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A multidimensional scale for evaluating food inflation's impact on nutritional behavior

Sevinç Eşer Durmaz[1*], Alev Keser[2] and Cansu Ergenç[3]

Abstract

Background Food inflation is considered an important factor that affects communities overall and individuals. Evaluating the impact of food inflation on nutrition behavior, particularly among low-income and disadvantaged groups, is crucial for assessing consequences and implementing effective solutions. This research was conducted to develop a scale of the effect of food inflation on nutrition behavior.

Methods This research was conducted with adults ($n = 275$) aged 19–64 years who voluntarily agreed to participate in the study and shop for food. The items were evaluated for content validity in accordance with the Lawshe method. The scale items were determined via exploratory factor analysis, confirmatory factor analysis and an internal consistency coefficient. Descriptive statistics, exploratory factor analysis, reliability analysis, and correlation analysis were performed in SPSS 26.0; confirmatory factor analysis and structural equation modeling were performed in IBM AMOS 24.0. The statistical significance level was accepted as $p < 0.05$.

Results The resulting scale consists of a total of 36 items, and as a result of the analysis, it is divided into four different subdimensions (food consumption, food insecurity, panic buying, budget). The Kaiser–Meyer–Olkin (KMO) value of the scale was determined to be 0.960. $p < 0{,}001$ according to Bartlett's sphericity test. According to the explained variance results of the scale, the 4 dimensions of the scale explained 69.8% of the total variance. The factor loadings of the scale vary between 0,407 and 0,917. According to the confirmatory factor analysis results of the scale, the good fit values of the single-factor model consisting of 36 items are $\chi 2 = 2083.903$, $df = 458$, $\chi 2/df = 4{,}55$, $TLI = 0{,}81$, $CFI = 0{,}82$, and $IFI = 0{,}82$, which was obtained as $SRMR = 0{,}06$. The item factor loadings were greater than 0.30 and had values between 0.349 and 0.965. The item t values ranged between 4,599 and 16,791 ($p < 0{,}001$; $t > 1{,}96$).

Conclusion A valid and reliable measurement tool that determines the effect of food inflation on nutritional behavior was developed. Food inflation is considered an important factor that affects the community overall and individuals.

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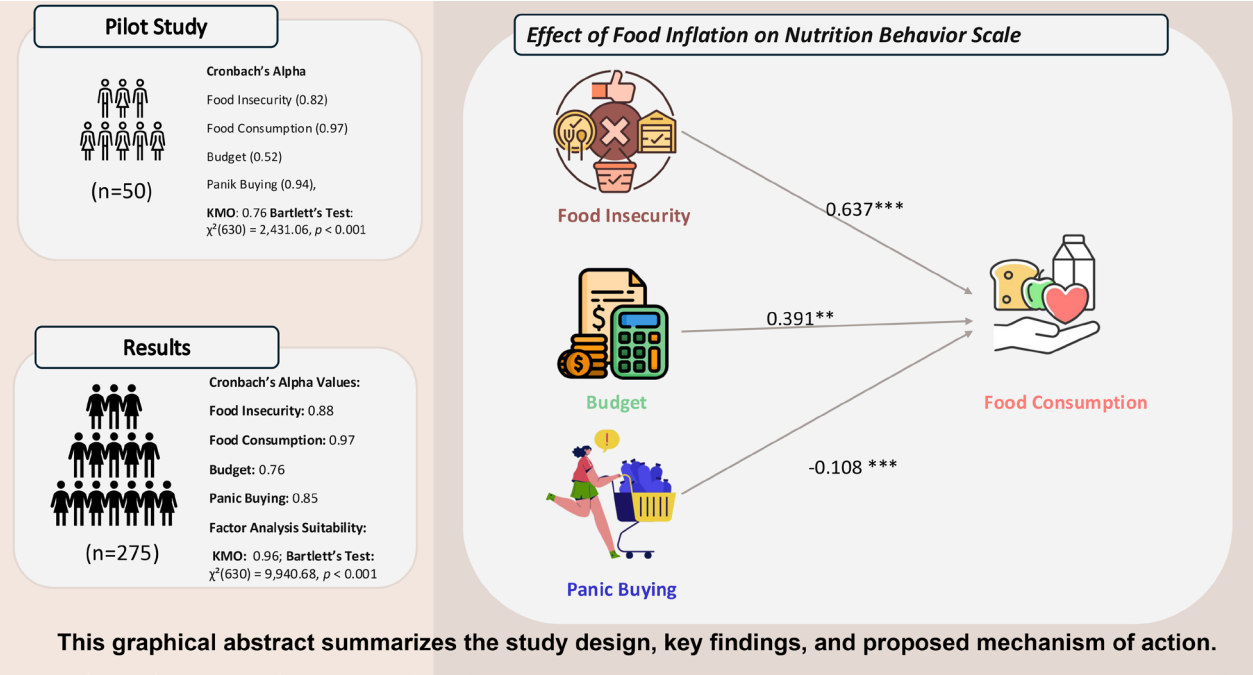
Graphical Abstract



Keywords Food inflation, Scale development, Nutrition behavior, Panic buying, Food insecurity

Introduction

Food inflation, one of the most important issues in the world, has occurred because of increases in agricultural products and food prices. "Inflation" refers to the rise in the overall price level in the economy over the course of a year. Food inflation refers to the rise in the producer pricing index (PPI) for essential food items in comparison to the overall PPI or the consumer price index (CPI) for food goods in comparison to the overall CPI [1]. Increasing food prices are a problem that affects all individuals in society. However, nutrition is a basic requirement for all individuals, and food products rank first in the hierarchy of human needs [2]. Food products play an important role in the consumption expenditures of low-income households. According to the results of the Türkiye Statistical Institute household budget survey for 2022, when the distribution of consumption expenditures of households in the lowest 20% income group in Türkiye is analyzed, the ratio of food expenditures is determined to be 35.8% [3]. Rising food prices play an important role in the management of inflation, as they affect the income and welfare levels of households and are considered determinants of inflation. In this context, food inflation is seen as both a social and economic problem [4]. According to reports, agricultural product prices have doubled in the last twenty years owing to pricing pressures caused by weather and climatic conditions, as well as worldwide supply and demand. In the same period, food and beverage producers endeavour to keep costs and prices low [5]. Rising food prices may affect mostly low-income households [6]. Food insecurity also increases with the contraction of family budgets due to inflation, especially between 2021 and 2022 [7]. Food and nutrition are fundamental components that are directly related to conditions of poverty and inequality in a society. In the second Sustainable Development Goals to be achieved by 2030, the United Nations considers "ending hunger, achieving food security, and improving nutrition for all people" [8]. The effects of increases in food prices on nutrition are becoming more noticeable every day. While several established instruments assess various dimensions of food insecurity and household coping strategies—particularly in response to economic hardship or price volatility—there remains a notable gap in the understanding of the psychological and cognitive factors that influence individual dietary behaviors [9, 10]. Existing tools, such as the Household Food Insecurity Access Scale (HFIAS), focus primarily on structural access to food, the frequency of food-related hardships, and reactive behaviors at the household level [9]. However, these instruments often overlook the internal behavior systems, motivational drivers, and behavioral intentions that shape everyday food choices, especially in populations experiencing nutritional transitions or economic uncertainty.

The Effect of Food Inflation on Nutrition Behavior (EFINUB) scale was developed to address this gap by offering a psychometrically sound tool that integrates nutrition behaviors, behavioral intentions, and health-oriented food decision-making. By focusing on individual-level cognitive and behavioral components, the EFINUB scale complements existing measures and provides additional explanatory power regarding how and why individuals make food-related decisions. This approach is particularly relevant in designing targeted public health interventions, where understanding personal motivations can significantly enhance the effectiveness of nutrition education and behavior change strategies.

It is essential that individuals consistently have access to a sufficient and dependable food supply to sustain a vibrant and well-functioning lifestyle. Given the increasing cost of food, it is crucial to examine how inflation affects nutrition, particularly in low- and middle-income nations, to address food insecurity in the 21st century. In this study, the aim was to develop a scale of the effect of food inflation on nutrition behavior and conduct validity and reliability analyses.

Methods

Sample of the study

The scope of the study, a questionnaire form including sociodemographic characteristics (age, gender, educational status, marital status, socioeconomic status, etc.), and the scale of the effect of food inflation on nutrition behavior were administered face-to-face by the researcher to the participants between June and September 2023. The study was conducted at the faculties and colleges of Ankara University with 275 adult individuals between the ages of 19 and 64 who voluntarily agreed to participate in the study and shop for food. Healthy adult individuals who could communicate well were included in the study. Individuals who did not voluntarily agree to participate in the study, had chronic diseases, did not shop for food, or were vegan or vegetarian were not included in the study. Informed consent, detailing the objectives and scope of the study, was obtained in writing from all participants prior to the administration of the survey instrument. Prior to administering the survey questions, the researchers inquired whether the participants were responsible for grocery shopping in their household, had any chronic health conditions, or followed a vegan/vegetarian diet. Participants were excluded from the study if they lacked voluntary consent, had chronic medical conditions, did not purchase household food, or followed a vegan or vegetarian dietary pattern.

Scale development process

Initially, researchers comprehensively examined the literature on food inflation and its impact on nutrition. A collection of 35 items was subsequently developed by the researchers to form the scale. During the literature review, articles were examined through the Google Scholar, PubMed, Science Direct, EBSCO, and Proquest databases via keywords such as inflation, nutrition behavior, food insecurity, food inflation, panic buying, and food consumption. The literature search was conducted for articles published between January 2010 and December 2022 to ensure the inclusion of both foundational and recent studies on the topic. After January 2023, the candidate scale form was delivered to an expert group with at least 5 years of experience in the fields of nutrition and dietetics within the scope of the Delphi technique, and the opinions and suggestions of 10 experts on the items were evaluated in accordance with the Lawshe method [11, 12]. At the end of the first round of expert opinions, the items related to food consumption were added by the researchers with expert contributions, and a draft of 43 items was created. As a result of the statistical analysis of content validity (CVR > 0.62), two items were removed, and a 41-item candidate scale was obtained. As a result of the analysis of the pilot study data, 5 items were removed from the scale, and the study was conducted with a 36-item scale.

The Delphi technique was completed in the second round by reaching a consensus on the expert opinion. Once the expert perceives on the scale that the items are finished, they receive evaluation by a language expert to assess their comprehension, spelling, punctuation, and other aspects. After this evaluation, the scale items were finalized. A flow chart of the research is shown in Fig. 1. At least 5–7 expert opinions will be sufficient for scale development studies in health sciences; however, applying the scale to at least 5 times the number of items, or 200–300 individuals, is considered sufficient in terms of validity and reliability [13, 14]. In the scope of the research, 10 expert opinions were evaluated, and more than 5 times more individuals (275 people) were reached than the final number of scale items (36 items). The scale is evaluated on a five-point Likert scale. The evaluation is made by giving 5 points for "always," 4 points for "often," 3 points for "sometimes," 2 points for "rarely," and 1 point for "never." After the scale was created, it was first applied to 50 individuals in a pilot study, and the results were evaluated.

Content validity

Content validity is a quantitative process used to assess whether expert judgments appropriately represent the meaning of a measurement instrument or item. The Lawshe method uses a measurement tool called the content

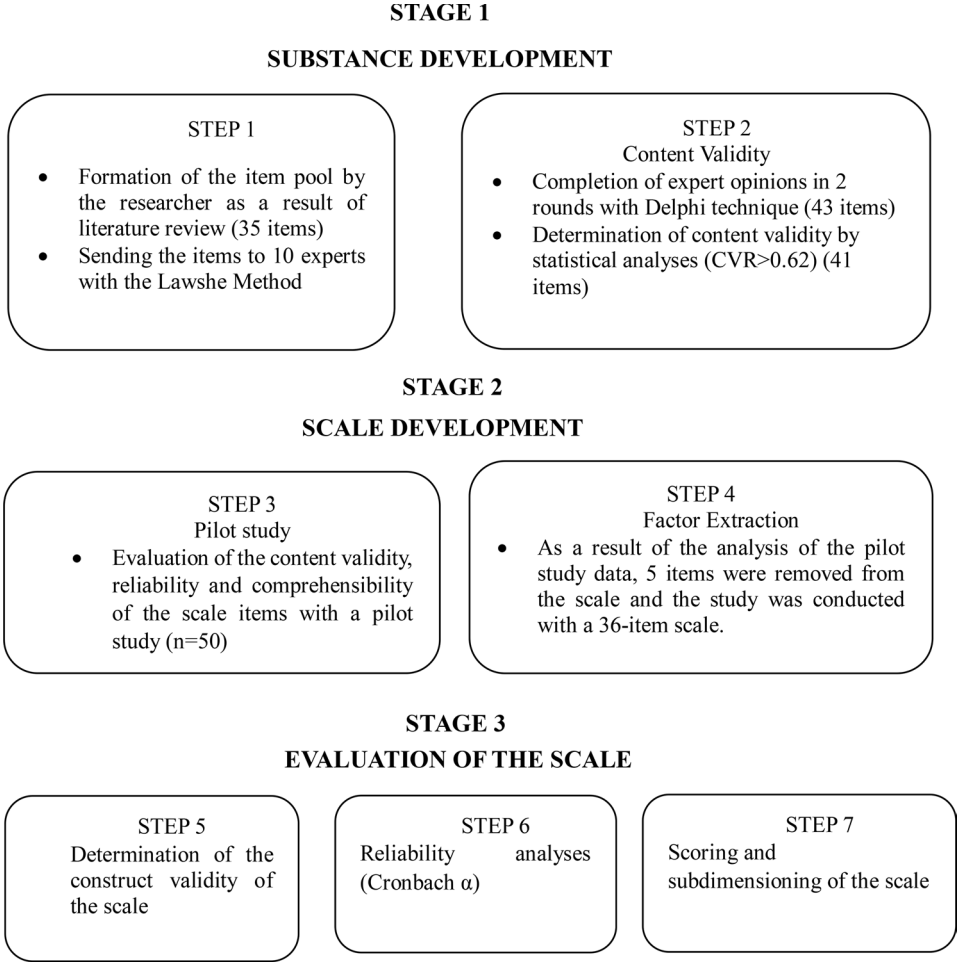


Fig. 1 Flow chart of the research

validity ratio (CVR) to make this assessment. CVR was calculated for each item via the formula CVR = (Ne–N/2)/(N/2), where Ne is the number of experts rating the item as essential and N is the total number of experts. CVR expresses a ratio that reflects the consistency of experts' opinions on an item. For the assessment of content validity, the Lawshe method suggests that the number of experts should be at least 5 and at most 40. Since the number of experts in the study is 10, a CVR value of 0.62 and above can be accepted [15].

Construct validity

Initially, exploratory factor analysis (EFA) was used to assess the structure of the scale. The analysis was used to ascertain the fundamental factor structure of the scale. Confirmatory factor analysis (CFA) was subsequently used to validate the acquired component structure. The two analytical approaches mentioned are the primary techniques used to ascertain the construct validity of the scale.

Reliability analyses

The use of the Cronbach's α coefficient developed by Cronbach to determine the reliability of the scale is recommended. This coefficient is an indicator of the internal consistency of the scale statements [16]. The high Cronbach's α coefficient of the scale reflects the consistency level of the scale statements. Cronbach's alpha coefficient; $0{,}00 \leq \alpha < 0{,}40$ means "the scale is not reliable", $0{,}40 \leq \alpha < 0{,}60$ means "the scale is at a low level of reliability", $0{,}60 \leq \alpha < 0{,}80$ means "the scale is reliable", $0{,}80 \leq \alpha < 1{,}00$ means "the scale is highly reliable".

Statistical analyses

Statistical analyses of the data were performed via SPSS 26.0 and IBM AMOS 24.0 software. Descriptive statistics, exploratory factor analysis, reliability analysis, and correlation analysis were performed in SPSS 26.0; confirmatory factor analysis and structural equation modeling were performed in IBM AMOS 24.0. The statistical significance level was accepted as $p < 0.05$. In this study, the subdimensions of the EFINUB were also examined via structural equation modeling. The theoretical framework

of the model is shown in Fig. 2. The conceptual model is based on prior literature demonstrating that food insecurity, panic buying, and budget constraints are important determinants of food consumption behavior, especially during periods of economic uncertainty and food inflation [17, 18]. Various goodness-of-fit measures were examined to evaluate the fit of the model to the data. Each criterion assesses different aspects of the model's fit to the data.

Results

The study was conducted with 275 academic and administrative personnel from the faculties and colleges of Ankara University to develop a scale of the effect of food inflation on nutrition behavior and to determine its validity and reliability. A total of 61.1% of the individuals included in the study were female, 38.9% were male, and the average age of the participants was 33.7 ± 8.87 years. Among the participants, 60.0% ($n = 165$) were married, and 40.0% ($n = 110$) were single. In terms of socioeconomic status, 31.3% of the participants stated that their income was lower than their expenses, 39.6% that their income was equal to their expenses, and 29.1% that their income was higher than their expenses (χ^2=4.439, $p = 0.109$) (see Supplementary Table S1).

Content validity

After the expert opinion, the CVR values of the scale items prepared within the scope of the research were determined, and the items with a CVR value < 0.62 were removed from the scale. The other items were finalized in line with the suggestions, and a pilot study was conducted.

Pilot study

The dimensions were determined by conducting a pilot study on the effects of food inflation on nutritional behavior. Pilot study data for the research were obtained from 50 individuals. In the analyses conducted as a result of the pilot study, the internal consistency coefficients (Cronbach's alpha) of the dimensions were determined to be 0.82 for the food insecurity dimension, 0.97 for the food consumption dimension, 0.52 for the budget dimension, 0.94 for the panic buying dimension and 0.958 for the whole scale. Bartlett's test of sphericity, $\chi 2\ (820) = 2.758.86\ p < 0{,}001$, is significant. This shows the suitability of the data for factor analysis. The KMO sampling adequacy value was determined to be 0.66. The principal component analysis method was applied for explanatory factor analysis, and varimax rotation was used on the draft of the Effect of Food Inflation on Nutrition Behavior Scale. This scale consists of 41 items in total and was divided into 4 different subdimensions as a result of the first analysis. To protect the integrity of the structure, it was decided that some items should be removed. After the removal of these items, factor analysis was applied again, and the structure of the scale was harmonized with 36 items and 4 dimensions. After the items were removed as a result of the pilot study, the KMO value of the Effect of Food Inflation on Nutrition Behavior Scale was calculated as 0.76. According to Bartlett's test of sphericity $\chi 2\ (630) = 2.431.06\ p < 0{,}001$, these results show that the sample size is sufficient and that the data are suitable for factor analysis. Therefore, the sample used for factor analysis is reliable and valid.

Item analyses

For the explanatory factor analysis, the principal component analysis method was applied, and varimax rotation was used. This scale consists of 36 items in total and was

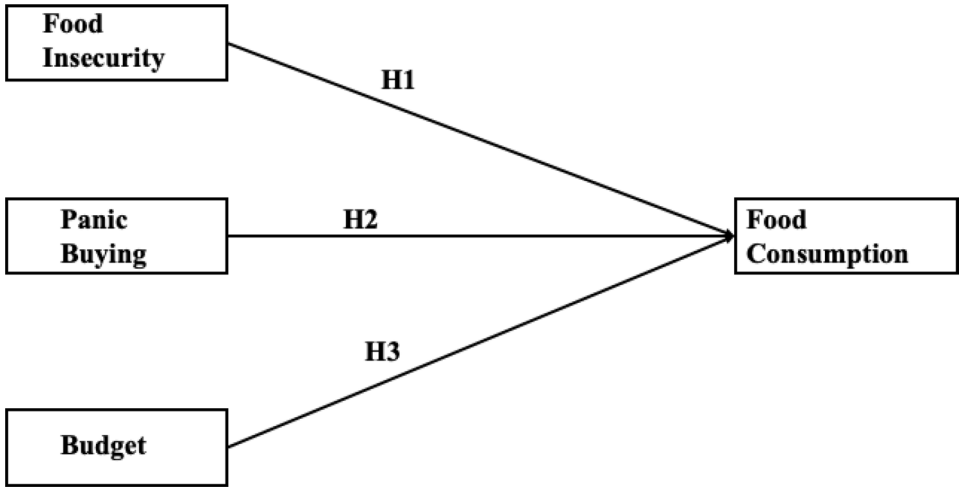


Fig. 2 Theoretical framework of the model

Table 1 Factor analysis of the scale of the effect of food inflation on nutrition behavior

Factor	Results without Rotation			Results with Varimax Rotation		
	Eigenvalue	Explained Variance%	Cumulative %	Eigenvalue	Explained Variance %	Cumulative %
Factor 1	18,9	52,7	52,7	10,8	30,2	30,2
Factor 2	3,1	8,7	61,5	8,1	22,5	52,7
Factor 3	1,8	5,2	66,7	3,5	9,7	62,5
Factor 4	1,1	3,1	69,8	2,6	7,3	69,8

Factor 1: Food consumption, Factor 2: Food Insecurity, Factor 3: Panic buying, Factor 4: Budget

Table 2 Factor matrix of the scale of the effect of food inflation on nutrition behavior

Items	Dimensions			
	1	2	3	4
FC1	0,671			
FC2	0,407			
FC3	0,536			
FC4	0,620			
FC5	0,747			
FC6	0,825			
FC7	0,765			
FC8	0,823			
FC9	0,478			
FC10	0,646			
FC11	0,536			
FC12	0,879			
FC13	0,862			
FC14	0,868			
FC15	0,695			
FC16	0,586			
FC17	0,530			
FC18	0,688			
FC19	0,691			
FC20	0,500			
FC21	0,683			
FC22	0,438			
FI1		0,603		
FI2		0,669		
FI3		0,801		
FI4		0,736		
FI5		0,619		
PB1			0,551	
PB2			0,630	
PB3			0,889	
PB4			0,813	
PB5			0,863	
PB6			0,917	
BUDGET1				0,560
BUDGET2				0,656
BUDGET3				0,525

1: Food consumption dimension, 2: Food insecurity dimension, 3: Panic buying dimension, 4: Budget dimension

divided into 4 different subdimensions as a result of the analysis. The KMO value of the effect of food inflation on the nutritional behavior scale was found to be 0.960. Since $p < 0.001$ according to the Bartlett sphericity test, these results show that the sample size is sufficient and that the data are suitable for factor analysis. Therefore, the sample used for factor analysis is reliable and valid.

After the validity of the data is examined, the eigenvalue statistics and explained variance results of these dimensions are shown in Table 1. When the results of the analyses were examined, four different dimensions with eigenvalues greater than one unit were determined. The first dimension explains 30.2% of the total variance. The first and second dimensions together represent 52.7% of the total variance. The other four dimensions together explain 69.8% of the total variance.

The factor matrix for the scale of the effect of food inflation on nutrition behavior is given in Table 2. The factor loads of the food consumption dimension are 0.407–0.879, those of the food insecurity dimension are 0.603–0.801, those of the panic buying dimension are 0.551–0.917, and those of the budget dimension are 0.525–0.656.

The number of factors can be checked by examining the scree plot graph in Fig. 3. According to the scree plot graph, the remaining components of the four-dimensional scale explain much more of the variance.

The confirmatory factor analysis results revealed that the goodness-of-fit values of the single-factor scale obtained with 36 items were $\chi 2 = 2083.903$ df = 458, $\chi 2/df = 4,55$, TLI = 0,81, CFI = 0,82, IFI = 0,82, SRMR = 0,06. While the SRMR value is within the acceptable range (≤ 0.08), the TLI, CFI, and IFI values fall slightly below the recommended cutoff point of 0.90 (Hu & Bentler, 1999). Despite this, all factor loadings in the model are above the 0.30 threshold (0.349–0.965) and are statistically significant (t values ranged from 4.599 to 16.791 ($p < 0.001$)), which shows the significant contributions of each item to the latent structure. In addition, the sample size ($n = 275$) exceeds the minimum size recommended for CFA, thus providing sufficient statistical power despite the χ^2/df ratio exceeding the ideal value of 3. Considering the theoretical integrity of the scale, in other words, when the theoretical background, factor loadings and SRMR values are evaluated, the model is considered acceptable for further analysis. The confirmatory factor analysis factor loadings are presented in Table 3.

Reliability analyses for the food consumption dimension yielded a corrected item–total correlation. Table 4

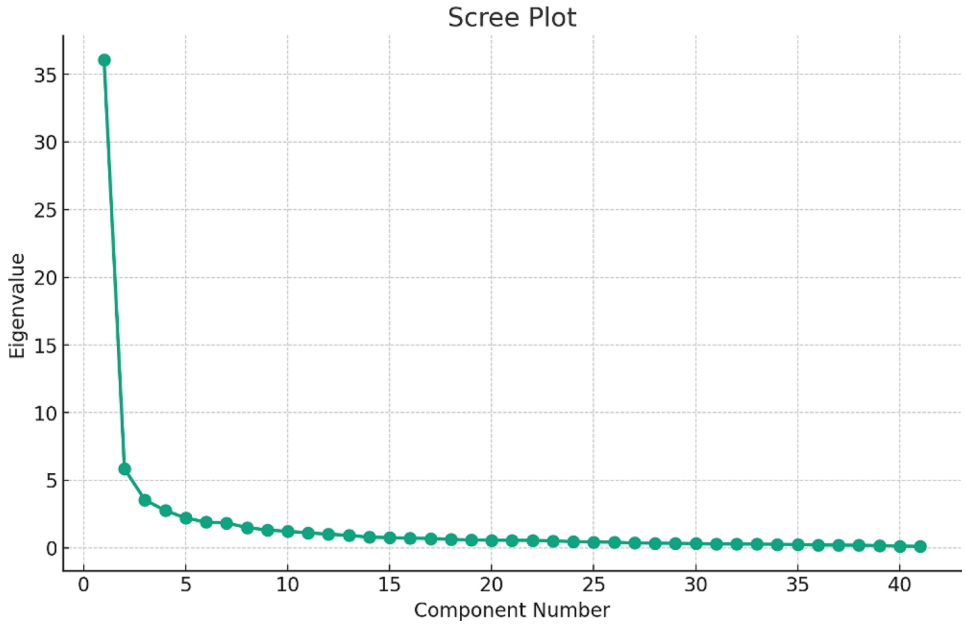


Fig. 3 Scree plot of the number of factors

shows that all the corrected item–total correlations are between 0.526 and 0.877. The internal consistency reliability coefficient (Cronbach's alpha) of the 22 items was 0.975. As a result of the reliability analysis for the panic buying dimension, the corrected item total correlations are between 0.452 and 0.775. The internal consistency reliability coefficient (Cronbach's alpha) of the total 6 items was determined to be 0.858. The reliability analysis for the food insecurity dimension revealed that all the corrected item–total correlations were between 0.602 and 0.804. The internal consistency reliability coefficient (Cronbach's alpha) of the total 5 items was found to be 0.881. As a result of the reliability analysis for the budget dimension, all the corrected item–total correlations are between 0.523 and 0.624. The internal consistency reliability coefficient (Cronbach's alpha) of the total 3 items was determined to be 0.765. The scale items for which validity and reliability were tested are included in the Additional file. (see Supplementary Table S2)

The results of the Pearson correlation analysis are shown in Table 5 to determine the relationships between food consumption, food insecurity, panic buying and budget size and the direction of these relationships. The food consumption dimension has a positive high level, with food insecurity ($r = 0.771$, $p < 0.01$), panic buying ($r = 0.463$, $p < 0.01$) and the budget dimension ($r = 0.698$, $p < 0.01$) seemingly having a moderately significant positive relationship. Food insecurity was found to have a moderately positive relationship with the panic buying dimension ($r = 0.539$, $p < 0.01$) and budget dimension ($r = 0.539$, $p < 0.01$). Panic buying has a moderately significant positive relationship with budget size ($r = 0.431$, $p < 0.01$) (Table 5).

The determinants of the effect of food inflation on nutritional behavior via structural equation modeling are shown in Fig. 4.

H1: Food insecurity dimension → food consumption dimension: This hypothesis suggests that the food insecurity dimension has a positive effect on the food consumption dimension. The β coefficient was determined to be 0.637. This value expresses a very strong effect size. The CR value is statistically significant at 6,538 and $p < 0{,}000$. These values strongly support the hypothesis (Fig. 4).

H2: Panic buying dimension → Food consumption dimension: In terms of the relationship between the panic buying dimension and food consumption, the β coefficient was found to be -0.108. The CR value was – 2.418, and the p value was 0.016 (Fig. 4).

H3: Budget dimension → Food consumption dimension: In the relationship between the budget dimension and food consumption, the β coefficient of 0.391 indicates that the budget dimension has a moderate positive effect on food consumption. The CR value is statistically significant at 3,990 and $p < 0{,}000$. These values indicate that the hypothesis is strongly supported and that budget size has a significant and positive effect on food consumption (Fig. 4).

Discussion

The increasing rate of food inflation, which started in the 2000s and reached its peak during the 2019 COVID-19 pandemic, has multifarious implications for individuals

Table 3 Confirmatory factor analysis, factor loadings of the scale of the effect of food inflation on nutrition behavior

Items	Standardized Regression Coefficients	t	SE	*p*
FC1	0,753	-	-	*
FC2	0,740	12,990	0,078	***
FC3	0,792	14,055	0,082	***
FC4	0,842	15,127	0,088	***
FC5	0,857	15,449	0,085	***
FC6	0,904	16,484	0,085	***
FC7	0,892	16,227	0,084	***
FC8	0,895	16,293	0,085	***
FC9	0,807	14,388	0,089	***
FC10	0,859	15,493	0,080	***
FC11	0,792	14,065	0,090	***
FC12	0,827	14,805	0,081	***
FC13	0,816	14,577	0,078	***
FC14	0,861	15,546	0,076	***
FC15	0,794	14,104	0,090	***
FC16	0,827	14,807	0,086	***
FC17	0,781	13,838	0,091	***
FC18	0,740	13,002	0,090	***
FC19	0,780	13,810	0,088	***
FC20	0,788	13,985	0,097	***
FC21	0,767	13,554	0,091	***
FC22	0,524	8,882	0,120	***
FI1	0,803	-	-	*
FI2	0,883	16,791	0,061	***
FI3	0,827	15,421	0,065	***
FI4	0,616	10,627	0,058	***
FI5	0,741	13,344	0,070	***
PB1	0,381	-	-	*
PB2	0,376	4,599	0,217	***
PB3	0,860	6,359	0,371	***
PB4	0,796	6,250	0,347	***
PB5	0,881	6,390	0,386	***
PB6	0,891	6,405	0,401	***
BUDGET1	0,614	-	-	
BUDGET2	0,831	10,011	0,127	***
BUDGET3	0,737	9,397	0,122	***

*Constant value, ***$p < 0{,}001$, SE = Standard Error 1: Food consumption dimension, 2: Food insecurity dimension, 3: Panic buying dimension, 4: Budget dimension

as well as the community [19, 20]. The persistent rise in food costs diminishes the buying capacity of people, resulting in food insecurity and a surge in nutrition-related chronic ailments and health issues [21, 22]. The literature contains very little information on the impact

Table 4 Scale item analysis of the effect of food inflation on nutrition behavior

Items	Adjusted Item Total Correlation	Cronbach's alpha value when item removed	Cronbach's alpha value
FC1	0,735	0,973	0,975
FC2	0,737	0,973	
FC3	0,785	0,973	
FC4	0,834	0,973	
FC5	0,838	0,973	
FC6	0,877	0,972	
FC7	0,864	0,972	
FC8	0,869	0,972	
FC9	0,802	0,973	
FC10	0,847	0,973	
FC11	0,786	0,973	
FC12	0,805	0,973	
FC13	0,795	0,973	
FC14	0,840	0,973	
FC15	0,778	0,973	
FC16	0,830	0,973	
FC17	0,784	0,973	
FC18	0,736	0,973	
FC19	0,781	0,973	
FC20	0,794	0,973	
FC21	0,776	0,973	
FC22	0,526	0,976	
FI1	0,710	0,857	0,881
FI2	0,804	0,834	
FI3	0,796	0,835	
FI4	0,602	0,880	
FI5	0,674	0,866	
PB1	0,452	0,867	0,858
PB2	0,440	0,869	
PB3	0,754	0,814	
PB4	0,739	0,817	
PB5	0,775	0,809	
PB6	0,737	0,816	
Budget1	0,523	0,770	0,765
Budget2	0,650	0,626	
Budget3	0,624	0,654	
Scale Cronbach's alpha			0,974

FC: Food consumption, FI: Food insecurity, PB: Panic buying

Table 5 Correlation analysis of scale dimensions

	Mean	SD	Skewness	Kurtosis	Food Consumption	Food Insecurity	Panic Buying	Budget
Food Consumption	51,8	24,71	0,642	-0,590	-			
Food Insecurity	14,6	5,29	0,150	-0,711	0,771**	-		
Panic Buying	9,6	2,86	-0,058	-0,681	0,463**	0,539**	-	
Budget	6,3	3,25	0,993	0,222	0,698**	0,539**	0,431**	-

*Pearson correlation analysis was performed **$p < 0{,}01$

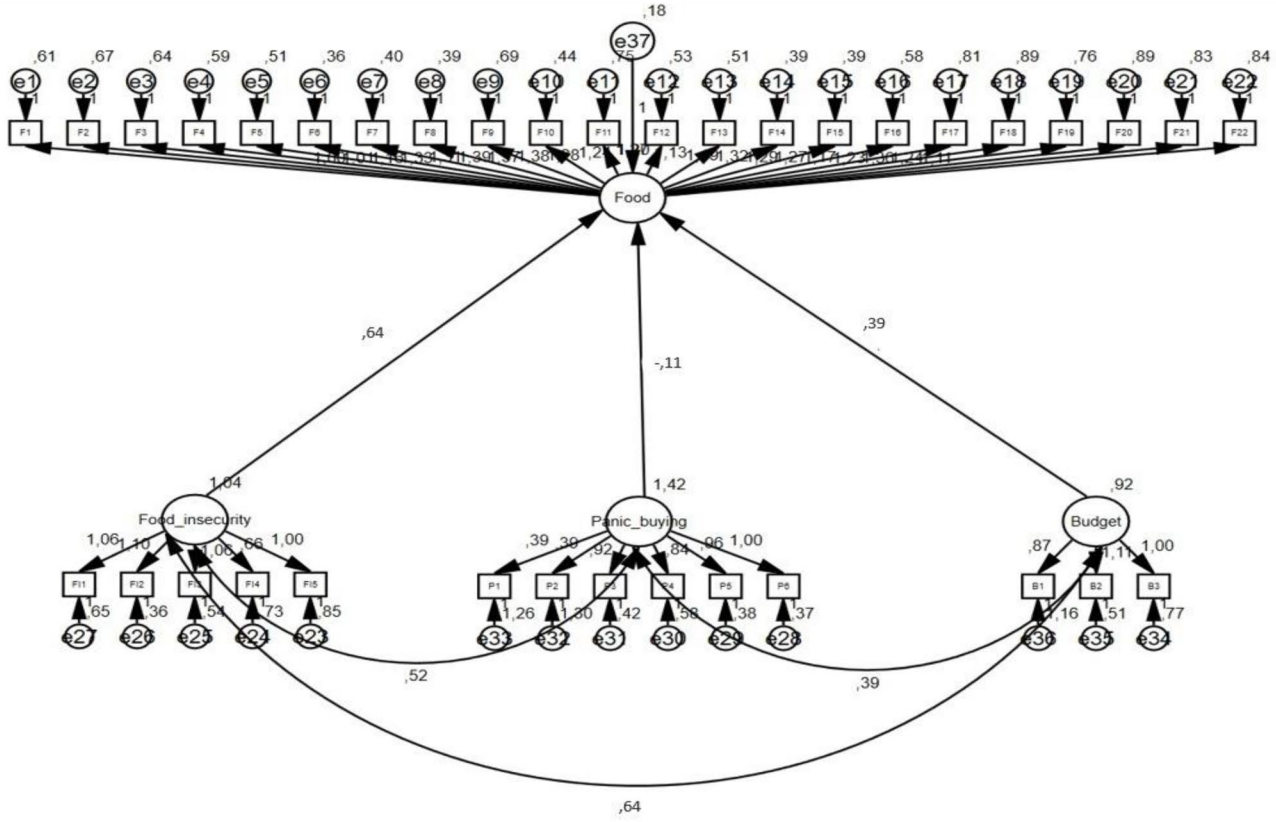


Fig. 4 Determinants of the effect of food inflation on nutrition behavior via structural equation modeling

of food inflation on nutrition behavior, and there is currently a lack of assessment methods for assessing the influence of food inflation on nutrition behavior [22–24]. The scale, designed to assess the effect of food inflation on nutrition behavior, is believed to have a global and local influence, particularly in Türkiye. It is expected to effectively enhance living conditions at both the individual and societal levels, improve health, and address nutritional issues faced by individuals.

A number of methods exist for determining the sample size in research related to scale development, validity, and reliability [13, 14]. It is essential to choose the appropriate approach for determining a sample on the basis of the purpose and structure of the scale, as well as the statistical analyses that will be used [25]. The optimal sample size for a pilot study in the field of scale development is typically 30 [26]. Following the development of the scale items as part of the research, a pilot study was conducted with 50 people, and the findings were assessed. A pilot study is an essential phase in the exploration of developing scales. Performing a pilot study enhances the likelihood of scale success [27]. Upon evaluating the findings of the pilot research, 36 items remained on the scale measuring the impact of food inflation on nutrition behavior. The goal was to increase the number of items to at least five times the initial amount, resulting in an acceptable number of 180 items (36*5 = 180) [14]. The study included 275 individuals, consisting of both academic and administrative staff members. This number was 7.6 times greater than the number of items, and all participants met the criteria for inclusion. An examination of the technique used in studies of scale development indicates that the sample size often exceeds the number of items by two, three, four, or five. It is generally advisable to have a minimum sample size of 100 [28]. The determination of the sample size in scale development studies might vary on the basis of the objective and structure of the scale. Furthermore, the studies also assess the sufficiency, suitability, and soundness of the sample size.

The COVID-19 epidemic and the Russia–Ukraine wars have caused a worldwide increase in food costs. However, in Türkiye, food inflation has been greater than the consumer price index since September 2020 [29]. It is crucial to examine the impact of food inflation resulting from the persistent rise in food costs. This study was conducted to assess the impact of food inflation on dietary habits. Scale development refers to the systematic process of creating a measure that is both valid and reliable for assessing a certain concept or variable in a research study [30]. The scale item pool, which was established

via a literature review, was offered to the experts for their judgment, in line with the scale's goal. Expert opinion provides crucial information when evaluating criteria such as the suitability of content, the level of comprehensibility, and the appropriateness for the intended purpose of each item. It is also valuable in identifying and rectifying any required corrections. Content validity refers to the sufficiency of the items used to measure the desired qualities in terms of both quantity and quality. According to reports, a range of 5–7 expert views is considered sufficient to establish the content validity of scale development studies [13]. In this study, the scale items prepared by the researcher were evaluated by 10 experts in the fields of nutrition and dietetics in accordance with the Delphi technique. The Delphi technique can be completed in at least 2 rounds if the experts reach a consensus on the content of the items, and this research is completed in 2 rounds as a result of the experts reaching a consensus [13]. After the expert opinion, the CVR values were calculated, and the items with CVR < 0.62 were removed from the scale because they were not suitable for the scale. During the scale development study, the items that were considered unsuitable were eliminated from the scale to guarantee content validity. This is determined by calculating the content validity ratio (CVR) on the basis of the judgments of experts and their replies [31, 32].

The KMO test is used to evaluate whether the developed scale is suitable for factor analysis, and Bartlett's test of sphericity is used to determine the significance level of the relationships between the variables to be analyzed [30]. In this study, the KMO value of the scale of the effect of food inflation on nutrition behavior was 0.960, which is considerably higher than the acceptable limit of 0.6. According to the Bartlett sphericity test, $p < 0.001$, the correlations of the variables were explained at a high level, the sample size was reliable and valid, and the data obtained were suitable for principal component analysis. In scale development studies, the KMO value should be greater than 0.6 [33], and the KMO value is appropriate in scale development studies [34, 35].

As a result of the analysis of eigenvalue statistics and variance rotation, the subdimensions of the EFINUB scale were determined. Bartlett's sphericity test confirmed the suitability of the data. The results indicate that four distinct dimensions with eigenvalues greater than one are considered suitable. The four dimensions together explained 69.8% of the total variance. The factor loading values of the items were analyzed via the rotated component matrix to identify the factor with the highest correlation. The food consumption dimension had the greatest association with the items. The eigenvalues of the scale dimensions are above one, the loading value of the items is determined to be at least 0.30, the items are included in a single factor, and there is a difference of at least 0.10 between the factors in two factors [33]. When the studies conducted are analyzed, the rate of explaining the total variance of the EFINUB scale dimensions is sufficient and high [34, 36].

According to the factor matrix results of the scale of the effect of food inflation on nutritional behavior, it was determined that all of the scale items had acceptable factor loads (> 0.40); the lowest item factor loading was 0.407, and the highest item factor loading was 0.917. However, the first dimension, the food consumption dimension, consists of 22 items; the food insecurity dimension consists of 5 items; the panic buying dimension consists of 6 items; and the budget dimension consists of 3 items. The number of factors was checked with the scree plot graph in Fig. 3 , and it was determined that the scale was suitable for use in four dimensions. Scree plot graphs are frequently used to evaluate the factor matrix in scale development studies [35]. For the scale of academic career awareness in higher education, a scree plot graph was obtained similar to that used in this research, and four dimensions were identified [36].

Confirmatory factor analysis plays an important role in assessing measurement models in studies focused on developing scales [37]. The confirmatory factor analysis findings of the EFINUB scale are valid and comprehensive.

Reliability analysis refers to the extent to which a measuring instrument accurately measures the intended variable or the extent to which measurement findings are free from mistakes. Importantly, a measurement scale with inadequate reliability might lead to measurement errors [38]. In this study, the internal consistency coefficient (Cronbach's alpha), which is a good measure of how homogeneous the questions, which are assumed to measure a certain field, are among themselves and whether the questions are suitable for the purpose, that is, whether they measure only the desired concept, was used to determine the reliability results of the scale. In this study, the Cronbach's alpha value of the scale indicates that the scale is highly reliable [16].

The EFINUB scale holds significant potential for practical application in various real-world settings. In educational contexts, the scale can be utilized to identify individuals or groups who may be at greater nutritional risk due to rising food prices, thereby informing the development of targeted nutrition education and awareness programs. In the realm of public policy, the scale can serve as a diagnostic tool to monitor the population-level impact of food inflation and to guide the creation of social support interventions, such as food subsidies or assistance programs tailored to those most affected. By providing quantifiable data on the relationship between food inflation and dietary behavior, the EFINUB scale offers a

valuable resource for practitioners and decision-makers seeking to promote food security and improve nutritional outcomes in economically unstable environments.

Conclusions

Increases in food prices have an impact on the dietary habits of individuals, which are vital for their existence. As a result, food inflation is considered an important factor that affects the community overall and individuals. Evaluating the impact of food inflation on nutrition behavior, particularly among low-income and disadvantaged groups, is crucial for assessing consequences and implementing effective solutions. Gaining a more comprehensive comprehension of the consequences of food inflation may result in an improved understanding of its impact on the nutritional and health status of people, as well as potential strategies to alleviate these situations.

Future research directions

Building upon the findings of the present study, future research could explore several avenues to further validate and extend the applicability of the EFINUB scale. First, longitudinal studies are recommended to examine the stability and evolution of individuals' eating behaviors and food choices over time. Such studies could provide valuable insights into how nutrition behaviors, intentions, and behaviors interact and change across various life stages or in response to external factors such as public health interventions or socioeconomic shifts. Second, the EFINUB scale could be employed in intervention-based research to assess its utility in identifying target groups and tailoring nutrition education programs. Interventions informed by the EFINUB results may enhance behavioral change by addressing specific cognitive and motivational factors influencing dietary decisions. Additionally, cross-cultural validation studies could be conducted to assess the scale's relevance and adaptability in different cultural contexts, thus supporting its broader use in global nutrition research. Overall, these directions would not only reinforce the scale's psychometric robustness but also contribute to the development of more effective, evidence-based strategies in public health nutrition.

Limitations

The weakness of the study is that we could not use a random sample. However, the fact that university staff are a heterogeneous group in terms of socioeconomic level is important in the evaluation of the scale. In addition, the analyzed internal consistency reliability indices indicate that the survey is a reliable measure. However, this scale is the first in the literature on this subject and has been developed by researchers from different fields of expertise. These features have contributed to the literature as pioneers and guides for future studies.

Abbreviations

KMO	Kaiser–Meyer–Olkin
PPI	Producer pricing index
CPI	Consumer price index
CVR	Content validity ratio
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
EFINUB	Effect of Food Inflation on Nutrition Behavior Scale
FC	Food consumption
FI	Food Insecurity
PB	Panic buying
SRMR	Standardized root mean square residual
TLI	Tucker–Lewis index
CFI	Comparative fit index
IFI	Incremental Fit Index

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Author contributions

Conceptualization: S.E.D, A.K, C.E.Ö Formal analysis and interpretation: S.E.D., C.E.Ö. Data collection: S.E.D. Writing - original draft preparation: S.E.D, C.E.Ö. Writing - review and editing: S.E.D, A.K, C.E.Ö. Final approval the article: S.E.D, A.K, C.E.Ö. Statistical analysis: C.E.Ö. Overall responsibility: S.E.D.

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Data availability

The data that support the findings of this study are available from the corresponding author, [S.E.D.], upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethics committee permission for the research was approved by Ankara University Rectorate, with decision number 18/172 taken at its meeting dated November 21, 2022. The participants were asked to sign a written informed consent form stating that they participated in the study voluntarily. This study adheres to the principles of the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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