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ARAŞTIRMA MAKALESİ **RESEARCH ARTICLE**

Modeling Drinking Milk Consumption Preferences under Climate Change and the Covid-19 Pandemics Conditions

İklim Değişikliği ve Covid-19 Salgını Koşullarında İçme Sütü Tüketim Tercihlerinin Modellenmesi

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Abstract

Climate changes and Covid-19 pandemic have dramatically led to adverse impacts on not only the food supply chains but also consumers' consumption preferences and purchase decisions in the last decade, and thus they have gradually threatened the welfare of current and next generations. The aim of the research was to determine the factors affecting consumers' milk consumption preference and purchase decisions at TRA1 region in Turkey, and then to construct the first and second-order consumption preference models based on the factors, and finally to test validation of the models. For the purposes, the main data of the study consisted of primary data obtained from 765 households residing in TRA1 region. The data were firstly used in Exploratory Factor Analysis (EFA) to determine factor dimensions, and then in Confirmatory Factor Analysis (CFA) for first and second-order multi-factor measurement models. The results of the study indicated that convergent and discriminant validities for each factor dimension in the CFA model were accepted by according to the compare and goodness-of-fit test threshold criteria. On the other hand, the results also highlighted that hygiene, sensory quality, and reliability factors at a higher level, and brand image, concern and nutrition value factors at a moderate level and milk supply source factor at a minimum level were major indicators on consumers' milk consumption preferences and purchase decisions. All the factors out of concern factor covering the variables related to climate change and Covid-19 pandemic were of positive relationships on their milk consumption pattern, indeed, but concern factor created the negative impacts on the others. Consequently, contraction of animal-based milk diet consumption could be relatively contributed to mitigate the effects of climate change by being transited gradually to moderate-mixed plant-based milk sources, and then to preparation of new national diet programs related to milk consumption.

Keywords: CFA, Climate change, Covid-19 pandemic, Goodness of fit test, Milk consumption pattern

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Öz

Son yıllarda yaşanan iklim değişikliği ve Covid-19 salgını, sadece gıda arz zinciri üzerinde değil aynı zamanda tüketicilerin tüketim tercihi ve satın alma kararları üzerinde de dramatik bir şekilde ters bir etkiye neden olmakta ve bu yüzden mevcut ve gelecek jenerasyonların refahlarını da tehdit etmektedir. Araştırmanın amacı, TRA1 bölgesinde tüketicilerin süt tüketim tercihi ve satın alma kararını etkileyen faktörlerin belirlenmesi, daha sonra bu faktörlere dayalı olarak birinci ve ikinci düzey tercih modellerini oluşturmak ve son olarak da bu modellerin geçerliliklerini test etmektedir. Bu amaçlar için çalışmanın ana materyali TRA1 bölgesinde 765 hane halkından toplanan birincil veriler kullanılmıştır. Bu veriler öncelikle faktör boyutlarını belirlemek için Keşfedici Faktör Analizinde (EFA) ve daha sonra ise birinci ve ikinci düzey çok faktörlü ölçüm modelleri için Doğrulayıcı Faktör Analizlerinde (CFA) kullanılmıştır. Araştırmanın sonuçları, CFA modelde her bir faktör boyutunun yakınsama ve ayrışma geçerliliği, model uyum ve karşılaştırma kritik değerlerine göre kabul edildiğini göstermiştir. Diğer taraftan sonuçlar; tüketicilerin süt tüketim tercihi ve satın alma kararı üzerinde hijyen, duyusal kalite ve güvenirlilik faktörlerinin daha yüksek bir seviyede, fakat marka imajı, endişe ve besin değeri faktörlerinin ise daha ılımlı bir seviyede ve süt temin kaynağının minimum bir seviyede temel göstergeler olduğuna işaret etmiştir. Gerçekten de tüketicilerin süt tüketim modellerinde iklim değişikliği ve Covid-19 salgını değişkenlerini içeren endişe faktörleri dışındaki bütün faktörler ile pozitif ilişkilere sahiptir, ancak endişe faktörü diğerleri üzerinde negatif bir etki yaratmıştır. Sonuç olarak, hayvansal kaynaklı süt diyeti tüketiminin azaltılması, kademeli olarak orta derecede karma bitkisel bazlı süt kaynaklarına aktarılarak ve ardından da süt tüketimiyle ilgili yeni ulusal diyet programlarının hazırlanarak iklim değişikliğinin etkilerinin azaltılmasına nispeten katkıda bulunulabilir.

Anahtar Kelimeler: CFA, İklim değişikliği, Covid-19 salgını, Uyum iyiliği istatistiği, Süt tüketim modeli

1. Introduction

Ongoing climate changes and Covid-19 pandemic have intensely led to adverse impacts on not only the food supply chains but also consumers' consumption preferences and purchase decisions in the last decade, and thus they have gradually threatened the welfare of current and next generations (Arumugan et al., 2021; Skalkos et al., 2021; Ritchie et al., 2018; Kleemann and Schmidt, 2017).

The previous researches indicated that livestock product supply chain under the negative effects of climate changes faced with serious challenges to meet the demands of the population due to their ecological footprint increases being created by carbon emission, water and energy uses in the production and manufacturing processes at livestock farms and food industries (Jawhara, 2020; Verain et al., 2017; Ritchie et al., 2018; Rana and Paul, 2017). Indeed, the researchers showed that the diet choices based on livestock products contributed considerably to increase the ecological footprint when compared with the vegetable-based diets (Li et al., 2022; Harguess and Hong, 2020; Sabate and Sabate, 2019; Neff et al., 2018; Graham and Abrahamse, 2017; Kleemann and Schmidt, 2017).

In order to mitigate the impacts of climate change, to conserve the natural resources, and to produce enough food along food supply chain, it was pointed that the plant-based products should be used for direct human diets rather than the animal feeds (Ritchie et al., 2018; Kleemann and Schmidt, 2017). These strong claims and evidences pointed out clearly that diet transition to diminish livestock products' consumption amounts could indeed played an important role to mitigate the effects of climate change and environmental degradation.

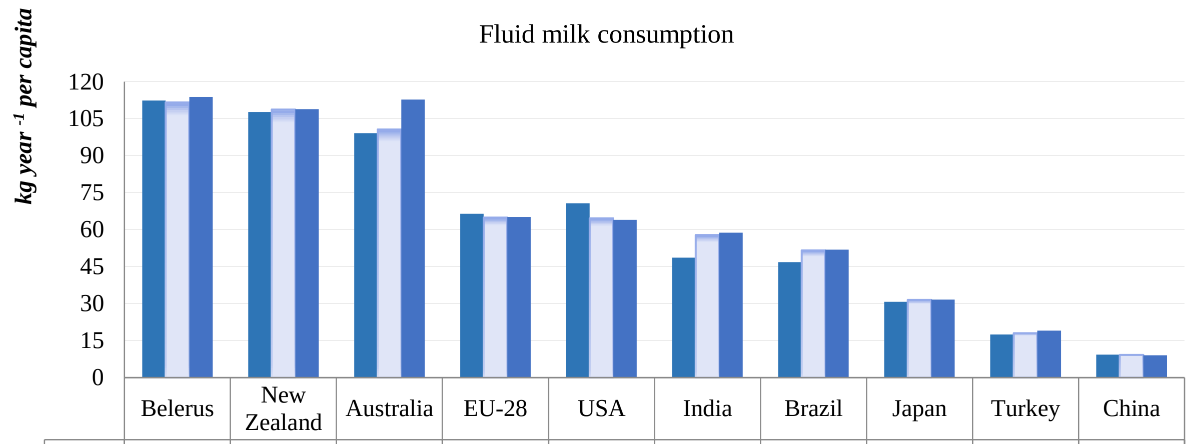
In diet guidelines, therefore, it was reported that moderate-mixed dietary transitions resulting in the uses of both less animal-based diets and higher plant-based ones would be a much more rational decision to implement a reducing approach rather than to eliminate livestock products in view of nationals' acceptance. Because, these diets could be also substituted by various common milk plants such as coconut, rice, soy, hemp, oat, pea and peanut milks instead of animal milk (Ritchie et al., 2018; Verain et al., 2017).

In order to mitigate climate change and to realize a sustainable consumption pattern, it has been gradually transited to moderate mixed plant-based diets by decreasing animal-based diets in the last years. While animal-based fluid milk consumption amount in developed countries (USA and EU-28), indeed, implementing the moderate mixed diets according to their dietary health guidelines has been gradually decreasing, that in developing and undeveloped countries (China, Turkey and India) using traditional diets has been increasingly fluctuating as seen in Figure 1 (CLAL, 2021; Eftimov et al., 2020).

In first years of the Covid-19 pandemic, various countries have rigorously implemented some restrictions with sanitizing hands, lowering social activities and a complete lockdown (Hassan et al., 2020). Under these conditions, therefore, societies' dietary perception and purchase attitudes have been considerably altered to healthier and balanced diets in order to maintain a correct nutrition status and to minimize health risks not only by decreasing their purchase frequencies, but also by increasing their buying quantities (Li et al., 2022; Cavallo et al., 2020; Chenarides et al., 2020).

With outbreak of the Covid-19, the higher incidence of the contaminations and human deaths caused consumers to shifting fundamental perception on their purchase pattern prioritizing the sensory quality, nutritional value, core benefit, food safety and hygiene along food supply chain. Attitude being the most vital determinant of perception to purchase the food products, hence, considers in a strong correlation with purchase intention, and impulsive drivers of these relations are also motives (Cavallo et al., 2020; Rana and Paul, 2017).

In fact, it is considered that consumers' purchase attitude and behaviors towards the food products could be assessed under the effects of not only the hedonic motives trigged by the extrinsic food quality clues but also the utilitarian motives stimulated by the intrinsic food attributes. Utilitarian motivation steams from food quality and safety, health concern, sensory appeal, nutritional value or product content, suitability/convenience, durability and core benefits. Contrary to utilitarian motives, hedonic motivation focuses on prestige, brand, label, emotion, affection, comfort, appeal, ambition, desire for individuality, pleasure, hunger and thirst, mood, reliability, familiarity and habits (Picot et al., 2021; Martinez et al., 2021; Li et al., 2020; Cavallo et al., 2020).



	Belerus	New Zealand	Australia	EU-28	USA	India	Brazil	Japan	Turkey	China
2015	112,3	107,7	99,1	66,5	70,7	48,7	46,8	30,7	17,5	9,3
2019	111,6	108,7	100,6	64,9	64,6	57,8	51,6	31,5	18,0	9,2
2020	113,8	108,9	112,8	65,1	64,0	58,7	51,9	31,6	19,1	9,0

Figure 1. Annual per capita fluid milk consumption

The results of previous researches conducted on the dairy products highlighted that psycho-social variables impacting on consumers' buying attitudes were of a much greater influence than the sociodemographic factors (Azabağaoğlu et al., 2016; Konyalı, 2019; Li et al., 2020; Ouyang et al., 2021; Martinez et al., 2021). In addition to these results, it was declared that the main reason of livestock product demand increase was also the campaigns supported by decision makers, and the effective utilitarian and hedonic motive drivers in the convergence guidelines recommended for livestock-based diet choices in FAO 2013 report (Gerber et al., 2013). Contrarily, animal-based dairy product consumptions could be decreased gradually by using moderate-mixed planted-based diets instead of animal-based diets. To do so, it is of a great importance to know societies' milk consumption trends and to determine the motive factors affecting them. Only then, could be taken the effective measures to reduce animal-based milk.

Consequently, drinking milk and dairy products being one of the essential components of human diets are fairly rich in view of protein, vitamin and mineral substances, especially calcium; and thus consumption of the products has a positive effect on human health, but also an adverse effect on climate change. It has partly estimated that drinking milk, furthermore, along food supply chain varying from dairy farms to retailer shelves also threated human health by exposing to various contaminations during the Covid-19. In sight of all the progresses, the aim of the study is to determine the factors impacting on consumers' milk consumption preference and purchase decision at TRA1 region in Turkey, and then to construct the first and second-order consumption satisfaction models, and finally to test validation of the models.

2. Materials and Methods

2.1. Material

The main material of the research consisted of the primary data obtained from households consuming drinking milk and residing at TRA1 Region, Turkey by taking into consideration the questionnaire form approved by Ataturk University Ethics Committee in 2021. On the other hand, secondary data was also collected from both the various institutions and organizations and numerous publications.

2.2. Methods

2.2.1. Method used in sample size calculation

Sample size identified by Simple Random Sampling Method considering the proportions of the households (75%, 80% and 85% milk consumption rates for Erzurum, Erzincan and Bayburt were determined by a preliminary research in each province) consuming drinking milk in TRA1 Region was given in Equation 1 (Malhotra, 1996). Sample sizes were calculated as 302, 258 and 205 households in Erzurum, Erzincan and Bayburt, respectively, and totally 765 those at TRA1 Region.

$$n = \frac{Z^2 \cdot p \cdot (1-p)}{c^2} \quad \text{(Eq. 1)}$$

In the Equation 1:

n: Sample size

Z: Standard Z value (%95 confidence range, 1.96)

p: The proportions of drinking milk consumption (75%, 80% and 85% for Erzurum, Erzincan and Bayburt)

c: Deviation from the mean (± 0.05)

In order to be able to exactly represented the households consuming milk at TRA1 Region, the research regions were first segmented into the sub-regions at central districts, and then it was derived the set of random numbers as much as the sample sizes calculated according to household rates in each region, and finally they were selected via the water subscriber numbers of the households.

2.2.2. Method used in data collection

By being added various agenda variables to the scales designed according to the results of Exploratory Factor Analysis (EFA) of the researches conducted by Topcu (2015), Topcu (2019a) and Topcu (2019b) on drinking milk consumption preferences, it was formed a questionnaires form (*Table 1*) with 5-point Likert Scale (1: minimum, 3: neutral, 5: maximum preference scores), and then it was used to collected the data from target consumer masses.

Table 1. Item names and codes related to drinking milk consumption preferences

Item codes	Item names	Item codes	Item names
M1	Taste and smell	M16	Product information
M2	Flavor	M17	Promotion
M3	Color and fatness of milk	M18	Packaging
M4	Hygiene in animal feeding	M19	Manufacturer brand
M5	Hygiene at retail level	M20	Local brand
M6	Hygiene in milking	M21	Retailer brand
M7	Hygiene in milk processing	M22	Advertisement
M8	Trust to farmer	M23	Price-quality relation
M9	Trust to manufacturer	M24	Ecological footprint concern
M10	Trust to retailer	M25	Covid-19 concern
M11	Protein content	M26	Antibiotic residual and hormone concern
M12	Vitamin content	M27	Artificial milk concern
M13	Mineral matter content	M28	Sheep milk
M14	Calcium content	M29	Goat milk
M15	Fat ratio		

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2.2.3. Methods used in statistical analyses

In order to determine the factor dimensions of drinking milk consumption preference scales, EFA and Parallel Analysis applied on "Patil et al. (2007)'s Parallel Analysis Engine" were used (Karagöz, 2020). Parallel Analysis calculates Eigenvalues from randomly generated correlation matrices based on parameters and sample sizes. Eigenvalues are then compared with eigenvalues extracted from the results of total variance explained of the EFA. The number of factors to retain will be initial eigenvalue numbers that are larger than the corresponding random eigenvalues (Patil et al., 2007). Approved EFA factor dimensions were used for first-order multifactor Confirmatory Factor Analysis (CFA) measurement model (Gürbüz, 2019; Civelek, 2020).

In order to test convergent and discriminant validities of CFA measurement model, AVE (average variance extracted), CR (construct reliability) and DV (discriminant validity) values assessed on the factor loadings and error variances, and MSV (maximum square variance), and ASV (average shared square variance) values computed on factor correlations were used.

AVE measuring the level of variance captured by a construct versus that due to measurement error and CR defining convergent validity criteria of items or constructs reliability among items must be greater than 0.5 *(AVE > 0.5)* and 0.7 *(CR > 0.7),* and thus CR > AVE should be. AVE and CR measurement values were calculated in Equation 2 and 3 (Gürbüz, 2019).

$$AVE_j = \frac{\sum_{i=1}^{k} \beta_{ij}^2}{(\sum_{i=1}^{k} \beta_{ij}^2) + (\sum_{i=1}^{k} \varepsilon_{ij})} \qquad \text{(Eq. 2)}$$

$$CR_j = \frac{\left(\sum_{i=1}^{k} \beta_{ij}\right)^2}{\left(\sum_{i=1}^{k} \beta_{ij}\right)^2 + \sum_{i=1}^{k} \varepsilon_{ij}} \qquad \text{(Eq. 3)}$$

Discriminant validity (DV) in CFA model also must have the least correlation among other factors and the factors including in their own items. DV, therefore, could be assessed by comparing the amount of the variance capture by the construct (AVEj) and the shared variance with other constructs (εij). For these aims, MSV criterion indicating maximum correlation among the factor constructs and ASV criterion determining average shared square correlations among the factor constructs were frequently used. Thus, DV for each construct should be greater than the correlation involving in the constructs, and the levels of the AVE for each construct should be greater than the squared correlation involving in the constructs (MSV < AVE, ASV < AVE and r < DV). MSV, ASV and DV measurement values were given the Equation 4, 5 and 6 (Ocak, 2020).

$$DV_j = \sqrt{\frac{\sum_{i=1}^{k} \beta_{ij}^2}{(\sum_{i=1}^{k} \beta_{ij}^2) + (\sum_{i=1}^{k} \varepsilon_{ij})} = AVE_j} \qquad \text{(Eq. 4)}$$

$$MSV_{ij} = Max\ r_j^2 \qquad \text{(Eq. 5)}$$

$$ASV_{ij} = \frac{\sum_{i=1}^{k} r_{ij}^2}{n} \qquad \text{(Eq. 6)}$$

In the Equation 2, 3 4, 5 and 6:

β: Standardized path coefficient (factor loadings)
ε: Error variance *(1- β^2)*
r: Partial correlation coefficient
n: Items and factor numbers

CMIN/df indices (likelihood ratio chi-square test/degree of freedom) were used for overall goodness of fit indices of CFA measurement model from structural equation modeling, and thus smaller values than 3 and 5 for goodness of and acceptable fit indices, respectively *(CMIN/df < 3 and 5*) were assessed (Meydan and Şeşen, 2015; Gürbüz, 2019). IFI (incremental fit index) for the problem solutions with wide variation, and CFI (comparative fit index) and RMSEA (root mean square error of approximation) being highly sensitive to sample sizes in comparative fit indices were considered. Goodness of fit and acceptable fit indices for IFI and CFI should be greater than 0.90 and 0.95 *(IFI and CFI > 0.95 and 0.90)*, but for RMSEA should be smaller than 0.08 and 0.10 *(RMSEA < 0.08 and 0.10)* (Meydan and Şeşen, 2015).

On the other hand, GFI (goodness of fit index) and RMR/SRMR (standardized/root mean square residual) from absolute fit indices of measurement models were assessed to test that model fit is independence than sample sizes on model and explain variance and covariance rations, to measure the residual correlations of global and sample correlations. Goodness of and acceptable fit indices for GFI and RMR/SRMR should be greater than 0.95 and 0.90, and 0.05 and 0.08 *(GFI > 0.95 and 0.90, and RMR/SRMR < 0.05 and 0.0*8) (Marsh et al., 1988; Civelek, 2020).

It was used IBM SPSS 25.0 package program for EFA, IBM AMOS 24.0 ones and for CFA measurement model, and a web-based parallel analysis engine presented by Patil et al. (2007) for optimal factor dimensions in statistical analyses applications.

3. Results and Discussion

The results of EFA highlighted that seven factor dimensions from drinking milk consumption preference scales with 29 items (*Table 1*), explaining 65% of total variance were constructed, and KMO statistics (Kaiser-Meyer-Olkin Measure of Sampling Adequacy) comparing observed and partial correlation coefficients and Bartlett's Test of Sphericity was found as 0.812 and 7959.80 ($\lambda^2_{0,05;378} = 7959{,}80$ *($p < 0.001$))*.

These statistics assessing the sample data, therefore, indicated that the data was at a very good level for EFA. On the other hand, percentile eigenvalues computed by Parallel Analysis Engine were compared with the eigenvalues extracted from total variance explained of EFA, and the number of factors to retain was determined seven initial eigenvalues that were greater than the corresponding random eigenvalues (*Table 2*).

Table 2. Factor dimensions determined by Parallel and EFA Analyses

Parallel Analysis				EFA Analysis	Results
Factor dimensions	Mean Eigenvalues	Percentile Eigenvalues		Initial Eigenvalues	
1	1.387	1.436	<	6.047	Accept
2	1.333	1.372	<	3.328	Accept
3	1.294	1.328	<	2.139	Accept
4	1.261	1.290	<	1.816	Accept
5	1.231	1.258	<	1.634	Accept
6	1.202	1.226	<	1.383	Accept
7	1.177	1.198	<	1.292	Accept
8	1.152	1.171	>	1.091	Reject
9	1.127	1.148	>	0.863	Reject
10	1.104	1.125	>	0.785	Reject

In order to test convergent validity of CFA measurement model according to seven factor dimensions, AVE and CR values were calculated in Table 3. AVE and CR values computed for each level indicated that they were greater than 0.50 and 0.70 threshold values, respectively, and AVE vales were smaller than CR values *(AVE < CR)*. Convergent validity of the model, therefore, was greatly provided. Similarly, internal consistencies among milk consumption preference items under each factor were also found significantly according to Cronbach alfa criteria values.

On the other hand; DV, MSV and ASV values related to discriminant validity of CFA measurement model were given in *Table 3*, *4* and *5*. *Table 4* and *5* showed that DV values calculated for each factor were greater than the correlation matrixes of factor constructs obtained from the results of CFA, and MSV and ASV values were also smaller than AVE values. DVs compared with seven factors of CFA model, therefore, were completely approved.

Path diagrams of first and second-order CFA models approved by convergent and discriminant validities for fluid milk consumption preferences were given in *Figure 2* and *3*. The CFA results highlighted that the factor structures of sensory quality with 3, hygiene with 4, reliability with 3 items, nutritional value with 5 items, brand image with 8 items, worry with 4 items and milk supply source with 2 items were at fairly good levels in terms of overall, absolute and comparative goodness of fit indexes (*Table 6*).

CMIN/df (overall goodness of fit indices), RMSEA (comparative fit indices) and SRMR (absolute fit indices) values were of a very good (excellent) fit, but IFI and CFI (comparative fit indices), GFI and RMR (absolute fit indices) values had a good (acceptable) fit. Conclusively, overall goodness of fit indexes of proposed first and second-order seven-factor CFA model indicated that the model was of considerably a good fit with applied data set and at range acceptable criteria.

Consumers' drinking milk consumption preference factors, their item path coefficients and some statistics for first and second-order seven-factor CFA model were given in *Table 7*. The CFA results indicated that the coefficients of items constructed under sensory quality varied from $\beta_0 = 0.66$ *($p < 0.001$)* to $\beta_0 = 0.82$ *($p < 0.001$)*, and taste and smell (M1) from the items was the most impact *($\beta_0 = 0.82$)* and explanatory *($R^2 = 0.66$)* variable. On the other hand, covariance among sensory quality and other factors varied from 0.04 to 0.48 (*Figure 2*), and correlation and explanation of sensory quality on drinking milk consumption preferences were also determined as 0.60 *($r = 0.60$)* and 36% *($R^2 = 0.36$)* (*Figure 3*).

Table 3. AVE, CR, Cronbach alfa and DV values for the convergent and discriminant validities

Items	Factors	AVE	DV	CR	Cronbach alfa
M1 M2 M3	Sensory	0.521	0.722	0.764	0.746
M4 M5 M6 M7	Hygiene	0.649	0.806	0.789	0.762
M8 M9 M10	Reliability	0.591	0.769	0.741	0.724
M11 M12 M13 M14 M15	Nutritional value	0.561	0.749	0.801	0.797
M16 M17 M18 M19 M20 M21 M22 M23	Brand image	0.492	0.702	0.823	0.831
M24 M25 M26 M27	Worry	0.561	0.749	0.833	0.807
M28 M29	Source	0.719	0.848	0.835	0.821
Measurement model					0.863

Table 4. Correlation matrix of the factor structures and DV values*

Factors	Sensory	Hygiene	Reliability	Nutritional value	Brand image	Worry	Source
Sensory	(0.722)						
Hygiene	0.481	(0.806)					
Reliability	0.339	0.419	(0.769)				
Nutritional value	0.373	0.318	0.085	(0.749)			
Brand image	0.291	0.359	0.342	0.070	(0.702)		
Worry	0.232	0.340	0.181	0.280	0.343	(0.749)	
Source	0.042	0.049	0.202	-0.109	0.320	0.142	(0.848)

Values in parentheses refer to DV values

Previous researches revealed that sensory quality attributes such as taste, smell, color, flavor and fat rate, effecting on drinking milk consumption preferences were a major determinant, and thus that there was a strong positive relationship between consumers' purchase intentions and fluid milk with high sensory attributes (Rana and Paul, 2017). The research results conducted by Delley and Bruner (2019) reported that nutritional composition and sensory quality in the attributes hierarchy of dairy products played a predominate role on buying intention and attitudes of consumers in USA and Europe countries.

Similarly, Ouyang et al. (2021) highlighted that sensory appeal for dairy products was an important factor, and also was of a strong and direct impact on consumers' food preference. Bus and Worsley (2002), additionally, declared that taste and flavor were a priority determinant of fluid milk choice and purchase intention, and these properties of drinking milk on consumers' buying decisions also were of a positive motivation.

Table 5. MSV and ASV values and requirement conditions for the discriminant validities of the factor structures

Factors	MSV		AVE	ASV		AVE	AVE		CR
Sensory	0.232	<	0.521	0.104	<	0.521	0.521	<	0.764
Hygiene	0.176	<	0.649	0.126	<	0.649	0.649	<	0.789
Reliability	0.117	<	0.591	0.082	<	0.591	0.591	<	0.741
Nutritional value	0.139	<	0.561	0.056	<	0.561	0.561	<	0.801
Brand image	0.129	<	0.492	0.093	<	0.492	0.492	<	0.823
Worry	0.118	<	0.561	0.070	<	0.561	0.561	<	0.833
Source	0.103	<	0.719	0.030	<	0.719	0.719	<	0.835

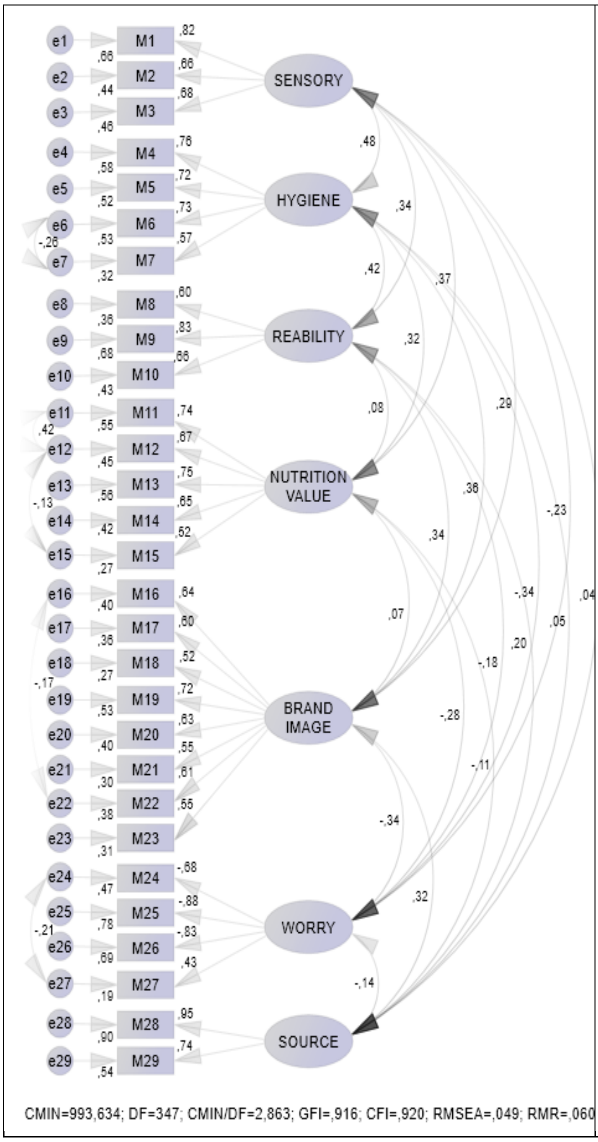

Figure 2. First-order seven-factor CFA model

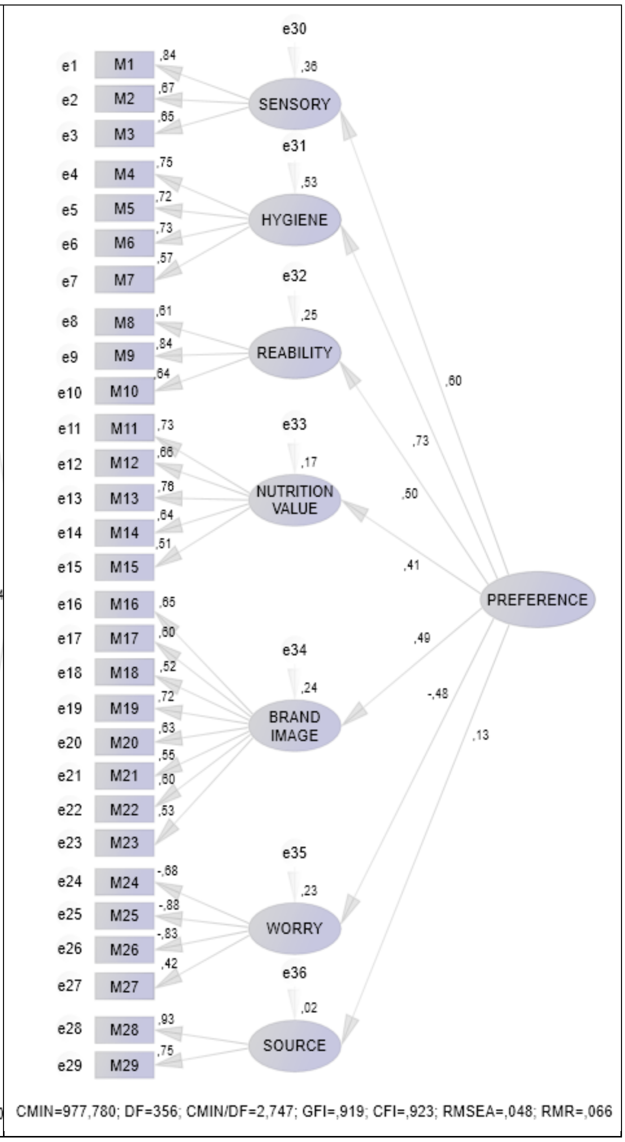

Figure 3. Second-order seven-factor CFA model

Table 6. Overall, absolute and comparative fit indices and threshold ranges of first and second-order seven-factor CFA measurement model

Fit indices	Goodness of fit indices threshold criteria	Acceptable fit indices threshold criteria	First-order *CFA* model values	Second-order *CFA* model values
CMIN/DF	< 3.00	< 5.00	2.863	2.747
IFI	> 0.95	> 0.90	0.921	0.924
CFI	> 0.95	> 0.90	0.920	0.923
GFI	> 0.95	> 0.80	0.916	0.919
RMSEA	< 0.08	< 0.10	0.049	0.048
RMR	< 0.05	< 0.08	0.056	0.066
SRMR	< 0.05	< 0.08	0.050	0.051

Items' loadings related to hygiene and reliability on drinking milk consumption satisfaction were calculated at range from $\beta_0 = 0.57$ and *0.60* $(p < 0.001)$ to $\beta_0 = 0.76$ and *0.83* $(p < 0.001)$, and hygiene in animal feeding at farm level (M4) and trust to manufacturer (M9) were analyzed as the most effect ($\beta_0 = 0.76$ *and 0.83*) and explanatory ($R^2 = 0.58$ *and 0.68)* items. Similarly, covariance among hygiene and reliability and the others indicated a variation between 0.05 and 0.08 and 0.48 and 0.42 (*Table 7* and *Figure 2*), and correlation impacts and explanation ratios of them on those were found as 0.73 $(r = 0.73)$ and 0.50 $(r = 0.50)$ and 0.53 $(R^2 = 0.53)$ and 0.25 $(R^2 = 0.25)$ (Figure 3). There was a compact relationship, therefore, not only between hygiene and reliability factors based on intrinsic fluid milk attributes but also on consumption preferences and purchase decisions.

In the last studies related to hygiene and reliability in dairy products were reported that base of sanitary fluid milk production depended on the animal health and hygiene conditions at dairy farms, and thus in order to minimize microbial contamination of milk must have been applied for animal rearing and housing, veterinary care and diagnostic approaches, milking hygiene, processing, packaging and sanitation practices.

In addition, it was emphasized that sanitary and health standards such as personal hygiene, waste management, warehouse and distribution control and maintenance of hygienic production practices based on alternative industrial applications in the dairy industry decreased considerably milk infection risks, and thus it could be conveniently used by all the consumers.

In result, the consumer demands have considerably increased in the last two decades due to innovative progresses such as sanitary animal rearing, dairy product manufacturing and retailing processes, and trust to their actors (Alegbeleye et al., 2018; Delley and Brunner, 2019; Berge and Baars, 2020). Especially, Skalkos et al. (2021) reported that a major issue in food purchase intention and choices of consumers in Covid-19 pandemic were reliability/trust involving safety, health, sustainability, hygiene, freshness, traceability at short supply chain varying from dairy farms to food retailers, and thus it was an important predictor of food acceptance by reducing risk perceptions. It was emphasized that this factor guided to their buying attitudes, therefore, and the greater trust to the actors at dairy product supply chain, the higher would have been consumers' purchase intention and consumption trends.

Item scores of nutritional value varied from $\beta_0 = 0.53$ $(p < 0.001)$ to $\beta_0 = 0.75$ $(p < 0.001)$, and the protein (M11) and calcium contents (M14) were the most effective ($\beta_0 = 0.75$ *and 0.74)* and explanatory ($R^2 = 0.56$ *and 0.55)* variables (*Table 7*). Additionally, it was analyzed that covariance among nutritional value with other factors varied from 0.07 to 0.37, and the correlation and explanation impacts of nutritional value on consumption preference and purchase intention were 0.41 $(r = 0.41)$ and 17% $(R^2 = 0.17)$ (*Figure 2* and *3*).

Experimental researches revealed that fluid milk and dairy products used frequently and widely in human diets were a crucial source of protein, vitamin and mineral matters, and thus their consumption strengthened the musculoskeletal system by preventing humans from osteoporosis, and that could decrease risks of coroner heart diseases, stroke, dental caries, hypertension and various types of cancer. It was also determined that positive perception and consumers' attitudes rather than their negative beliefs about nutritional attribute and values of drinking milk, therefore, led to an increasing trend and positive perceptions on their demands (Delley and Brunner, 2019; Guo et al., 2020; Perez et al., 2020).

Table 7. Path coefficients of first order measurement model related to consumers' drinking milk consumption preference factors and items

Items	Path	Factors	β_0	β_1	S.E.	C.R.	p
M1	<---	Sensory	0.816	1.000			
M2	<---	Sensory	0.662	0.986	0.063	15.600	***
M3	<---	Sensory	0.678	0.862	0.054	15.856	***
M4	<---	Hygiene	0.760	1.000			
M5	<---	Hygiene	0.725	0.914	0.050	18.255	***
M6	<---	Hygiene	0.720	0.918	0.053	17.409	***
M7	<---	Hygiene	0.570	0.830	0.061	13.568	***
M8	<---	Reliability	0.652	1.000			
M9	<---	Reliability	0.831	1.437	0.106	13.551	***
M10	<---	Reliability	0.602	1.269	0.096	13.275	***
M15	<---	Nutritional value	0.647	1.000			***
M11	<---	Nutritional value	0.750	1.126	0.090	12.463	***
M12	<---	Nutritional value	0.667	1.034	0.092	11.268	***
M13	<---	Nutritional value	0.526	1.271	0.101	12.575	***
M14	<---	Nutritional value	0.736	0.979	0.083	11.832	***
M21	<---	Brand image	0.562	1.000			
M16	<---	Brand image	0.642	1.260	0.095	13.553	***
M17	<---	Brand image	0.518	1.213	0.102	11.897	***
M18	<---	Brand image	0.600	1.038	0.096	10.837	***
M19	<---	Brand image	0.646	1.630	0.123	13.196	***
M20	<---	Brand image	0.612	1.102	0.089	13.563	***
M22	<---	Brand image	0.543	1.319	0.110	11.969	***
M23	<---	Brand image	0.715	1.167	0.103	11.329	***
M27	<---	Worry	0.430	1.000			
M26	<---	Worry	-0.831	-2.231	0.192	-11.637	***
M25	<---	Worry	-0.881	-1.599	0.133	-12.045	***
M24	<---	Worry	-0.630	-2.052	0.177	-11.594	***
M29	<---	Source	0.735	1.000			
M28	<---	Source	0.948	1.301	0.135	9.628	***
Structure Equation Modelling							
Sensory	<---	Preference	0.600	1.000			
Hygiene	<---	Preference	0.730	1.223	0.131	9.352	***
Reliability	<---	Preference	0.500	0.719	0.097	7.418	***
Nutritional Value	<---	Preference	0.413	0.494	0.076	6.469	***
Brand image	<---	Preference	0.489	0.788	0.107	7.337	***
Worry	<---	Preference	-0.476	-0.512	0.076	-6.770	***
Source	<---	Preference	0.134	0.335	0.125	2.685	***

β_0: Standardized path coefficients *β_1: Unstandardized path coefficients* $^{***}p < 0.001$

The CFA results also pointed that variable coefficients of brand image on drinking milk consumption preferences changed between $\beta_0 = 0.52$ *(p < 0.001)* and $\beta_0 = 0.72$ *(p < 0.001)*, and that price-quality relation (M23), manufacturer brand (M19) and product information (M16) among them were the most effective *(β_0 = 0.72, 0.65 and 0.64)* and explanatory *(R^2 = 0.53, 0.40 and 0.40)* items (*Table 7*). In the same time, it was determined that covariance impact of brand image on the other factors varied from 0.07 to 0.36, and that brand image on the consumption preferences was of correlation with 0.49 *(r = 0.49)* and regression coefficient with 0.24 *(R^2 = 0.24)* (*Figure 2* and *3*). Various previous studies indicated that brands were one of the fundamental tools pushing the consumers to select particular products and their subsequent repurchase, compared to others, and thus determined loyalty leading to a competitive advantage (Rihn et al., 2019; Slade et al., 2019; Marchini et al., 2021;). Brand image, therefore, affects prominently the consumer preferences and attitudes, purchase decisions, willingness to pay towards dairy products.

These researches also highlighted that considered to be the indicators of brand image with labelling under product information; quality, price, region of origin, nutritional information, health claims, quality and price relation of dairy products were essential determinants for the consumers, and thus they could considerably increase their sustainability consumption trends under brand image with more favorable motivation drivers on purchase attitude and intention (Boncinelli et al., 2018; Yin et al., 2018; Perito et al., 2019; Marchini et al., 2021).

In *Table 7*, it was reported that item loadings of worry/concern factor affecting negatively milk consumption preference varied from $\beta_0 = +0.43$ $(p < 0.001)$ to $\beta_0 = -0.88$ $(p < 0.001)$, and that Covid-19 infection (M25) and antibiotic residual and hormone concerns (M26) were the most effective ($\beta_0 = -0.88$ *and* -0.83) and explanatory ($R^2 = 0.78$ *and* 0.69) variables. Creating a negative impact on drinking milk consumption, worry factor was of the covariance varying from -0.14 to -0.34 with other preference factors, and then, the correlation and regression coefficients were also measured as -0.48 $(r = -0.48)$ and 0.23 $(R^2 = 0.23)$ *(Figure 2 and 3)*.

Indeed, various studies reported that the worry/concern items such as ecological footprints of dairy products, Covid-19 pandemic, antibiotic residuals and hormone concerns, as well as production of artificial milk and dairy products claims led to a downwards influence on fluid milk consumption of consumers. At the same time, outgoing outbreak of Covid-19 and climate changes were adversely affected consumers' purchase attitude and behaviors at the agro-food markets ranged from the dairy farms to dairy food retailers due to food quality and safety, hygiene and trust to market actors. As result, all the concern factors impacting on food quality and safety caused significantly to contraction of consumers' fluid milk demands in all economic and social systems (Bentivoglio et al., 2020; Arumugam et al., 2021; Shamim et al., 2021; Skalkos et al., 2021). Especially, Covid-19 pandemic, as well as ecological and water footprint as a result of dairy cow farming and their industrial applications gaining increasing momentum to climate changes have considerably led to negative trends on the consumers' attitudes and behavior towards dairy products in the last years.

The results of CFA indicated that variable coefficients and relative explanation levels of sheep milk (M28) and goat milk supply sources (M29) were $\beta_0 = 0.95$ *and* 0.74 $(p < 0.001)$, and $R^2 = 0.90$ *and* 0.54, respectively (*Figure 2*). Milk supply source exhibited a negative correlation with both worry (-0.14) and nutritional value (-0.11), but a positive one with the others varying from 0.04 to 0.32 (*Figure 1*). Its impact and total variance explain rate, moreover, on milk consumption preferences were also computed as 0.13 $(r = 0.13)$ and 2% $(R^2 = 0.02)$ (*Figure 3*).

In researches conducted the effects of milk from producing species, cow, sheep and goat in human diet intake were reported that sheep and goat milk contained higher levels of key macro-nutritional fractions, essential and trace minerals, protein, vitamin, lipid and total solids compared with cow milk, and they were used as a milk allergy-alternatives for those suffering allergic reactions to cow milk, and thus consumption of sheep and goat milk created a greater benefit to bone healthy than consumption of cow milk (Moatsou and Sakkas, 2019). In research area, however, it was almost impossible to find the sheep and goat milk at local markets due to dairy cow rearing under geographical and agro-ecological conditions, and the consumers' sociocultural attitudes, economic conditions and consumption preferences. In present study, it was measured that goat and sheep milk, therefore, were of a much low effect on consumers' drinking milk consumption preferences.

4. Conclusions

The results of the study showed that the most impact and explanatory factors influencing the consumers' drinking milk consumption preferences were attributed to the hygiene, sensory quality and reliability, and thus there were strong relationships among these factors on consumption satisfaction. Similarly, brand image, concern and nutrition value were attributed to be moderate correlation and determination impacts on consumption preferences, but milk supply source created a smaller impact. On the other hand, all the factors out of the risk factor were of positive linear relationships on consumption preference. The societies decreasing animal-based milk consumption due to environmental friendliness and ethical consumerism could gradually transit to moderate-mixed plant-based diets, and thus could considerably mitigate the impacts of climate change.

Consequently, in order to mitigate ecological footprint and the ethical concerns of drinking milk consumption, it should be considerably encouraged and supported cattle milk farming herds consisting of high-yielding dairy cows with fewer cultured breeds instead of low-yielding dairy cows in milk production along with plant-based milk. Plant-based milk consumption should be increased, therefore, by being decreased animal-based milk consumption. On the other hand, the farmers and manufacturers at animal production and processing stages could considerably contribute to mitigate the negative impacts of livestock on ecological footprint by providing sequestration of carbon through various means, improving the feeds to reduce enteric fermentation, improving manure management, and using more efficient fertilizers.

For a sustainable consumption under animal food supply safety and security, moreover, the farmers, therefore, could comprehensively adapt the livestock system management strategies to climate change by diversifying cattle herd species and forages, changing breeding strategies (tolerance to heat stresses and the diseases), adopting scientific and technological advances, implementing the institutional and policy changes. All these measures would not contribute to adapt only the cattle breeders' farm management strategies to climate change, but could also provide possibility to retain the consumers' milk consumption satisfaction. Consumption patterns of the products including in sensory quality attributes under sanitary production and trust to the actors along livestock product supply chain, moreover, as well as nutritional ingredients providing their core benefits should be considerably integrated with milk of plant-based and other species, and then diversified under brand images satisfied to target consumers.

Ethical Statement

This study was prepared under the permission numbered 2021/13, dated 24.08.2021, from the Ethics Committee of Atatürk University.

Conflicts of Interest

There is no conflict of interest between the article authors.

Authorship Contribution Statement

The author carried out the planning, execution and conclusion of the study.

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