean	SD	n	Mean	SD	n	Mean	SD	df	t
1.	81	9331.625	7192.615	-	-	-	151	6647.567	4994.413	150	-3.313 (0.000)
Concentration Coefficients	0.156 (0.000)						-0.108 (0.000)				

Note: p values are in parentheses. n donates number of observations; SD refers to standard deviation.

t represents t statistic and df is the degree of freedom.

Table 7. Logistic Regression for Income Effect on Food Supplement Taking Behaviour

Income	The individuals taking food supplements regularly in pre and peri-pandemic period			The individuals started to take food supplements in peri-pandemic period			The individuals never take food supplements				
	n	Mean	SD	n	Mean	SD	n	Mean	SD	df	t
1.	81	9331.625	7192.615	-	-	-	151	6647.567	4994.413	150	-3.313 (0.000)
Concentration Coefficients	0.156 (0.000)						-0.108 (0.000)				

Note: p values are in parentheses. Standard errors are in brackets. ME represents marginal effects and LR is likelihood ratio statistic[1].

In addition to these, the effects of income on the increases in food supplements intakes in the peri-pandemic period was investigated. To understand this, the income levels of those started to take food supplements in the peri-pandemic period with the income levels of those already taking food supplements regularly in the pre, and the peri-pandemic periods and of those never take food supplements were compared. Subsequently, the concentration analysis was exploited to find out where the individuals who started to take food supplements in the pre, and peri-pandemic periods were concentrated among the participants ranked according to their income levels. Finally, logistic regressions were employed to identify whether there were any income effects on the increase in food supplement intakes in the peri-pandemic period.

Accordingly, it was revealed that the individuals started to take food supplements in peri-pandemic period have higher income levels than the individuals had never taken food supplements (Table 8). In contrast, they had lower levels of income compared to the individuals already taking food supplements in the pre-, and peri-pandemic period. However, the concentration analysis indicates that the individuals who started to take food supplements in peri-pandemic period were not concentrated among certain parts of the participants those were ranked according to their monthly income levels. The findings imply that the increase in the intakes of food supplements in the peri-pandemic period may not be associated with their income levels. To understand this, a binary logit model where the outcome variable indicates whether an individual started to take food supplements in the peri-pandemic period was estimated. Then the marginal effects of the income on the status of regular food supplements intake were calculated. No significant impacts of income were observed on the outcome variable which is an indicator of whether an individual started to take food supplements in peri-pandemic period. This result confirms that income does not have any significant impacts on starting to take food supplements in peri-pandemic period. The finding strengthens the arguments of that food supplements might be perceived as a necessity good in the peri-pandemic period.

Table 8. t-tests' Results and Concentration Coefficient for Income – Increase in Food Supplement Intake

5	The individuals taking food supplements regularly in pre- and peri-pandemic period			The individuals started to take food supplements in peri-pandemic period			The individuals never take food supplements				
	n	Mean	SD	n	Mean	SD	n	Mean	SD	df	t
1.	81	9331.625	7192.615	61	7745.61	4971.446	-	-	-	137	1.4559 (0.027)
2.	-	-	-	61	7745.61	4971.446	151	6647.567	4994.413	207	-1.4325 (0.077)
Concentration Coefficient					0.069 (0.103)						

Note: p values are in parentheses. n donates number of observations; SD refers to standard deviation.

t represents t statistic and df is the degree of freedom.

Table 9. Logistic Regression for Income Effect on the Increase in Food Supplement Intake

	Coefficient	ME
(Income)/1000TL	0.039 (0.104) [0.039]	0.007 (0.110)
Constant	-1.328 (0,000) [0.318]	
Number of Obs.	227	
LR	1.84 (0.000)	
Pseudo R2	0.007	

Note: p values are in parentheses. Standard errors are in brackets. ME represents marginal effects and LR is likelihood ratio statistic.

4. DISCUSSION

The COVID-19 pandemic has significantly affected the lifestyles of individuals all over the world including the changes in their health-related and nutritional behaviours. In Turkey, the use of food supplements has increased in the peri-pandemic period (Food Supplementation and Nutrition Association 2020). Therefore, this study aims to identify food supplements intake behaviour and its motivations in the pre-and peri-pandemic period in Turkey.

This study revealed that 45% of the participants took food supplements in the peri-pandemic period where the rate of taking food supplements on regular basis was found to be 32% before the pandemic. This finding confirms that the food supplements taking behaviour has increased after the Covid-19 pandemic emerged in Turkey. This result is in line with the previous studies (Food Supplementation and Nutrition Association 2020; PIEA 2020; Mohsen et al. 2021; Zhao et al. 2020; Hamulka et al. 2020; Sami et al. 2021; Altun et al. 2020; Dost et al. 2021; Karapinar 2021; Aydin, 2021; Tolun & Bulut 2021; Demir et al. 2021). This outcome was underpinned as 34% of the respondents reported that their expenses for the food supplements had increased in the peri-pandemic period. Since Turkey has experienced an inflationary conjuncture in the peri-pandemic period, such an increase in the expenses may owe to the increases in the price levels of the food supplements. Therefore, future studies clarifying inflation effects on the market of food supplements in the peri-pandemic period will contribute to the literature. Therefore, it would be possible to understand whether taking food supplements for strengthening immunity in the peri-pandemic period is perceived as a mandatory need or not.

Since approximately 45% of the participants reported their vitamin intake, vitamins were the most common food supplement in peri-pandemic period. This finding is in line with the results of Lam et al. (2021) examining the take of traditional, complementary, and integrative medicine in Hong Kong in peri-pandemic period. It is also consistent with the results of Ozenoglu et al. (2021) stating the changes in nutritional habits and lifestyle in Turkey in peri-pandemic period. It was identified that vitamins D (45%) and C (37%) were the most taken vitamins, respectively. Further, it is revealed that the highest increase in the peri-pandemic period is in the intake of vitamins D (32%) and C (27%). These confirm the literature listing mostly took vitamins in different populations (Alyami et al. 2020; Tuncer et al. 2020; Demir et al. 2021).

It is understood that individuals mostly prefer food supplements when practitioners (62%) and pharmacists (31%) recommend taking them where Choi (2019) suggests that the nutritional values on the package (48.0%) and other people's recommendations (28.7%) are the major factors in choosing supplements in South Korea. Additionally, it was detected that the supplements were mostly purchased from pharmacies (65%) and e-commerce sites (35%). This is in line with the studies suggesting that supplements are mostly purchased from pharmacies (Al Tamimi 2019; del Balzo et al. 2014; Samar 2021; Ozbekler 2019), and those suggesting that they are mostly purchased from e-commerce (Demir et al. 2021; Baltacıoglu 2019). Conversely, in the study of Kobayashi et al. (2017), the participants state that although they obtain the information about supplements from the internet, they generally purchase the supplements from pharmacies.

Those who did not take supplements reported that they had not use them mostly because they did not need it (45%) or because they tried to have better dietary intake instead (35%). However, their healthy eating scores and of those who started taking food supplements during the pandemic period were lower than those who took regular food supplements before and during the pandemic. The literature is consistent with the current findings (Altun et al. 2020; Demirel 2021).

Surprisingly, almost half of the respondents believed that food supplements could be harmful to their health. Nevertheless, the previous literature suggests that most of individuals believed that food supplements could be beneficial for their health (Mohsen et al. 2021; Kanak et al. 2021; Cavdar et al. 2018). The reasons for the difference between previous studies and the current study might be the factors including sample characteristics (socioeconomic characteristics), the timing of the studies, and the perspectives of the populations on the supplementary food intakes.

It was identified that the Covid-19 fear levels of those who started taking food supplements in the peri-pandemic period were higher than those taking food supplements on regular basis even before the pandemic. This is confirmed since the individuals started to take food supplements in peri-pandemic period are more concentrated among higher fear levels of Covid-19. This might imply that increased food supplement intake in peri-pandemic period could be associated with higher fear levels of Covid-19 of the individuals. Previous literature (Alyami et al. 2020) affirms that food supplements are taken to prevent disease and reduce the risk of being infected. Similarly, Hwang et al. (2020) stated that individuals take food supplements when infectious diseases threaten. On the other hand, Polatcan and Kaptangil (2021) detect no significant relationship between the take of food supplements and the anxiety of being infected.

Although the concentration coefficient was not statistically significant, the increase in food supplement intake during the peri-pandemic period could be related to the healthy nutrition knowledge of individuals who started to take food supplements in the peri-pandemic period. Due to their knowledge of healthy diet, they may desire to have a healthier diet than before in order to strengthen their immune systems. Thus, the demand for a healthier diet may explain the increases in food supplement intake in the peri-pandemic period. This finding is compatible with Al Tamimi (2019) while it is inconsistent with the Ruiz-Roso et al. (2020), Mattioli et al. (2020), and Sidor & Rzymski (2020). The reasons for the similar or different results between these studies and the current study may be (i) cultural differences, (ii) time difference, (iii) perspective on the disease, (iv) nutritional characteristics of the society.

It is revealed that the income levels of the individuals taking food supplements regularly in pre-and peri-pandemic periods are significantly higher than those who did not take any food supplements. The findings imply that income may have some effect on food supplement-taking behaviour. We estimate that an increase of 1000 TL in monthly income is associated with 2% increase in food supplements taking behaviour. We believe that this result may be due to the increasing accessibility to nutritional supplements as the income level rises. Our findings are consistent with the previous literature reporting income effects on the take of food supplements (Gong et al.2018; Alwafaz et al. 2021; Mestaghanmi et al. 2021; Demir et al. 2021; Demirel 2021). However, this effect may change or disappear in an inflationary environment. Therefore, the studies examining food supplements taking behaviour in inflationary conjuncture may contribute to the literature about the demand for food supplements.

In addition to these, we investigated the effects of income on the increases in food supplements intake in peri-pandemic period. It has been revealed that the income levels of individuals who started to take food supplements during the pandemic period were higher than those who did not take any food supplements. In contrast, they had lower income levels than individuals who were already taking food supplements before and during the pandemic. However, the concentration analysis shows that individuals who started taking food supplements during the pandemic period were not concentrated among certain segments of the participants, ranked by their monthly income level. The finding implies that the increase in food supplement purchases during the pandemic may not be associated with the income levels. This result is similar to the previous studies in the literature (Tolun & Bulut 2021).

This finding strengthens the arguments that food supplements could be perceived as a compulsory need during the pandemic period. To clarify this, the studies investigating income effects in details are required to be carried out in an inflationary environment during the pandemic period. The data used in this study were collected before the prices of the supplements were increased. With the approvals of the studies conducted on supplementary food demand after the prices have increased, it could be alleged that food supplements are perceived as a compulsory need in the pandemic, so people buy them regardless of their income.

5. CONCLUSION

As a result, approximately half of the participants were found to take food supplements which seemed to be related to the Covid-19 pandemic. Among these people, the intake of vitamins C and D had been increased during the pandemic at most, respectively. It is expressed that the participants purchase the supplements when it is suggested by practitioners or pharmacists. This purchase is made from pharmacies and e-commerce sites in order to strengthen the immune system. This result revealed that the participants are sensitive to their health especially in the peri-pandemic period. It also shows their propensity to trust suppliers as well as experts.

It is understood that health anxiety and Covid-19 fear levels are increasingly effective on the take of food supplements. When the income effect on food supplement intake was examined, it has been revealed that income is a determinant of food supplement intake. Finally, it is important to note that the study deals with the decisions just before the increases in the prices of food supplements in Turkey. The current claim could be justified once the studies conducted on the demand of supplementary foods and income effects after prices have increased confirm.

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Conflict of Interest

All authors declare that there is no conflict of interest.

Author contribution

All authors contributed to the study’s conception and design. Data processing and analysis were performed by all. The first draft of the manuscript was written by Merve Ebrar Yılmaz, Havvana Degerli and, Hakan Degerli and all authors commented on previous versions of the manuscript. Hasan Giray Ankara revised the paper before submission. All authors read and approved the final manuscript.

Ethical approval

This study was ethically approved by the Scientific Research Projects unit of the University of Health Sciences with the registration number 21/586 on 17.09.2021.

Submission Declaration Statement

This study was previously presented as an abstract at 4nd International 14th National Congress on Health and Hospital.

Endnotes

1 LR (likelihood ratio statistic), which is the equivalent of the F test in the linear regression model.

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RESEARCH ARTICLE

The evaluation of Turkey's foreign trade with different country groups within the framework of the gravity model

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Abstract

The gravity model is based on the law known as the gravitational law discovered by Newton and was first used by Tinbergen to explain the foreign trade flow. It assumes that the size of the countries affects the foreign trade flow positively and the distance variable affects the foreign trade flow negatively. After the collapse of the Soviet Union, the Black Sea Economic Cooperation Organization was established under the leadership of Turkey to develop foreign trade with the countries that declared their autonomy. Similar to the story of the disintegrating Soviets, the Balkan Countries also declared their independence by leaving Yugoslavia. This study aims to investigate whether the gravity model is appropriate to explain Turkey's exports and imports to the Black Sea Economic Cooperation (BSEC), Balkan and selected countries during the 1996-2019 period. Export and import were used as dependent variables. Gravity model variables such as GDP, distance, population, language and common border variables were used to explain the exports and imports of the respective countries. For all these models, panel data analysis techniques were employed; pooled, random and fixed effects models were estimated and then tests for the model selection were carried out to choose the most appropriate model. After the appropriate models were determined, the assumption tests were executed. As a result of the study, it was concluded that the gravity model was suitable to explain Turkey's imports to the Balkan countries and exports to the selected country groups. The results of the study suggested that while the gravity model was suitable for explaining the factors affecting Turkey's trade flow for some country groups, it further suggested that it was not suitable for some countries.

Keywords: Panel Data Analysis, Gravity Model, Foreign Trade, BSEC, Balkan Countries

JEL codes: C2, C23, F1

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1. INTRODUCTION

The Black Sea region is the connection point with the Europe and Central Asia due to the institutional and geopolitical ties. This geopolitical context shows that the Black Sea states compose an compelling paradigm of cooperation along with the conflict in the international system. In the early 1990s, emerging states in the Black Sea region came to the basic understanding that institutionalizing their relations at the regional level would do much to enhance their security (Manoli 2003: 208). In other words, the fall of the Soviet Union was a turning point for countries located at the Black Sea Region. After the collapse, not only new states were established in the region, but also new problems and threats emerged in the region, therefore the idea of acting together in peace appealed to those countries. In this direction, the Black Sea Economic Cooperation was established in order to form a free trade zone in the region. Before the Economic Cooperation, there was no regional formation in this region. When the region is considered from this perspective, the first concrete breakthrough is the Black Sea Economic Cooperation (Cagıran 2000: 4).

The main purpose of the Black Sea Economic Cooperation is to increase the economic, commercial, scientific and technological cooperation by making use of the geographical proximity of the member countries and the complementary qualities of their economies. First of all, it aims to remove the obstacles in this regard by increasing trade. Afterwards, it is to ensure the free movement of goods, services, and goods for the development of economic relations between these countries. As stated in the articles in the Summit Declaration of the Black Sea Economic Cooperation, the cooperation is the main way to establish peace and security in the region (Oktay 2003: 246).

During the Cold War, Yugoslavia became a shield against the direct threat of the Soviet Union to Europe (Ucar et al. 2019: 347; Kenar 2005: 126). At that time, Yugoslavia was supported by the Western countries. However, immediately after the Cold War, Yugoslavia was dragged into a civil war. In addition to the European Union's inability to intervene in this civil war, the increase in the number of refugees and its inability to prevent arms and human smuggling caused a loss of reputation. The European Union developed different types of strategies after the Dayton Peace Agreement in 1995 to resolve this great civil war in the Western Balkans (Kodaman and Bas 2017: 48-49). After the treaty, Yugoslavia was officially dissolved. The state, which continued as the Federal Republic of Yugoslavia until 2003, renamed to Serbia-Montenegro. Then, in 2006, Serbia and Montenegro became two independent states. Vojvodina and Kosovo are located within the borders of Serbia. In 2008, Kosovo was separated from Serbia, leaving Vojvodina as the only autonomous region.

Trade means exchange. This exchange can be defined as goods or services. The exchange of goods between individuals and/or groups creates trade. The person who offers the good or service for sale would charge a fee for this, and the person benefiting from this good or service would pay the price and demand that his request is fulfilled completely. This exchange forms the basis of trade (Yarbasi and Gurtan 2012: 1). Exports are the purchase of goods and services produced by one economy for other economies (Dinler 2012: 399) whereas imports are defined as the purchase of goods or services produced in a foreign country. Imports are also defined as foreign purchase which is the entry from customs, nationalization and realization of the value of goods or services purchased from abroad, free zones for a fee through banks (Yarbasi and Gurtan 2012: 52).

While 12.3% of Turkey's total exports are to the BSEC, 6.5% to the Balkan, 35.87% to selected countries whereas 16% of its imports are to the BSEC, 4% to the Balkan and 55.42% to the selected countries. The crisis that occurred in 2008 was reflected in the percentages of exports and imports in 2009.

This study's aim is to find an answer to the question of whether the gravity model is suitable to explain Turkey's exports and imports to the BSEC, Balkan and Selected Countries between 1996 to 2019. The gravity model is a model that is frequently used to explain the flow of foreign trade since the 1960s. The panel data analysis techniques were used in this study. The study is outlined as follows; Section 2 provides the literature. Section 3 consists of the methodology concerning the gravity model for the panel data. Section 4 presents the data set and the analysis results and finally Section 5 reports the conclusion.

2. REVIEW OF PREVIOUS LITERATURE

The gravity model, which was first applied by J. Tinbergen in 1962, was criticized for its lack of theoretical background. Subsequently, Poyhonen (1963) and Linneman (1966) developed the specifications and provided estimates for the determinants of trade flows, and in 1973 Aitken applied this model to the regional trade agreements. There is a bulk of literature employing the gravity model.

Aitken (1973) aimed to investigate the determinants of European's trade flow in his study. Using data from 1951-1967, the effects of the European Economic Community (EEC) and the European Free Trade Association (EFTA) on trade flow within the gravity model framework were investigated. The independent variables used in the model were the country's gross national product (GNP), population, distance of the trade centre and for the dummy variables for common border and being a member of the EEC or EFTA. The study reported that GNP had a positive effect on the trade flow whereas population and distance variables were associated with a negative effect on the trade flow. Being a member of the EEC had positively affected the trade flow between these countries, and the trade between EFTA countries also had a positive effect, albeit small.

Endoh (1999) determined the impact of regional formations of the Mutual Economic Assistance Council (CMEA) and the Latin American Free Trade Area (LAFTA) on Japan's trade flow (EEC), as well as analyzed the trade-enhancing and reducing effects of these regional formations during the 1960-1994 period. He predicted the gravity model using the cross-sectional data. The explanatory variables were Gross domestic product (GDP), common language, population, the distance between the capitals of the countries for the dummy variables common border, and being a member of CMEA, LAFTA, and EEC. According to the estimation results, common border, common language and GDP positively affected, population and distance negatively affected the trade flow. The effects of CMEA, LAFTA, and EEC memberships varied according to the models established over the years.

Soloaga and Winters (1999) aimed to determine the effects of the member of selected organization on the imports and exports of the member countries; these organizations were North American Free Trade Agreement (NAFTA), Latin American Integration Association (LAIA), Central American Common Market (CACM), Gulf Cooperation Council (GCC), Association of Southeast Asian Nations (ASEAN), Andean Commonwealth (AP), EEC, EFTA. For this purpose, a gravity model was established by using the panel data for the period from 1980 to 1996. GDP of countries, distance between economic centers, population, the surface area of countries, common border, not having a common language, and the effects of these regional formations were used as independent variables. The analysis results reported that the trade flow was associated with positive effects of countries' populations, GDPs, and the use of a common language while distance and common borders were associated with negative effects. It was concluded that regionalization did not have a major impact on the trade flow.

Egger (2002) examined the trade flow of the Organization for Economic Cooperation and Development (OECD) and Central and Eastern Europe (CEEC) countries during the 1986-1987 period. The gravity model in the context of the random effects model was estimated. The independent variables used by Egger in his gravity model were GDP, the distance of their capitals from each other, real exchange rate, sizes, factor endowment differences and the dummy variables for common language and common border. Although there were problems with the model results, he concluded that the gravity model was a useful model for the trade flow.

Kien and Hashimoto (2005) examined the trade flow of the ASEAN Free Trade Area (AFTA) for the period 1988-2002. The model was estimated within the framework of the panel gravity model. In the model, countries' GDP, distance between capitals of two countries, population, exchange rates, common language and regional trade agreements were used as explanatory variables. Results of the analysis reported that the trade flow was affected by GDP, exchange rate, and common language positively, while it was affected negatively by population and distance.

Rojid (2006) aimed to calculate the effect of the regional formation among the Eastern and Southern Africa Common Market (COMESA) of 147 countries on the trade flow. Besides, the COMESA members aim to explore the trade potential. Rojid estimated the gravity model using panel data from 1980-2001. GDP, population, distance between the capital cities of the country, exchange rate, common border, and language were used in the model as the explanatory variables. As a result of the analysis, the trade flow was affected by common language and common border positively while negatively by GDP, population, real exchange rate, and distance.

Nitsch (2007) examined the effects of the G7 and G8 countries on the trade flow of 175 countries. In the analysis, the gravity model was estimated by using panel data for the period from 1948-1999. The independent variables used in the model were countries GDP, GDP per capita, distance between the capital cities of countries, the land area of countries, coast to the sea, having a common language, and border. While GDP, GDP per capita, common language, and border had positive effects on the trade flow, the area of the countries, being landlocked, and distance affected the trade flow negatively.

Ozkaya (2011) investigated the effect of Turkey's commercial agreements on its exports to 113 countries. Three different models were estimated using a panel data set for the period 1996-2006. Variables used to explain the trade volume were gross national income, population, distance between countries, per capita income, cross-exchange rate, foreign exchange reserve and the dummy variable for the trade agreement between countries. As a result, while the signed bilateral agreements did not have a statistically significant effect on Turkey's exports, it was concluded that the multilateral agreements (apart from the Customs Union Agreement), to which Turkey was a party had a statistically significant positive effect on Turkey's exports.

Aysun, Oksuzler and Yılgor (2012) examined Turkey's trade potential with the EU-15 of the Customs Union, which was established between Turkey and the EU. The import and export gravity models were estimated using panel data for the period 1980-2009. Independent variables in the gravity models were GDP, population, distance between the capital of the countries and a dummy variable for Customs Union. While the Customs Union had a strong effect on Turkey's imports, its effect was weaker on the exports.

Dinç (2012) examined Turkey's export potential with different country groups. Panel data for the period 1990-2006 were used for the gravity model. The variables used in the model were GDP per capita, population, distance between countries and whether there was a customs union agreement or not. As a result of the analysis, while GDP and common border variables were reported to affect the export potential positively, the distance variable affected the export negatively. Other variables' effects on the export varied according to the country groups.

Golovo (2014) aimed to examine the changes in the foreign trade of the Eurasian countries in the period 1994-2012 and analyze the trade potential through the gravity model. Between 1994 and 2012, 86 countries were included in the analysis. The study stated that the economic size of the countries, the distance between them, the common border and common language, the WTO membership and the existence of free trade agreements were determined as the main factors affecting the world trade. It was reported that the quality of the infrastructure and institutions of the countries and the level of protectionism had a lower effect.

Šimâkovâ and Stavârek (2015) investigated the effect of the exchange rate volatility on Hungarian foreign trade on different product groups with the gravity model. The variables included in the model as independent variables were GDP, population, distance, exchange rate volatility and whether there was a common boundary. The result of the analysis varied according to the product groups, but one important point to note was that the exchange rate volatility affected Hungarian foreign trade negatively.

Ramaswamy, Choutagunta and Sahu (2020) examined the determinants of trade flows of 31 Asian countries for the period 2007-2014 within the framework of the gravity model. In the study, they examined the performance of free trade agreements. As a result of the analysis, the trade flow was affected by distance and some trade agreements negatively whereas GDP and population could significantly explain trade flows.

3. METHODOLOGY

3.1. Gravity Model

The gravity model is formulated on the Law of Gravity which was developed by Newton in the 17th century. Tinbergen explained the foreign trade flow by using the economic size and distance variables of the countries in his model. Tinbergen states that there are variables other than economic size and distance affecting trade, but he further states that the main factors among them are economic size and distance as listed below:

• The amount of exports a country can supply depends on its economic size.

• The amount that can be sold to a particular country would vary according to the market size of that country.

• Trade volume would depend on shipping costs (Tinbergen 1962: 263).

$$T_{ij} = G \frac{M_i^{\alpha} * M_j^{\beta}}{D_{ij}^{\theta}} \quad (1)$$

where T_{ij} is trade flow between countries i and j, M_i and M_j are economic size of countries i and j, here, if Tij, is a monetary flow, measured as (e.g. export values). M refers to the gross domestic product (GDP) or gross national product (GNI) of each country if the Tij is the flow of people. It would be more accurate to measure M with population. D_{ij} is defined as distance between countries i and j, G indicates the constant. α, β, and θ show the model parameters. We would like to note that when α=β=0, θ=2, Newton's equation is reached (Tinbergen 1962: 263).

Economic size (GDP, GNP) has positive effect whereas distance has negative effect on the foreign trade flow. The mathematical format of the model is shown in Equation 2:

$$logT_{ij} = a + \beta logY_i + \gamma logY_j + \theta logD_{ij} + \varepsilon_{ij} \quad (2)$$

In the basic gravity model, economic size and distance are used. To expand the model, population variable is included. In addition to, dummy variables for border, language, and colonial ties are added to the model.

As the economic size of the countries that trade together increases, their mutual trade would increase. However, as the distance between countries increase, the counterpart trade would decrease (Dincer 2013, 7). Dummy variables for common language, common border, landlocked or economic integration could be included in the model to represent geographical and cultural factors.

3.2. Panel Data

Panel data consists of data that includes observations of several individuals or companies over time. Panel data observations, therefore, contain at least two dimensions: a) the sub-index i indicates the cross-section size, and b) the t-index indicates the time dimension (Hsiao 2005).

In general, the panel data model is expressed as below:

$$Y_{it} = \alpha_{it} + \beta_{kit} X_{kit} + u_{it} \quad i = 1,..,N \; t = 1,..,T \quad (3)$$

where Y refers to the dependent variable, X_k represents the explanatory variable, α is the constant parameter, β and u are the slope parameter and the error term respectively. i indexes units and t represents time.

Panel data are divided into two groups: a) balanced panel data and b) unbalanced panel data. Unbalanced panel data consists of missing observations for some variables during a certain time in the data collection process (Xu, Lee and Ho 2007: 572). Balanced panel data in which each unit is observed in every time dimension and as therefore, there exist no missing observations in the data.

In panel data, more than one unit comes together; each unit has its characteristics. Variables that reflect the properties of units are called unit effects. While this effect varies by unit, it is constant over time. Panel data that deal with the time dimension together with the unit, each period may have its own characteristics. The variable that reflects time-specific features is called the time effect. While this effect is constant among units, it varies according by time (Yerdelen Tatoglu 2013: 5).

3.3. Panel Data Models

In general, there are two types of commonly used panel data models in the literature (fixed and random effect models). We further include pooled model in this section. These models are explained as follows:

a) Pooled Model (POLS Model): A model in which all parameters are constant is called a classical model. In the absence of the effects of units and time, all data can be estimated with an ordinary least squares regression model. Although most of the time unit and/or time effects are present, sometimes none of these effects are statistically significant. This model is also called the pooled regression model (Yaffee 2003: 3). The model is as follows:

$$Y_{it} = \beta X_{it} + u_{it} \qquad i: 1, \ldots., N \quad t: 1, \ldots, T \tag{4}$$

b) Fixed Effects Model: Panel data, changes occur due to the differences between units or times, or differences between units and over time. One way to include this change in the model is to assume that this change causes another change in some or all the regression model coefficients. The regression coefficients are obscure, but fixed parameters. If these are allowed to vary in one or two dimensions, this is a fixed effect model. In this sense, to distinguish between two kinds of regression coefficients: the intercept and the slope parameters. When just variations in the intercept are considered, the resulting regression name the covariance model (or dummy variable model (Mátyás, L. & Sevestre 2008: 30).

The one-way fixed effects models in other words dummy variable/covariance model are shown in Equation 5:

$$Y_{it} = \alpha_i + \beta_2 X_{2it} + \cdots . \beta_k X_{kit} + u_{it} \tag{5}$$

The change of the constant coefficient from unit to unit is provided by dummy variables. One-way fixed effects model with dummy variables are expressed as follows (Guris 2015: 14):

$$Y_{it} = \alpha_1 D_{1\mathrm{i}} + \cdots \alpha_N D_{\mathrm{Ni}} + \beta_2 X_{2it} + \cdots + \beta_k X_{2kt} + u_{it} \tag{6}$$

where $D_{it} = \left\{ \begin{matrix} 1 & for\ i.unit\ (i = 1, \ldots N) \\ 0 & Other\ Situation \end{matrix} \right\}$

where

c) Random Effects Model: In panel data models, if the effects are treated as random variables, such as the error term, the existence of random effects is mentioned. Unlike the fixed-effects model, the effects of the units are random, depending on the random draw process of the sample (Baltagi: 2005: 14).

One-way random-effect models: In the error component model, the change in unit or time dimension is added to the model as a component of the error term, affecting only the constant parameter. In the random coefficient model, the change in unit or time dimension is added to the error term to affect all parameters (Mátyás, L. & Sevestre 2008: 47).

The one-way random effects models are shown as below:

Error components model:

$$Y_{it} = \delta_i + \beta_2 X_{2t} + \cdots + \beta_k X_{kt} + \nu_{it} \qquad \delta_i = \bar{\delta} + a_i \tag{7}$$

$$Y_{it} = \bar{\delta} + \beta_2 X_{2t} + \cdots + \beta_k X_{kt} + u_{it} \qquad u_{it} = a_i + \nu_{it} \tag{8}$$

where $\bar{\delta}$, is population mean is the constant parameter while a_i is the unit effect error term component.

Torres-Reyna (2007) states that it is important to check three assumptions when using panel data analysis techniques. These assumptions are the cross-sectional dependence, autocorrelation and heteroscedasticity. Tests should be carried out to examine the existence of the autocorrelation, cross-sectional dependence, and heteroscedasticity. The Ordinary Least Squares (OLS) in classical and fixed effects models, the Generalized Least Squares (GLS) estimator for random effects model lose BLUE (Best Linear Unbiased Estimator) features. The alternative estimators should be used to determine the standard errors that are robust to these problems (Cınar 2021: 469). In determining the robust standard errors, the number of T and N is also important in addition to the model properties. Suitable robust estimators are determined and the model is estimated.

4. DATA AND ANALYSIS

The analysis covers the period 1996-2019. The reason for choosing this period is because Turkey joined to the World Trade Organization in 1995 and the first case of the Covid-19 pandemic in Turkey which disrupted trade sector, occured in March 2020.

This study aims to analyze whether the gravity model is appropriate to explain Turkey's exports and imports to the member of the Black Sea Economic Cooperation Organization, Balkan countries and other selected countries the period 1996-2019, using panel data analysis techniques. To explain the exports and imports of the member states of the Black Sea Economic Cooperation Organization, two different models were estimated. Due to the embargo imposed by Turkey on Armenia, there does not trade data from Turkey to Armenia for the years 1996-2008 and 2014-2015. For this reason, two different models were created by completing the missing Armenia data with the interpolation method in the analysis and by excluding Armenia from the analysis.

Table 1. Variables and Abbreviations

Name of Variable	Description	Source
X	Turkey's exports to the relevant country (1000 USD$)	Turkish Statistical Institute
M	Turkey's imports to the relevant country (1000 USD$)	Turkish Statistical Institute
GDP	GDP of the exporting /importing country (USD$)	World development indicators, world bank
TRGDP	Turkey's GDP (USD$)	World development indicators, world bank
POP	Population of the exporting/importing country	World development indicators, world bank
TRPOP	Turkey's population	World development indicators, world bank
DISTANCE	Distance of capitals of exporting /importing countries from Ankara, capital of Turkey (km)	Tr.distance.to
BORDER	1 if it shares a common border with Turkey, 0 otherwise	Centre d'études prospectives et d'informations internationales
LANG	1 if it shares a common language with Turkey, 0 otherwise	Centre d'études prospectives et d'informations intçernationales

The country groups used in the analysis are as follows: Albania, Azerbaijan, Bulgaria, Georgia, Macedonia, Moldova, Romania, Russia, Serbia, Ukraine, Greece, and Armenia as the BSEC member states. In the model established for the Balkan countries, Bulgaria, Albania, Romania, Bosnia and Herzegovina, Croatia, North Macedonia, Serbia, Slovenia, and Greece. The countries used for the selected countries were Canada, France, Germany, Iran, Norway, Qatar, Russian Federation, Sweden, the United Kingdom, and United States.

After estimating the pooled, fixed and random effects models, the tests were conducted to determine the appropriate model among these models. The results for the model selection are presented in Table 2.

Table 2. Results for the Model Selection

		EXPORT		IMPORT		EXPORT	IMPORT	EXPORT
		ALL BSEC	**NONARM BSEC**	**ALL BSEC**	**NONARM BSEC**	**BALKAN**	**BALKAN**	**SELECTED COUNTRIES**
F Test	Prob > F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Breusch Pagan LM Test	Prob>chibar2	0.00	0.00	0.21	0.00	0.00	0.00	0.00

The hypotheses of the F test, which allows us to choose between fixed effects and pooled models, are as follows:

H_0: $\beta_i = \beta$ [There is no unit effect in the model.]

H_1: $\beta_i \neq \beta$ [There is unit effect in the model.] (9)

Since the p probability value for all models is less than 0.001, the H_0 hypothesis is rejected. For all models, estimation is not appropriate with the POLS.

Breusch Pagan LM test hypotheses comparing the pooled model and the random effects model are presented in Equation 10.

H_0: $\sigma^2\mu = 0$ [There is not unit effect in the model.]

H_1: $\sigma^2\mu \neq 0$ [There is unit effect in the model.] (10)

Except for the model in which all the BSEC countries established for import were included, the H_0 hypothesis was rejected because the p probability value was below the critical value of 0.001 in all other models, the POLS was not suitable for all models. H_0 hypothesis was not rejected since the p probability value was 0.208>0.001 in the model that includes all the BSEC countries established for import. As a result, the pooled effects model was suitable.

All models included the DIST variable, which was one of the main variables of the gravity model and did not change according to years. If the fixed effects model was chosen, the DIST variable is dropped from the model. For this reason random effects model would be continued for all models.

Table 3. Assumption Tests Results

			EXPORT ALL BSEC	EXPORT NONARM BSEC	IMPORT ALL BSEC	IMPORT NONARM BSEC	EXPORT BALKANS	IMPORT BALKANS	EXPORT SELECTED COUNTRIES
homoscedasticity			Pr>F	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F	Pr>F
	W0		0.000	0.000	0.000	0.000	0.000	0.000	0.000
	W50		0.000	0.000	0.000	0.000	0.000	0.000	0.000
	W10		0.000	0.000	0.000	0.000	0.000	0.000	0.000
cross-section dependence			P-value	P-value	P-value	P-value	P-value	P-value	P-value
	Pesaran		0.00	0.00	0.00	0.00	0.00	0.814	0.57
autocorelation			pr>chi2	pr>chi2	pr>chi2	pr>chi2	pr>chi2	pr>chi2	pr>chi2
	Random Effects Two Sided	LM(Var(u)=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		ALM(Var(u)=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Random Effects One Sided	LM(Var(u)=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		ALM(Var(u)=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Serial Correlation	LM(Var(u)=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		ALM(Var(u)=0)	0.040	0.000	0.000	0.000	0.000	0.000	0.000
	Joint Test	LM(Var(u)=0) Lambda=0)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

H_0: $\sigma_i^2 = \sigma^2$ [The variances of the units are equal in the model. / The homoscedasticity assumption is valid.]

H_1: $\sigma_i^2 \neq \sigma^2$ [The variances of the units are unequal in the model. / The homoscedasticity assumption violated.] (11)

According to the Levene, Brown and Forsythe (1974) test results, since the p probability value was 0.000<0.001, the H_0 hypothesis was rejected, and all models were reported to have the heteroscedasticity problem.

H_0: $\rho_{ij} = 0$ [There is no correlation between units. / There is no cross-section dependence.]

H_1: $\rho_{ij} \neq 0$ [There is a correlation between units. / There is a cross-section dependence.] (12)

Since the probability value was greater than 0.001 according to Pesaran (2004) test results of the export model established with the selected countries and the import model established with the Balkan countries, the H_0 hypothesis could not be rejected, there was no cross-section dependence. Other alternative models had the cross-section dependence.

H_0: $\rho = 0$ [There is no autocorrelation.]

H_1: $\rho \neq 0$ [There is autocorrelation.] (13)

According to the results of The Augmented Lagrange Multiplier (ALM) and Lagrange Multiplier (LM) test statistics, the H_0 hypothesis was rejected because the p probability value for all models was below the critical value of 0.05. All installed models had the autocorrelation problem.

As a result of the diagnostic tests, the models were re-estimated using the appropriate resistant estimators. Since there were autocorrelation, heteroscedasticity, and cross-sectional dependency problems in the models established for the analysis of exports and imports to the BSEC countries and Balkan's export, the Driscoll Kraay Estimator was used for these models. There were autocorrelation and heteroscedasticity problems in the export model established with the selected countries and the import models established with the Balkan countries. These models were re-estimated using the Arellano, Froot, and Rogers estimators.

4.1. Results of the Model Including Armenia for the BSEC Member States

In this chapter, the estimation results of export and import models to the BSEC countries are included.

The Export Model is expressed as below:

$$log\, X_{ijt} = \beta_0 + \beta_1\, log\, GDP_{jt} + \beta_2\, log\, TRGDP_{it} + \beta_3\, log\, POP_{jt} + \beta_4\, log\, TRPOP_{it} + \beta_5\, log\, DIST_{ij} + \beta_6 BORDER_{ij} + \beta_7 LANG_{ij} + u_{ijt} \quad (14)$$

The Import Model is defined as in Equation 15:

$$log\, M_{ijt} = \beta_0 + \beta_1\, log\, GDP_{jt} + \beta_2\, log\, TRGDP_{it} + \beta_3\, log\, POP_{jt} + \beta_4\, log\, TRPOP_{it} + \beta_5\, log\, DIST_{ij} + \beta_6 BORDER_{ij} + u_{ijt} \quad (15)$$

Table 4. Including Armenia for the BSEC Member States Models Results

Including Armenia For the BSEC Member States								
	EXPORT				IMPORT			
Independent Variables	Coef.	P> |t|	Std. Err.	t	Coef.	P> |t|	Std. Err.	t
GDP	0.248	(0.15)	0.165	1.51	-0.306	(0.410)	0.364	-0.8
TRGDP	0.839	(0.000)***	0.182	4.61	0.736	(0.110)	0.443	-1.66
POP	0.293	(0.72)	0.796	0.37	2.121	(0.000)***	0.277	7.66
TRPOP	0.604	(0.48)	0.839	0.72	1,133	(0.391)	1.296	0.87
DIST	-1.452	(0.82)	6.22	-0.23	-2.158	(0.009)**	0.752	0.75
BORDER	-0.796	(0.64)	1.681	-0.47	0.517	(0.403)	0.517	0.51
LANG	0.537	(0.40)	0.62	0.87				
constant term	-9.192	(0.65)	20.003	-0.46	7.594	(0.033)*	7.594	7.59
sigma_u		1.237				0.213		
sigma_e		0.284				0.903		
Wald chi2		421.68				3052.74		
Prob > chi2		0.00				0.00		
Rho		0.95				0.052		
Number of Observations (N)		288				288		
overall R^2		0.371				0.451		

Note: Coef. refers to coefficient and Std. Err. represents standard error.

In the export model in which Armenia was included, there was a significant positive relationship 1% significance level between Turkey's exports to the BSEC countries but Turkey's GDP, while the GDP and population of the exporting countries, Turkey's population, DIST, BORDER and there was no significant relationship with LANG.

A 1% increase in Turkey's GDP increases Turkey's exports to the BSEC countries by 0.83%. The Wald test, which evaluates the general significance of the model, indicates that the probability value is significant for the model as a whole. R^2 value is 0.37, one could suggest that the changes in the independent variables explain 37% of changes in the dependent variable. In the import model, the effect of the population of the importing countries was found to be significant the level of 1% and the impact of the DIST variable as statistically significant at the level of 5% for the Turkey's import to BSEC countries. Other variables in the model were found to be insignificant. A 1% increase in the population of importing countries increased imports by 2.12%, while a 1% increase in DIST decreased imports by 2.15%. The variables in the import model explained imports by 45%, the model was generally significant.

4.2. Results of the Model Excluding Armenia for the BSEC Member States:

In this section, the estimation results of export and import models to the Balkan countries without Armenia are included.

The Export Model is represented as in Equation 16:

$$\log X_{ijt} = \beta_0 + \beta_1 \log GDP_{jt} + \beta_2 \log TRGDP_{it} + \beta_3 \log POP_{jt} + \beta_4 \log TRPOP_{it} + \beta_5 \log DIST_{ij} + \beta_6 BORDER_{ij} + \beta_7 LANG_{ij} + u_{ijt} \quad (16)$$

The Import Model is demonstrated as below:

$$\log M_{ijt} = \beta_0 + \beta_1 \log GDP_{jt} + \beta_2 \log TRGDP_{it} + \beta_3 \log POP_{jt} + \beta_4 \log TRPOP_{it} + \beta_5 \log DIST_{ij} + \beta_6 BORDER_{ij} + \beta_7 LANG_{ij} + u_{ijt} \quad (17)$$

Table 5. Excluding Armenia for the BSEC Member States Models Results

	Excluding Armenia for the BSEC Member States							
	EXPORT				IMPORT			
Independent Variables	**Coef.**	**P> |t|**	**Std. Err.**	**t**	**Coef.**	**P> |t|**	**Std. Err.**	**t**
GDP	0.542	(0.001)***	0.135	2.22	0.153	(0.358)	0.163	0.94
TRGDP	0.648	(0.001)***	0.172	3.77	1.261	(0.000)***	0.248	5.07
POP	-0.056	(0.84)	0.281	-0.2	1.358	(0.001)***	0.364	3.73
TRPOP	1.241	(0.12)	0.776	41.6	0.293	(0.640)	0.620	0.47
DIST	0.068	(0.94)	0.937	0.07	-1.309	(0.011)**	0.475	-2.75
BORDER	0.218	(0.018)**	0.085	2.55	0.514	(0.146)	0.341	1.50
LANG	0.382	(0.09)**	0.215	1.77	0.125	(0.763)	0.410	0.31
CONSTANT TERM	-17.216	(0.036)**	7.738	-2.22	-18.857	(0.005)**	6.096	-3.09
sigma_u	0.173				0.246			
sigma_e	0.121				0.208			
Wald chi2	1198.86				502.59			
Prob > chi2	0.00				0.00			
Rho	0.671				0.583			
Number of Observations	264				264			
overall R^2	0.8822				0.913			

Note: Coef. refers to coefficient and Std. Err. represents standard error.

In the export model in which Armenia was included, there was a significant positive relationship at 1% significance level between Turkey's exports to the BSEC countries and Turkey's GDP and GDP of the exported countries, 5% significance level BORDER and LANG. However, Turkey's population and population of the exporting countries, DIST there was no significant relationship with Turkey's export. While a 1% increase in Turkey's GDP increased the exports to these countries by 0.64%, 1% increase in the GDP of the exporting countries affects exports by 0.54%, positively.

The effects of common language and common border variables on exports were found to be significant and positive. When the Wald test probability value was considered, it was found be highly significant. The R^2 value of 0.88 means that the independent variables explain 88% of exports. In the import model excluding Armenia, Turkey's GDP was significant at the level of 1% and the DIST variable was significant at the level of 5%. Other variables in the model are not statistically significant. 1% increase in Turkey's GDP affected imports positively by 1.26%, while a 1% increase in DIST affects 1.35% negatively. 91% of the variables used in the model, which were in general significant, explained imports.

4.3. Balkan Countries Model

In this section, the estimation results of export and import models to the Balkan countries are reported.

The Export Model is reported as in Equation 18:

$$log\, X_{ijt} = \beta_0 + \beta_1\, log\, GDP_{jt} + \beta_2\, log\, TRGDP_{it} + \beta_3\, log\, POP_{jt} + \beta_4\, log\, TRPOP_{it} + \beta_5\, log\, DIST_{ij} + \beta_6 BORDER_{ij} + u_{ijt} \quad (18)$$

The Import Model is shown below:

$$\log M_{ijt} = \beta_0 + \beta_1 \log GDP_{jt} + \beta_2 \log TRGDP_{it} + \beta_3 \log POP_{jt} + \beta_4 \log TRPOP_{it} + \beta_5 \log DIST_{ij} + \beta_6 BORDER_{ij} + u_{ijt} \quad (19)$$

Table 6. Balkan countries Models Results

BALKAN COUNTRIES								
	EXPORT				IMPORT			
Independent Variables	**Coef.**	**P> |t|**	**Std. Err.**	**t**	**Coef.**	**P> |t|**	**Std. Err.**	**z**
GDP	0.307	(0.282)	0.278	1.10	0.572	(0.017)**	0.238	2.39
TRGDP	0.842	(0.009)**	0.295	2.85	0.843	(0.003)**	0.283	2.98
POP	-0.211	(0.629)	0.431	-0.49	0.105	(0.895)	0.794	-0.13
TRPOP	2.374	(0.120)	1.471	1.61	1.720	(0.258)	1.522	1.13
DIST	-2.087	(0.027)**	0.885	-2.36	-2.572	(0.059)*	1.360	-1.89
BORDER	0.557	(0.004)***	0.174	3.20	0.462	(0.166)	0.333	1.38
CONSTANT TERM	18.468	(0.083)*	10.191	-1.81	15.784	(0.002)	5.208	-3.03
sigma_u	0.184				0.446			
sigma_e	0.149				0.256			
Wald chi2	1106.07				9804.24			
Prob > chi2	0.000				0.000			
rho	0.604				0.751			
Number of Observations	216				216			
overall R^2	0.842				0.76			
					R^2 within	0.718	R^2 between	0.782

Note: Coef. refers to coefficient and Std. Err. represents standard error.

Turkey's exports to the selected Balkan countries had a significant effect on Turkey's GDP and DIST variables at the level of 5% and the common border variable at the level of 1%. 1% increase in the Turkey's GDP affected exports by 0.84%, positively but DIST variable affected negatively. Export countries and Turkey's population did not have a significant effect on exports to Balkan countries. According to the Wald test result, the model was statistically significant. R^2 of the model was 0.84, and the independent variables used in the model explained exports by 84%. In the model explain Turkey's imports to selected Balkan countries, the GDP of the importing countries and Turkey was significant at the level of 5%, and at the level of 10% the variable of DIST was significant. Other variables were statistically insignificant for this model. %1 increase in Turkey's GDP affected imports by 0.84%, 1% increase in GDP of importing countries was 0.57% positive, DIST affected imports negatively. The independent variables used in the model explained 76% of model, the model was generally significant.

4.4. Selected Countries Model

In this section, the estimation results of the export model to the selected countries are included.

The Export Model indicated as below:

$$log\, X_{ijt} = \beta_0 + \beta_1\, log\, GDP_{jt} + \beta_2\, log\, TRGDP_{it} + \beta_3\, log\, POP_{jt} + \beta_4\, log\, TRPOP_{it} + \beta_5\, log\, DIST_{ij} + \beta_6 BORDER_{ij} + \beta_7 LANG_{ij} + u_{ijt} \quad (20)$$

Table 6. Selected Countries Models Results

SELECTED COUNTRIES EXPORT				
Independent Variables	**Coef.**	**P> |t|**	**Std. Err.**	**t**
GDP	0.642	(0.001)***	0.179	3.59
TRGDP	0.478	(0.004)**	0.168	2.84
POP	0.505	(0.001)***	0.147	3.44
TRPOP	1.506	(0.019)**	0.642	2.35
DIST	-1.315	(0.000)***	0.292	-4.51
BORDER	0.729	(0.000)***	0.175	4.16
CONSTANT TERM	-18.196	(0.000)***	4.012	-4.54
Number of Observations		264		
Mean dependent var		6.102		
SD dependent var		0.711		
Chi-square		5.128.466		
R^2 within		0.863		
R^2 between		0.938		
overall R^2		0.913		
Prob > chi2		0.000		

Note: Coef. refers to coefficient and Std. Err. represents standard error.

While there was a positive and significant relationship between Turkey's exports to the selected countries and Turkey's GDP and population, the GDP and population of exporting countries, and the LANG dummy variable, there was a negative significant relationship between the DIST variable. While the 1% increase in Turkey's GDP increased its exports to the selected countries by 0.47%, a 1% increase in the population increased exports by 1.50%. While 1% increase in the GDP of the selected exporting countries increased exports by 0.64% and 1% increase in population increased export by 0.50%. A %1 increase in distance reduced exports by 0.72%. The effect of the common language variable was positively significant. The R^2 value of 0.91 means that the variables in the model explained 91% of exports. Due to the data structures, the expected estimates for import to selective country models could not be obtained.

5. CONCLUSION

This study aims to find an answer to the question of whether the gravity model explains Turkey's exports and imports to Black Sea Economic Cooperation Organization members, Balkan, and the selected countries. Due to the deficiencies in the data of Armenia, two different models were created for the Black Sea Economic Cooperation Organization, in which Armenia was included and then excluded. The missing data were produced by the interpolation method. In the study, export and import data according to the countries included in the foreign trade data group of TURKSTAT were used as the dependent variable. The analysis covers the period from 1996, when the Customs Union Agreement entered into force, to 2019, when there were no Covid-19 cases in Turkey.

The pooled, fixed and random effects models were estimated for all models. In order to select among these models, F, Breush Pagan (1980), Hausman tests were performed. According to the F test results, the fixed effects model was more suitable among all models compared to the pooled model. According to the result of the Breush Pagan test, the random effects model was more suitable compared to the pooled model. Hausman test was used to compare the fixed effects and random effects models and to select the appropriate model. Regardless of the test result, since the distance variable, which was one of the gravity model variables, was a constant variable according to years, the random effects model was chosen as the appropriate model for all country groups. The assumptions of the models created for all country groups were tested. As a result of the tests, there was heteroscedasticity, cross-section dependence and autocorrelation problems in export model for the Balkan countries and models for BSEC countries. here was heteroscedasticity and autocorrelation problems in export model for the selected countries and import model for Balkan countries. The result was reached by estimating the models with resistant estimators developed against these problems. Arellano, Froot and Rogers Estimators were used for the selected countries export and Balkan countries import, while Driscoll Kraay Estimator was used for other models. In terms of the gravity model, our study concluded that Turkey's exports to the selected countries and BSEC (Except Armenia) countries were suitable in explaining Turkey's import model of Balkan countries.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

Submission Declaration Statement

We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

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RESEARCH ARTICLE

The analysis of the factors affecting the stringency index during COVID-19 pandemic

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Abstract

Coronavirus (COVID-19) pandemic, which started in China's Wuhan providence in the late 2019s, and then affected the entire world in a short time, causing high disease and death rates, was one of the most important unexpected crises of 21st century. In order to manage the risk the pandemic posed on public health and public order, and to control spread of the disease, governments implemented restriction policies, in which precautions such as limitation and closure were taken. This study aims to examine the factors affecting the stringency index, an indicator of the political measures taken by governments against the epidemic in the selected countries (the United Kingdom, Italy, France, Germany, Türkiye, Russia, Brazil, the United States of America, India) during COVID-19 pandemic. In the analysis, non-additive fixed effect panel quantile regression model with the instrumental variable was used. The data set covers the period between March 11, 2020 and June 29, 2021. The findings indicate that although the level of effects varied, an increase in the number of daily deaths has an increasing effect on the stringency index value in all the countries within the study. Meanwhile, it is observed that as the rate of people with age 65 and over increases, the stringency measures also increase in the countries implemented moderate and high-level restrictions.

Keywords: COVID-19, Pandemic, Stringency Index, Government Responses, Non-Additive Fixed Effect Panel Quantile Regression

JEL Codes: C31, C33, I18, J18, D81

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1. INTRODUCTION

A disease that has spread across a large region such as multiple countries and continents is called pandemic[1]. It is known that many pandemics in history caused deaths by affecting lives. Although the factors affecting these types of diseases that occur from time to time are different, they have caused significant challenges for countries and thus the whole world influencing hundreds of thousands of people and even millions of people.

In the last months of 2019, information regarding the cases of a disease that differed from other diseases in the city of Wuhan in the Hubei Province of China began to take place in the world press. After the cases of an unidentified disease, the health committee of Wuhan Municipality made an explanation on December 31, 2019 and announced that a disease with unknown origin was encountered. Upon the statement by experts that these diseases were caused by a new type of coronavirus, World Health Organization declared to the public that this outbreak was a pandemic on March 11, 2020 (Dashraath et al. 2020: 521). After this period, COVID-19 disease spread firstly to the other provinces of China, then to neighboring countries, and other parts of the world, influencing the whole world at last.

The coronavirus (COVID-19) outbreak has struck the whole world since the early days it emerged. The absence of a definitive treatment regarding the recovery process led to an increase in the number of cases, which has caused more burden on the healthcare system, prolonged treatment periods, and loss of lives. The uncertainty brought by the outbreak also negatively affected the economy in many industries and thus many countries. During this period, relevant public authorities have responded with several implementations both to prevent (protective) the emergence of the disease and also to treat the existing disease and hinder the spread of the disease. Public service ads, announcements and trainings about mask, distancing, and hygiene are the most basic practices for the prevention of the disease. As well as these basic precautions, some economic and social measures (such as isolation, distance-learning, flexible working, lockdowns) were also applied to reduce the spread risk of the disease.

With filiation works carried out against the disease, it was aimed to detect both the ill individual and those who had contact with the ill person and to treat these people by isolating them from healthy individuals through different isolation methods, preventing the spread of the disease. The lack of an effective treatment against coronavirus epidemic has made vaccination the most important fighting tool as well as other main means of prevention. At the early stages of the pandemic, there was no vaccination or medicine to be effectively used against this disease. Therefore, during the period many countries started to develop vaccines that could be effective for COVID-19 virus, some of which were proven to be effective through scientific trials were presented for use. Governments provided vaccination programs to their citizens by supplying different vaccines produced for this purpose. During the period, elderly people who were highly affected by the epidemic and healthcare professionals who were in intense contact with patients were prioritized in the vaccination programs. Gradually, many countries started to vaccinate their citizens. The introduction of new vaccines and their approval for use during this process were considered as positive developments in the fight against the pandemic.

However, the difficulties experienced in vaccine production and supply and the fact that all countries could not reach these vaccines equally have slowed down the fight against the epidemic. These problems in the vaccine supply with regard to world population and the appearance of new variants of the virus made the period of fight against the epidemic longer and the effects of the epidemic continue. In addition to the main measures mentioned above, social and economic many practices were implemented by governments in order to prevent the spread of the disease, continue life effectively, and overcome this period with the least harm.

Since the outbreak of this disease, although precautions were sometimes made flexible, the various mutations of the virus led to the continuation of the measures though in part.

Stringency Index is an index obtained by weighting nine different indicators during the COVID-19 disease. School closures, workplace closures, restrictions on public gatherings, cancellation of public events, stay-at-home requirements, closures of public transport, public information campaigns, restrictions on internal movements, and international travel controls; are the nine indicators that were used to calculate the Stringency Index. Stringency Index of a country is obtained according to the index score between 0-100 calculated based on these indicators. While 0 refers to no stringency, 100 refers to full restriction. While this index is calculated, the composite index value is obtained by taking the average of sub-index scores collected by assessing each situation:

$$Stringency\ Index_i = \frac{1}{k}\sum_{j=1}^{k} I_j$$

k is the number of indicators in an index and I_j value is the sub-index value (Hale et al. 2020: 530, 536)

In this study, the factors affecting the stringency index, an indicator of the political measures taken by governments against the epidemic, will be analyzed for nine countries (the United Kingdom, Italy, France, Germany, Türkiye, Russia, Brazil, the United States of America, India) through the non-additive fixed effect panel quantile regression method with the instrumental variable. This method is preferred to use in the analysis in order to reveal the effect levels of included factors in countries that applied different levels of stringency measures. In this context, this study aims to contribute to the literature through the method used and the time period it examines.

2. LITERATURE

Since the early days of the coronavirus outbreak, it has been seen that many studies that examine the effects of the pandemic in started to take place in the literature in many areas. These studies examined the effects of the outbreak on health, society, psychology, and economics, and tried to contribute to the improvement of the process from different angles. This study analyzes the factors that had an impact on the restriction policies applied by the governments during the pandemic. When the previous studies in the literature are reviewed, it has been seen that there are quite a few studies on this topic. One of the fundamental studies in the field that contributed to the literature and was taken as a reference by later studies is made by Hale et al. (2020) from Oxford University. Hale et al. (2020) calculated the stringency level of the measures regarding limiting social mobility and lockdown applied by states to prevent COVID-19 by means of an index. In their study, they transformed 9 different data into a Stringency Index that takes values between 0 and 100.

Razzak (2020) analyzed the Stringency Indexes of New Zealand, Australia, Denmark, Sweden, and the US between the period of January 1, 2020 and April 23, 2020 with unrestricted Vector Auto Regressive model and continued the study by completing the data set until June 30, 2020, using dynamic stochastic baseline projections. In the first months of the pandemic, the policies of stringency measures implemented by the countries had a reducing effect on the number of cases in these countries except for the US. In addition, the daily number of new cases declined when these policies were tightened. Nevertheless, the study also found that the effect of the stringency policies varied between countries due to the time when these policies were put into practice.

Kaçak and Yıldız (2020) analyzed the effects of stringency measures policies on the course of the pandemic in countries by comparing the stringency policies in five European countries and Türkiye. According to the findings, it has been found that the application of early restriction measures influences the number of coronavirus cases and deaths.

Koç and Saraç (2020) examined factors affecting the number of coronavirus cases and deaths in OECD countries through multiple linear regression model in their study and they determined that the rate of healthcare expenditures, the rate of being overweight, the rate of people with diabetes, and the scores of stringency index had an impact on the number of coronavirus cases and deaths.

Tassinari et al. (2020) examined the factors that affected the restrictions against Coronavirus pandemic in different regions of Italy by creating a “regional stringency index”. It was found that the most effective factor on stringency index was “weight of exports on regional GDP”. The second most effective factor was GDP per capita.

Taşdoğan and Taşdoğan (2020) investigated the effect of the stringency index on the number of coronavirus cases in 13 countries that were mostly influenced by the epidemic through the panel quantile regression method. In the study it was found that, according to the Stringency Index scores, the countries that took strict measures in the first two and half months after the outbreak were more successful in the fight against the pandemic.

Fuller et al. (2021) examined the relationship between the time when 37 European countries put stringency measures into practice and the mortality as of June 30, 2020, through linear regression method. This study revealed that mortality in the countries that implemented stringency measures earlier was lower.

Based on online data collected from 547 employees in Türkiye, Yiğitol and Büyükmumcu (2021) analyzed the relationships between fear of COVID-19, personality traits, job performance, and turnover intention with the Structural Equation Model. This study discovered that the fear of COVID-19 had an impact on turnover intentions, but it did not affect job performance significantly. However, it was seen that the fear of COVID-19 was enhanced by personality traits like neuroticism and responsibility.

Prasad et al. (2021) analyzed the stringency measures, economic measures, social and public information policies enforced in India against coronavirus outbreak according to 21 indicators by means of AI-based predictive analytics tools. The results showed that there was a close and reverse relationship between the stringency level and the number of COVID-19 cases. In other words, there was a reverse relationship between the Government's Response Index and the total number of cases.

Piccinali et al. (2021) examined the relationships between the stringency measures applied in 34 countries from January 2020 to November 2021 and the levels of libertarian and authoritarian governance through bivariate, multivariate, and panel data regression analyses. According to the findings of this study, there was a reverse interaction between the stringency measures and libertarian governments, however, the stringency measures applied were seen to rise as the share of authoritarian governments increased. This study also revealed that the only exceptions were Italy and Ireland which gave different results.

Gökçen's study (2021) analyzed the economic effects of non-medical measures against COVID-19 outbreak on manufacturing and service industries and the role of supportive fiscal and monetary policies through panel data analysis. The findings showed that the stringency of applied restrictive measures had a higher impact on the PMI index of services, but it also affected the PMI index of the manufacturing industry. And it was asserted that the negative effects of these measures on the observed industries could be eliminated through public finance and monetary policies.

Chen et al. (2021) analyzed the measures taken by six countries selected from East and Southeast Asia (China, Japan, Singapore, South Korea, Taiwan, and Vietnam) against COVID-19 pandemic, applied between January 1 and May 30, 2020. Control measures were split into different categories — administrative, public health, and health system measures. Initial Response Index (IRI) and Modified Stringency Index (MSI) were formed to assess the stringency and the timeliness of the measures. Findings of this study put forward that early and timely measures, especially with regard to public health, had a significant role in controlling the outbreak optimally.

Çelik (2021) examined the data from 27 European Union (EU) countries regarding the period between January 2020 and March 2021 through spatial panel data analysis. According to the findings of this study, there was a positive spatial interaction among EU countries, and the COVID-19 measures negatively affected the economic growth of these countries. It was also found that the COVID-19 measures taken by neighbouring countries had a greater negative effect on the economic growth of the relevant country. From other control variables analyzed in the study, Exports and Imports had a positive impact on growth while Inflation had a negative impact. No statistically significant effect of Foreign Exchange Rate on growth was observed.

Violato et al. (2021) tested the lockdown measures in eight European countries (Austria, Belgium, France, Germany, Italy, the Netherlands, Spain, and the United Kingdom) on COVID-19 infection rates and mortality rates with Stepwise Multiple Regression, Factor Analysis and Latent Variable Path Analysis through the Structural Equation Modelling. The results showed that the Stringency Index scores had a high impact on COVID-19 infection and mortality rates.

3. METHODOLOGY

Quantile regression is a model in which regression models are estimated by minimizing the absolute deviation of error terms by taking different quantiles into consideration. Koenker and Bassett (1978) started to contribute to the literature with their article. The approach is a method based on the minimization of the absolute deviation of errors terms obtained from the estimated model of;

$$Y_t = X_t'\beta + u_t \tag{1}$$

$$\min_{\beta \in \mathbb{R}} \left[\sum_{t \in \{t: Y_t \geq X_t'\beta\}} \theta |Y_t - X_t'\beta| + \sum_{t \in \{t: Y_t < X_t'\beta\}} (1-\theta) |Y_t - X_t'\beta| \right] \tag{2}$$

θ, refers to different quantiles. Quantile regression is a method which is preferred especially when the error terms are not distributed normally and there are extreme values in the series and also which is less responsive to extreme values. This method is expanded to panel data with an article by Koenker (2004).

Non-additive fixed effect panel quantile model started to take place in the literature with a definition of quantile regression for panel data (QRPD) with Powel's (2016) study. In this method, the distribution of (Y_{it}/X_{it}) dependent variable and the heterogenous effects of the explanatory variables on the dependent variable can be observed. The model is estimated as below:

$$Y_{it} = X_{it}'\beta(U_{it}^*) \tag{3}$$

U_{it}^* in the model is defined as in Equation 4:

$$U_{it}^* = f(\alpha_i + U_{it}) \tag{4}$$

by taking the fixed effects into consideration. Y_{it} dependent variable is obtained by calculating the conditional probabilities for different quantiles (Powel 2016: 7; Baumparis, Milas, Panagiotidis, 2017: 44):

$$P(Y_{it} \leq X_{it}'\beta(\theta)/\, X_{it}) = \theta \tag{5}$$

Due to the endogeneity problem in variables, the approach has been extended with the instrumental variables approach. QRPD approach with instrumental variable, $Z_i = (Z_{i1}, \dots, Z_{iT})$, is shown:

$$E[1\big(Y_{it} \leq X_{it}'\beta(\theta)\big) - 1(Y_{is} \leq X_{it}'\beta(\theta)/\, Z_i)] = 0 \tag{6}$$

while showing instrumental variables set. In Powel's (2016) study, it is stated that QRPD approach provides asymptotically normal and consistent estimations even when the size of T is small (Powel 2016: 3).

4. DATA

In the study, the effects of different indicators obtained by the World Health Organization in the relevant period on the stringency index were examined. During and after the pandemic period, it is seen that there are studies in the literature (Tassinari et al. 2020; Vialato et al. 2021) examining whether there is a relationship between the number of deaths per day, population density, gross domestic product per capita and the stringency index variables. In addition to these variables, since the closure of workplaces and schools and the obligation to stay at home are included in the restriction measures, it is thought that variable of the rate of 65 years and over has an effect on the stringency index.

The model was estimated using the variables that were thought to affect the stringency index and were found to be significant. These variables are the number of deaths per day, the rate of people with age 65 and over, population density, and gross domestic product per capita. As it was thought that there could be an interrelationship between the stringency index and the number of deaths per day and population density, the variables of the number of cases per day, the number of tests per day, the rate of positive tests were determined as instrumental variables for the number of deaths per day, and population variable was determined as instrumental variable for population density.

Table 1. Identification of the Variables

Name of the Variable	Description of the Variable	Definition of Variable
SI	Stringency Index	Stringency index determined based on 9 indicators
DPD	The Number of Deaths Per Day	The number of deaths due to COVID-19 (per day)
ASAO	The Rate of People With Age 65 And Over	The rate of people with age 65 and over in the population
PD	Population Density	The number of people per square kilometer
GDP per Capita	Gross domestic product per capita	Gross domestic product per capita with 2011 fixed prices [according to purchasing power parity (PPP)]

Source: https://ourworldindata.org

In the study of Powel (2016), it was stated that the QRPD approach gives consistent estimates even if the T time dimension is small, and that T should be at least 2 in annual data. In this study, it was studied with daily data. The duration of the pandemic period and policy restrictions covered in the study is approximately 1.5-2 years for all countries. In the study, by using the data for the period from March 11, 2020 to June 29, 2021, the factors affecting the stringency index during the pandemic period were tried to be revealed.

In this section, the factors affecting the stringency index will be assessed for nine countries (the United Kingdom, Italy, France, Germany, Türkiye, Russia, Brazil, the United States of America, India) through the daily data for the period between March 11, 2020 and June 29, 2021 when the restrictions were effectively applied to fight against COVID-19 disease. Spain and China were excluded from this analysis due to lack of observations in the data structure.

The QRPD approach was preferred in this study to determine the distribution of the dependent variable and the heterogeneous effects of explanatory variables on the dependent variable. The possibility of making the estimation with instrumental variables in the study and the short time dimension on an annual basis also supported our purpose of choosing the QRPD method. In this study, non-additive fixed effect panel quantile regression model with the instrumental variable that can reflect the situations in various quantiles (10th, 25th, 50th, 75th, and 90th) will be used and the results will be interpreted.

5. EMPIRICAL RESULTS

In terms of revealing the distribution characteristics of the variables, descriptive statistics are given in the table below.

Table 2. Descriptive Statistics

	Mean	Median	Max.	Min.	Std. Deviation	Skewness	Kurtosis	Jarque-Bera Test (Prob.)
SI	67.31668	68.98	100	11.11	13.43083	-0.41202	3.130556	123.0921* (0.000)
DPD	510.6946	266	7374	0	726.1258	2.838865	12.96375	23162.7* (0.000)
ASAO	14.99933	15.413	23.021	5.989	5.880113	-0.21176	1.584549	389.6435* (0.000)
PD	162.5728	122.578	450.419	8.823	135.843	0.760339	2.689086	430.0292* (0.000)
GDP per Capita	31495.46	35220.08	54225.45	6426.674	14356.81	-0.2355	2.09333	186.3328* (0.000)

Note: * indicates the rejection of the null hypothesis that the distribution is normal according to 5%.

When looking at the table, the variables were found to be not distributed normally according to the Jarque-Bera test. The null hypothesis which states there is normal distribution at the 5% level is rejected. When the values in the table are interpreted, Stringency Index (SI) is found 67.32 on average. This value was found to be 11.11 at the lowest and 100 at the highest.

The average number of deaths per day was determined to be 510.69. This value varies from 0 to 7374. And the standard deviation is determined to be 726. The rate of people with age 65 and over was found to be 5.989 at the lowest and 23.021 at the highest, and the average value was determined to be 14.99933. According to the population density, the number of people per square kilometer was found to be 162.5728 and this value varied from 8.823 to 450.419. The average income per capita was determined to be 31495.46 and this value was seen as 6426.674 at the lowest and 54225.45 at the highest.

Quantile regression estimators can be used in situations where the distribution is not normal and there are extreme values. These estimators are less responsive to extreme values then least squares estimators. The quantile distributions of the Stringency Index of the countries are given in the Figure below. Due to the fact that there was not a normal distribution and because of the existence of extreme values as a result of the analyses of both descriptive statistics and quantile distributions, non-additive fixed effect panel quantile regression method with the instrumental variable was preferred for this study.

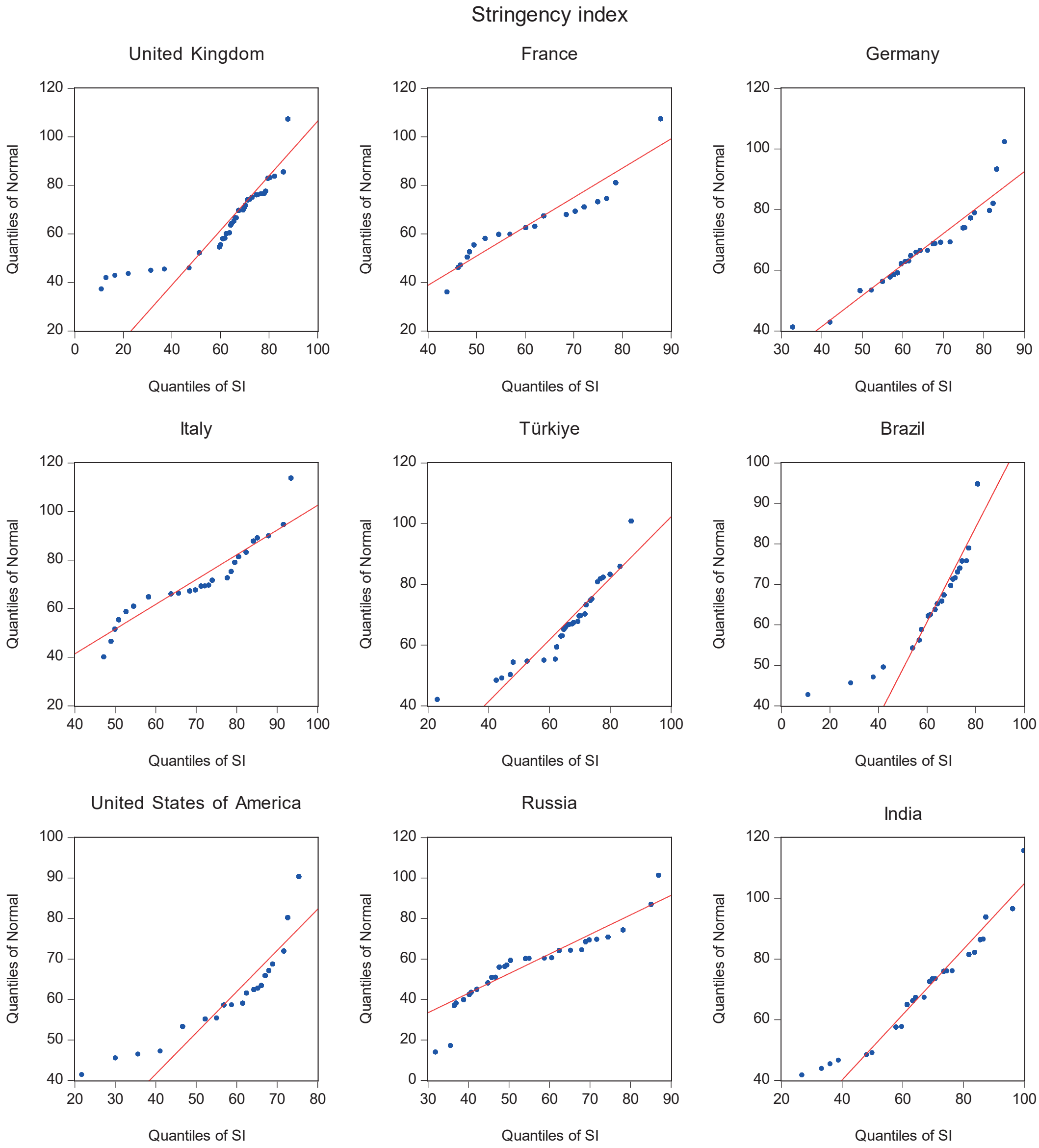

Figure 1. The Stringency Index Quantile Distribution of Countries

The estimated results in case of the application of the stringency index with 10th, 25th, 50th, 75th, and 90th quantile values (too low, low, moderate, high, and too high) in terms of revealing factors affecting the Stringency Index of the countries included in this study are presented in the table below. In the estimation stage of the panel quantile model, non-additive fixed effect panel quantile regression model with the instrumental variable, introduced by Powel (2016) to the literature, was applied. In this model estimation, Markov Chain Monte Carlo (MCMC) method was used, and the iteration number was taken as 10.000.

The existence of an endogeneity problem was analyze with Davidson-MacKinnon test and Davidson-MacKinnon test statistics was estimated to be 3.565385 (Prob=0.0591). As a result of the analysis, the null hypothesis claiming that the internality problem caused by the variables is not statistically significant was rejected at a 10% level. Therefore, models will be estimated by using instrumental variables. The factors affecting the stringency index were estimated through non-additive fixed effect panel quantile regression model with the instrumental variable for different quantiles (10th, 25th, 50th, 75th, and 90th) and the results are given in the table below:

Table 3. Results of the Panel Quantile Regression Model

Q. Quantile	SI	Coefficient	Standard Error	Z Test Statistics	Prob.
Q10	DPD	0.0049174	0.0000262	187.81*	0.000
	ASAO	-0.4223595	0.0035274	-119.74*	0.000
	PD	0.0475384	0.0001004	473.72*	0.000
	GDP per Capita	0.0003285	1.33e-06	247.61*	0.000
Q25	DPD	0.0029221	0.0000213	137.13*	0.000
	ASAO	-0.9565494	0.0064374	-148.59*	0.000
	PD	0.0441378	0.000101	436.97*	0.000
	GDP per Capita	0.0003885	1.92e-06	202.36*	0.000
Q50	DPD	0.0034836	1.30e-06	2685.82*	0.000
	ASAO	0.208152	0.0006141	338.98*	0.000
	PD	0.0294143	9.62e-06	3058.39*	0.000
	GDP per Capita	0.0000109	1.29e-07	84.66*	0.000
Q75	DPD	0.0022149	2.91e-06	761.35*	0.000
	ASAO	0.3940768	0.0001592	2475.93*	0.000
	PD	0.0278776	0.0000403	691.33*	0.000
	GDP per Capita	-0.0001936	1.62e-07	-1192.44*	0.000
Q90	DPD	0.0011216	3.46e-06	323.87*	0.000
	ASAO	0.6766029	0.0004752	1423.94*	0.000
	PD	0.0156704	0.0000177	883.35*	0.000
	GDP per Capita	-0.0003441	1.99e-07	-1726.32*	0.000

Note: a) * represents the statistical significance at the 1% level. b) Instrumental Variables: Number of new cases per day, Number of tests per day, Rate of positive tests, Population. c) The result of Davidson-MacKinnon Test Statistics: 3.565385 Prob. = 0.0591

The 10th quantile refers to the situations where governments applied less restrictions while the 90th quantile refers to the situation with strict restrictions. The 50th quantile indicates that restrictions were moderate.

When the estimation results of the model are examined, it is seen that the increase in the number of deaths increases the stringency index value at all quantile levels. Each increase in the number of deaths per day causes a unital increase of 0.0049174 in the 10th quantile; 0.0029221 in the 25th quantile; 0.0034836 in the 50th quantile; 0.0022149 in the 75th quantile; and 0.0011216 in the 90th quantile. As a high measure policy is applied in environments where higher restrictions are applied, the increase in the number of deaths had less impact on the stringency index than where low restrictions were applied. However, the increase in the number of deaths per day in low quantiles had more increasing impact on less stringency measures.

The population density variable showed a similar effect as the number of deaths per day variable. A one-unit increase in population density has less increasing effect on the stringency index as the quantiles rise (as more restrictions are applied) than in the less restrictive situations (compared to the lower quantiles). As a high stringency policy is applied in higher quantiles, the change in the population density has a less effect compared to the lower quantiles.

It is known that the measures applied on people with age 65 and over as per the stringency policies applied by countries with regard to COVID-19 measures had an impact on the restrictions. In this context, when the impact of the rate of people with age 65 and over variable is examined, a one-unit increase in the rate of people with age 65 and over at medium, high, and too high quantiles shows an increasing effect on the stringency index value. In other words, as the rate of people with age 65 and over increases, the stringency measures also increase. In situations where low restrictions are applied, the rate of people with age 65 and over is found to have a negative effect on stringency index.

When the effect of gross domestic product per capita on the stringency measures is analyzed, a one-unit increase in the GDP per capita variable has an increasing impact on the stringency index in situations where too low, low, and moderate stringency policies are applied. In situations where low-level stringency measures are applied, the increase in income increases the stringency index while a decrease in income decreases this index value. In situations where high and very high stringency policies are practiced, a one-unit increase in the GDP per capita variable affects the stringency measures negatively. As the value of GDP per capita increases, it can be said that stringency applications decrease (at 75th and 90th quantiles).

6. CONCLUSION

During Coronavirus (COVID-19) pandemic, governments have responded with several implementations and restrictions in order to manage the risk posed to the public health. Public authorities tried to control the spread of the disease by ensuring social isolation and maintain physical distance. In the fight against the epidemic, in addition to the basic principles of hygiene, mask and distancing, certain rules were determined to apply to all areas of daily life and measures were implemented.

In order to explain the stringency levels and the restriction policies implemented by countries during this unexpected pandemic, the stringency index, which was developed by a group of researchers in Oxford University was utilized. This index is created by taking into consideration whether or not the governments implemented nine different precautions that have the characteristics of limitation and closure.

This study examines factors that affect the stringency index, which is an indicator of the precaution policies implemented by countries and their extent during the fight against the COVID-19 pandemic through non-additive fixed affect panel quantile regression method with the instrumental variable. In this study, the daily data is used between March 11, 2020 and June 29, 2021.

There are various studies in the literature examining the factors that affect stringency index and the measures taken by countries during COVID-19 pandemic. In line with literature, in this study it was determined that the number of deaths per day, the population density, the rate of people with age 65 and over and gross domestic product per capita as the effective variables on policies implemented by countries.

According to the obtained results, it was found that the increase in the number of deaths per day raised the stringency index scores in all quantile levels during the pandemic — although the level of effects varied, in other words in all countries that implemented few or harsh restrictions. In this context, it seems that the number of deaths per day is one of the main indicators for the countries while putting measures and restrictions into practice during the pandemic.

In the study it has been seen that, the population density variable showed a similar effect as the daily number of deaths variable. The increase in population density is less effective on stringency index in high quantiles as harsh stringency policies are already applied. On the other hand, in the countries that take few stringency precautions, the increase in population density is more effective on stringency index.

Within the study when the effect of gross domestic product per capita on stringency measures is examined, it is revealed that as gross domestic product per capita increases, high and very high stringency applications decrease. It has been shown that the impact of economic factors on the stringency policies applied by the countries during the COVID-19 pandemic.

In the meantime, it is observed in this study that as the rate of people with age 65 and over increased stringency measures also went up in countries where mean and high restrictions were implemented. Therefore, due to the higher risk of diseases and the high number of deaths in this age group, while stringency measures are applied in societies where the population over 65 is more concentrated, the protection of this age group against pandemic diseases should be a priority.

This study is thought to contribute to the literature since the method used enables to obtain the stringency index results for different quantiles rather than results of a single model. Thus, the model results give detailed information about the stringency index in the study. In addition to this, it refers to the revelation that measures regarding only public health is not enough to fight against the pandemics, there is also a need for multidimensional policies that are demographical, sociological and economical.

The coronavirus pandemic has brought social and economic risks in addition to the public health crisis. This crisis has been assessed in three different scales as on individuals, countries, and the whole world, and it has revealed the need for developing fiscal policies and insurance measures to mitigate the financial effects of unexpected similar incidents and risks. As a result, it can be said that applying multidimensional policies and measures to deal with unexpected crises serves to mitigate the potential risks and to ensure that the countries overcome the process with less damage.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere

Endnotes

1 https://covid19.saglik.gov.tr/TR-66493/p.html

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