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Original article

Added sugars and non-nutritive sweeteners in the food supply: Are they a threat for consumers?



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SUMMARY

Background & aims: Excess sugar intake can cause chronic diseases such as obesity, diabetes, and cardiovascular disease. Thus, limiting the intake of sugar in the diet is an important preventive measure. Food manufacturers have considered non-nutritive sweeteners (NNS) as an alternative to sugars. To date, there has been no systematic monitoring of the types of added sugars and NNS in Turkey's food supply. The aim of this study identified the added sugars and NNS in packaged foods and beverages that were available in supermarkets across Turkey.

Methods: A cross-sectional study was conducted from April to December 2020. Three supermarkets in Turkey were chosen for this study.

Results: Of the 2514 packaged foods and beverages analyzed, 1647 (65.5%) contained added sugars or NNS. Out of 1647 products, 9.7% contained both added sugars and NNS; 86.5% only added sugars whereas 3.8% had only NNS. The most used added sugar was white sugar in all food groups (50.6%–100%) while the most used NNS was sorbitol (28.4%).

Conclusion: The use of added sugars and NNS in Turkey's food supply was found to be high, and white sugar being the most used sweetener in products available in the food supply. Therefore, it may be important to start monitoring the prevalence of products containing added sugars and NNS due to their negative health effects.

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1. Introduction

The latest report from the World Health Organization (WHO) observed a 32.1% obesity prevalence in Turkey, ranking it first among European countries [1]. This is an important finding considering obesity and diet-associated risk factors cause other chronic diseases. In the early 20th century, important changes have been observed in dietary habits, especially with Western-style diets along with a global increase in packaged food consumption [2]. Therefore, added sugars to packaged foods and beverages have increased globally [3].

The WHO has described free sugars as a dietary component related to an increasing overweight and obesity population, which

are the risk factors of diabetes, cardiovascular diseases (CVD), and metabolic syndrome [3]. According to the WHO guideline about free sugar recommendation in adults and children, free sugar consumption should be less than 10% of the total energy intake. However, its consumption in quantities of less than 5% would provide additional health benefits, especially dental health [4]. The recommendations on free sugar consumption according to the Turkish Dietary Guideline, are similar to the WHO guideline [5]. Considering the negative effects, it is necessary to reduce free sugar contents in foods.

The term sugars as applied to human diets is a collective term. For example, table sugar is substantially pure sucrose, while fruit juice, honey, and syrups usually contain sucrose, glucose, fructose, and different oligosaccharides. All of these terms are combined as “sugars”. “Free sugar” includes all monosaccharides and disaccharides that are added during food manufacturing and preparation as well as sugars that are naturally present in honey, syrups, fruit juices and fruit concentrates according to the WHO and the United Nations' Food and Agriculture Organization definition [4].

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However, “added sugar” includes sucrose, fructose, glucose, dextrose, table sugar, starch hydrolysates (glucose syrup, high-fructose syrup), and other isolated sugar preparations which are added during food preparation and manufacturing [6]. Also, the “total sugar” includes all sugars regardless of the source [4].

Sweeteners are considered an alternative to added sugars and are comprised of both caloric sweeteners (CS) that provide energy and non-nutritive sweeteners (NNS) that do not provide energy [7,8]. In this context, food and beverage manufacturers are showing a growing interest in added sweeteners, both caloric and non-nutritive, in package foods and beverages [9]. Additionally, people's interest in sweeteners, especially NNS, has increased, which may increase the consumption of products containing sweeteners as consumers deem them to be harmless compared to sugars [3]. However, the effects of NNS on health are controversial. Some researchers have shown that NNS have similar results to sugars consumption and can lead to weight gain [10,11], glucose intolerance [11], diabetes [12,13], CVD [14], and metabolic syndrome [10] while others have shown that it does not have any negative effects on health [15,16]. There is also a concern that increased exposure to dietary NNS may affect taste preferences and dietary patterns, therefore increasing energy intake [17,18]. The maximum amount of NNS to be added to packaged foods and beverages is regulated by the Turkish Food Codex [19]. It is important to understand and monitor how prevalent both added sugars and/or NNS are in packaged foods and beverages sold in Turkey.

Limited studies worldwide identified the presence of added sugars and/or NNS in packaged foods and beverages [3,7,9,20–24]. However, there is not a single study on packaged foods and beverages sold in Turkey. Therefore, it was hypothesized that most of the packaged products contain added sugars or NNS. This is the first study that aims to identify the added sugars and/or NNS in packaged foods and beverages that are available in supermarkets across Turkey.

2. Methods

The present study was a cross-sectional analysis of ingredient information from packaged food and beverage products available in three of the largest supermarkets, which represents 26.6% of market share in Turkey. The food products sold in these stores are similar to those sold in other supermarket chains throughout the country. We visited one chain of these supermarkets in middle-income areas.

2.1. Data collection

Data were gathered between April–December 2020. Information on identification (product name and type) and ingredients were obtained in the stores from labels of all of the food and beverage products. The following fields of information were extracted: Universal Product Code (UPC), serving size (g/mL), and product description. To facilitate data collection, photos of the packaged food and beverage products were taken and posteriorly analyzed. Then, their information was manually entered into Microsoft Office Excel 2016. Each product was classified and coded according to label denomination.

2.2. Food categorization

All packaged food and beverage products available in the supermarket that met the criteria established by the last report of Turkish Food Codex (Communiqué No: 28,693) were included in the study. These criteria were: be labeled, had a brand, had food approval number, the net amount of the product and its

ingredients, the ingredients were readable, the production and expiry date were found [19]. Food for babies and toddlers, fresh fruits or vegetables, 100% of fruit juices, eggs, specific dietary use (e.g., protein powders, nutritional supplements), and those that did not require nutrition labeling (bakery products produced, packaged and labeled in-store); and meat and cheese products (cut, packaged and labeled in-store) were excluded. Foods were categorized into 35 subgroups and 9 main groups (Supplementary Table 1).

2.3. Determination of the presence of added sugars and non-nutritive sweeteners ingredients

“Added sugars” are defined by the European Food Safety Authority (EFSA) definition [6].

Types of NNS were identified according to the European Union Food Labeling Regulations (EU) and Food Additives Regulation of the Turkish Food Codex [19,25].

Nutritional content information of packaged products was recorded. Nutritional content information of packaged products includes total sugars content, but not added sugars content in Turkey. For this reason, added sugars content was calculated according to the proposed methodology for estimating added sugars content of foods and beverages [26,27] (Supplementary Table 1). Additionally, data for added sugars and/or NNS were obtained from the ingredient lists of packaged products. After entering data into Microsoft Office Excel 2016 spreadsheets; a separate column was opened for each added sugars and/or NNS in the Excel spreadsheets and all added sugar and/or NNS were analyzed with the formula “IF(COUNTIF)” with a double filter.

2.4. Statistical analyses

All statistical analyses were conducted using SPSS Statistics 24.0 (Statistical Package for the Social Sciences, Inc.; Chicago, Illinois, United States). Descriptive statistics (count and percent etc.) were used for added sugars and/or NNS in the packaged foods and beverages subgroups. Mean levels of added sugars were calculated by each main and subgroup. Individual or combined use of added sugars and/or NNS were assessed in each food group. The top three sweeteners in food groups were calculated. Additionally, the types of NNS in packaged foods and beverages were analyzed.

3. Results

We analyzed the ingredients lists of 2514 packaged foods and beverages, of which 1647 (65.5%) contained added sugars and/or NNS (56.7% of total packaged products only contained added sugars, while 6.3% of them contained added sugars and NNS, and 2.5% of them contained only NNS), while 867 (34.5%) of them did not contain added sugars or NNS. Out of 1647 products, 9.7% of them contained both added sugars and NNS. 86.5% only contained added sugars and 3.8% only contained NNS. Most of the products with both added sugars and NNS were in the “snack foods” (n: 68), followed by the “sugars, sweets and other desserts” (n: 58), and the “non-alcoholic beverages” (n: 27) groups. The majority of products with only NNS were in the following categories: “sugars, sweets and other desserts” (n: 36), and “non-alcoholic beverages” (n: 24) groups (the mean number of NNS 0.56 ± 1.58 , and 0.42 ± 0.78 , respectively). Only the “cheese” and “meat and meat products” subgroups contained no added sugars or NNS (Table 1).

According to our results, the most used added sugar was white sugar. Interestingly, all the main groups contained white sugar (50.6%–100%). In addition, 766 products contained “syrup” (not shown in tables). The most used of these syrups was glucose syrup,

Table 1
Frequency of added sugars and/or NNS, the mean amount of totalsugar and the mean number of NNS in a sample of Turkey packaged foods and beverages (n: 2514).

Food Category	Products (n, %)	Products without added sugar and/or NNS (n, %)	Contains added sugar and NNS (n, %)	Contains NNS only (n, %)	Contains added sugar only (n, %)	Mean number of NNS	Mean added sugar g/100 g or ml \pm SD
Meats products							
Meat and meat products	176 (7.0)	176 (100)	–	–	–	–	–
Seafood and seafood products	39 (1.6)	34 (87.2)	–	–	5 (12.8)	–	0.55 \pm 0.38
Total	215 (8.5)	210 (97.7)	–	–	5 (2.3)	–	0.12 \pm 0.79
Oil, fat and nuts							
Edible oil and oils emulsions	16 (0.6)	15 (93.8)	–	–	1 (6.2)	–	–
Nuts	87 (3.5)	73 (84.0)	–	–	14 (16.0)	–	–
Total	103 (4.1)	88 (85.4)	–	–	15 (14.6)	–	–
Dairy products							
Flavoured milk	58 (2.3)	17 (29.3)	–	2 (3.5)	39 (67.2)	0.034 \pm 0.18	5.36 \pm 3.32
Yoghurt	35 (1.4)	2 (5.7)	–	–	33 (94.3)	–	3.73 \pm 2.30
Cheese	160 (6.4)	160 (100)	–	–	–	–	–
Daily desserts and creams	54 (2.1)	4 (7.4)	–	–	50 (92.6)	–	16.17 \pm 13.87
Ice cream	89 (3.5)	–	1 (1.2)	–	88 (98.8)	0.01 \pm 0.10	21.32 \pm 8.21
Total	396 (15.8)	183 (46.2)	1 (0.3)	2 (0.5)	210 (53.0)	0.00 \pm 0.08	13.50 \pm 11.48
Bread, cereal and bakery products							
Packaged bread	49 (1.9)	32 (65.3)	–	–	17 (34.7)	–	–
Breakfast cereals	58 (2.3)	12 (20.7)	2 (3.4)	–	44 (75.9)	0.03 \pm 0.18	7.99 \pm 4.69
Packaged pasties	27 (1.1)	4 (14.8)	3 (11.1)	–	20 (74.1)	0.07 \pm 0.26	10.16 \pm 5.47
Other cereal related products	26 (1.0)	14 (53.8)	–	–	12 (46.2)	–	–
Total	160 (6.3)	62 (38.8)	5 (3.1)	–	93 (58.1)	0.03 \pm 0.17	4.57 \pm 5.85
Sugars, sweets and other desserts							
Jams	64 (2.5)	24 (37.5)	1 (1.6)	8 (12.5)	31 (48.4)	0.40 \pm 1.01	24.58 \pm 10.00
Candies	104 (4.1)	–	18 (17.3)	8 (7.7)	78 (75.0)	0.36 \pm 0.69	54.50 \pm 25.36
Chocolates	270 (10.7)	–	6 (2.2)	–	264 (97.8)	0.03 \pm 0.15	39.84 \pm 12.68
Sugar, halva, molasses and related products	57 (2.3)	1 (1.7)	3 (5.3)	2 (3.5)	51 (89.5)	0.15 \pm 0.62	22.42 \pm 13.71
Chewing gums	57 (2.3)	6 (10.5)	30 (52.6)	18 (31.7)	3 (5.2)	4.67 \pm 2.37	6.04 \pm 19.06
Powder desserts mixes	56 (2.2)	–	–	–	56 (100)	–	16.16 \pm 8.82
Total	608 (24.2)	31 (5.1)	58 (9.5)	36 (5.9)	483 (79.5)	0.56 \pm 1.58	24.49 \pm 23.34
Snack foods							
Packaged cakes	84 (3.3)	–	50 (59.5)	–	34 (40.5)	0.52 \pm 0.50	31.30 \pm 7.46
Biscuits	185 (7.4)	3 (1.7)	18 (9.7)	–	164 (88.6)	0.11 \pm 0.35	30.04 \pm 9.25
Crackers	46 (1.8)	6 (13.0)	–	–	40 (87.0)	–	6.92 \pm 8.03
Chips	51 (2.0)	8 (15.7)	–	–	43 (84.3)	–	1.49 \pm 1.41
Low calorie snacks	19 (0.8)	14 (73.7)	–	–	5 (26.3)	–	10.33 \pm 10.50
Total	385 (15.3)	31 (8.1)	68 (17.7)	–	286 (74.2)	0.17 \pm 0.38	21.89 \pm 14.96
Sauces and broth							
Sauces for breakfast	15 (0.6)	3 (20.0)	–	–	12 (80.0)	–	3.05 \pm 2.07
Ready to eat sauces	103 (4.1)	33 (32.00)	–	–	70 (68.0)	–	5.63 \pm 6.72
Broth	13 (0.5)	7 (53.8)	–	–	6 (46.2)	–	2.02 \pm 2.81
Total	131 (5.2)	43 (32.8)	–	–	88 (67.2)	–	4.89 \pm 6.13
Miscellaneous							
Packaged soup	54 (2.1)	26 (48.1)	–	–	28 (51.9)	–	1.75 \pm 3.22
Ready to eat dishes	132 (5.3)	64 (48.5)	–	–	68 (51.5)	–	1.16 \pm 0.86
Canned foods	127 (5.1)	102 (80.3)	–	–	25 (19.7)	–	1.41 \pm 1.98
Total	313 (12.5)	192 (61.3)	–	–	121 (38.7)	–	1.41 \pm 2.25
Non-alcoholic beverages							
Beverage powder mixes	18 (0.7)	–	–	1 (5.6)	17 (94.4)	0.58 \pm 0.24	5.73 \pm 3.41
Flavoured waters	68 (2.7)	–	15 (22.1)	16 (23.5)	37 (54.4)	0.85 \pm 0.98	7.21 \pm 5.91
Soft drinks	21 (0.8)	9 (42.8)	4 (19.1)	1 (4.8)	7 (33.3)	0.47 \pm 1.07	9.57 \pm 9.11
Fruit juices	59 (2.3)	16 (27.1)	4 (6.7)	–	39 (66.2)	0.67 \pm 0.25	5.33 \pm 1.92
Ice tea and coffee	14 (0.6)	–	4 (28.6)	1 (7.1)	9 (64.3)	0.50 \pm 0.65	4.29 \pm 2.19
Milk drinks and milk substitutes	23 (0.9)	2 (8.7)	–	5 (21.7)	16 (69.6)	0.21 \pm 0.42	2.89 \pm 1.94
Total	203 (8.1)	27 (13.3)	27 (13.3)	24 (11.8)	125 (61.6)	0.42 \pm 0.78	5.41 \pm 4.56
TOTAL (all products)	2514	867 (34.5)	159 (6.3)	62 (2.5)	1426 (56.7)	–	–

Note: Percentages of product with/without added sugars and/or NNS were calculated over the total amount of product in the group, NNS: non-nutritive sweeteners, SD: standard deviation.

being the 2nd and 3rd most used added sugar in most products. Sorbitol with 10.8% in the “sugars, sweets and other desserts” group. Acesulfame potassium was the third most used sweetener at 12.7% in the non-alcoholic beverage group (Table 2).

Additionally, 503 products contained NNS (83.1% packaged foods, 16.9% packaged beverages). The most used NNS was sorbitol (28.4%) (only found in packaged foods), followed by acesulfame potassium with 16.3% (the most used NNS in beverages with 28 products) and aspartame with 14.3%, respectively (Table 3).

4. Discussion

It is important to monitor the added sugars or types of sweeteners used in food and beverage supplies as it is an ongoing challenge for health organizations, globally [7,23]. Limited studies investigated the use of added sugars and/or NNS in packaged foods and beverages [3,7,9,20–24]. To our knowledge, this is the first study to investigate the added sugars and/or NNS in Turkish packaged foods and beverages. 65.5% of the packaged foods and

beverages analyzed contained added sugars or NNS. The most used added sugar was white sugar across all food groups (50.6%–100%) while sorbitol (28.4%) was the most used NNS.

According to our results, of the 2514 packaged products examined, 56.7% of them contained at least one type of added sugar. These results were lower compared to the US (67.9%) (the highest proportion of products with added sugars found in snack foods) [9], Canada (66.0%) (the highest proportion of products with added sugars found in beverages) [21], and Australia (60.6%) (the highest proportion of products with added sugars in confectionery) [7]. In the current study, the highest proportion of products from the “sugars, sweets and other desserts” group contained added sugars (79.5%, n: 483). Only two subgroups “cheese” and “meat and meat products” did not have any added sugars or NNS ingredients. Additionally, the snack foods group was the second-highest number of added sugar products with 74.2% (n: 286). In Turkey, it was reported that sweets, and chocolates, as well as chips, cakes, biscuits, and/or crackers, are consumed at least once per week among Turkish adults [28]. Primary school children consumed chocolate with sugar as a sweetener at least once a week [29]. Consumption of products in these groups can lead to many health problems, especially obesity and type 2 diabetes [28]. These products contain high added sugar as well as fat. Considering the negative health effects, policies to reduce added sugar content in these products are urgently required.

Consumers' interest in low-calorie snacks is increasing day by day. However, the consumption rate of these products is still unclear. It is estimated that the reason for the demand for healthier food choices is the desire for healthier eating habits [30]. The present study showed that only 5 of these products (26.3%) contain added sugars, whereas the mean added sugars amount is 10.33 ± 10.56 g/100 g. As the prevalence of diet product consumption continues to increase, sugar consumption may exceed the WHO recommended rate and may cause greater negative health effects when considering consumption in other foods and beverages.

Childhood obesity in Turkey has shown a dramatic increase in the past few decades. According to the WHO European Childhood Obesity Surveillance Initiative, 22.5% of 7–8-years-olds were obese or overweight (14.2% overweight, 8.3% obese) in 2013. In 2017, it was reported that the prevalence of obesity had grown to around 10% [31]. A study conducted in Turkey stated that consuming sugar-sweetened beverages (soft drinks, juice drinks, etc.) was one of the most common risk factors for childhood obesity [32]. Most of the children consumed fruit juices as an additional food source [33]. In this study, 61.6% of total beverages contained only added sugars,

and 13.3% contained both added sugars and NNS. The results show that it is important to initiate public practices to prevent childhood obesity and related co-morbidities for the regulation of packaged products in addition to healthy nutrition education.

Additionally, food types that are not typically thought of as having added sugars (such as seafood and edible oil and oils emulsions) were also found to contain added sugars. In the edible oil and oils emulsions group, one margarine brand was found to contain added sugars. Added sugars are not only used as a sweetening agent but also used for binding ingredients, fermentation, and coloring of food products in the food industry [7].

White sugar was the most prevalent added sugar in all main food groups while syrups were the second most prevalent one. Compared to previous investigations, our results were similar to the Australian food supply which found white sugar to be the most commonly used [7] but different from the US food supply [9]. The US study found corn syrup as the most prevalent added sugar, followed by sorghum and high-fructose corn syrup, whereas in our study, only one product of all products contained corn syrup and the others were not found [9]. These findings indicate that crops used for sweetening are different in the countries. Turkey is globally the 5th largest country in the world that cultivates sugar beets [34] while Australia's sugar industry produces refined sugar from sugarcane, and the US's sugar industry produces refined sugar from corn [7].

NNS are food additives generally recognized as safe (GRAS) by the Food and Drug Administration (FDA) in the US and EFSA in the European Union. Consumers' interest in NNS is increasing day by day [35], as they are also used in certain medications and health-care products including toothpaste [24]. Although we cannot accurately estimate the intakes of NNS, our results could shed light on the major types of NNS from the packaged food and beverage supply in Turkey for consumers. In the present study, we found 159 (6.3%) of 2514 products contain added sugars and NNS, and 62 (2.5%) of them contain only NNS. Additionally, 20.0% (n: 503) of all products contain more than one NNS (83.1% packaged foods, 16.9% packaged beverages). Comparing countries, Chile had 55.5% of products with NNS, compared to Brazil (13.3%), Mexico (11.0%), the US (4%), New Zealand (1%), and Australia (<1%) [22–24]. According to studies in Spain and Brazil, the most used NNS were acesulfame potassium (25% and 20.1%, respectively) and sucralose (25% and 16.8%, respectively) [3,22]. Therefore, it can be said that acesulfame potassium is a prevalent one compared to the other NNS, especially in beverages. Since in Brazil study, 11.5% of the products were beverages [22] and in Spain study, the majority of the products were beverages [3]. In the current study, acesulfame potassium was

Table 2
Primarily added sugars and NNS for each major food category in a sample of Turkey packaged foods and beverages (n: 2514).

Main Food Groups	Products (n, %)	Top three sweeteners								
		1			2			3		
		Type	n	%	Type	n	%	Type	n	%
Meats Products	215 (8.5)	Sugar (White)	5	100	–	–	–	–	–	–
Oil, fat and nuts	103 (4.1)	Sugar (White)	15	83.3	Dextrose	3	16.7	–	–	–
Dairy Products	396 (15.8)	Sugar (White)	213	68.7	Glucose syrup	51	16.5	Glucose-fructose syrup	46	14.8
Bread, Cereal and Bakery Products	160 (6.3)	Sugar (White)	94	71.8	Glucose syrup	26	19.8	Honey	11	8.4
Sugars, sweets and other desserts	608 (24.2)	Sugar (White)	497	68.0	Glucose syrup	155	21.2	Sorbitol	79	10.8
Snack foods	385 (15.3)	Sugar (White)	310	50.6	Glucose-fructose syrup	199	32.5	Glucose syrup	104	16.9
Sauces and broth	131 (5.2)	Sugar (White)	80	79.2	Glucose syrup	13	12.9	Glucose-fructose syrup	8	7.9
Miscellaneous	313 (12.5)	Sugar (White)	115	81.0	Glucose syrup	13	9.2	Dextrose	7	4.9
								Glucose-fructose syrup	7	4.9
Non alcoholic beverages	203 (8.1)	Sugar (White)	129	58.3	Glucose-fructose syrup	64	29.0	Acesulfame potassium	28	12.7
TOTAL	2514		1458			524			283	

Note: Percentages of primarily added sugars and NNS were calculated on the total amount of product in the group, One product can contain more than one added sugars or NNS, NNS: non-nutritive sweeteners.

Table 3
Frequency of NNS (in descending order) in ingredients lists in a sample of Turkey packaged foods and beverages (n: 2514).

NNS groups	Food and beverage products (n, %)	Food products (n, %)	Beverages products (n, %)
Sorbitol	143 (28.4)	143 (34.2)	–
Acesulfame potassium	82 (16.3)	54 (12.9)	28 (33.0)
Aspartame	72 (14.3)	55 (13.2)	17 (20.0)
Sucralose	62 (12.3)	38 (9.1)	24 (28.2)
Xylitol	47 (9.3)	47 (11.2)	–
Maltitol, maltitol syrup	45 (9.0)	45 (10.8)	–
Isomalt	17 (3.4)	17 (4.1)	–
Saccharin	13 (2.6)	–	13 (15.3)
Mannitol	12 (2.4)	12 (2.9)	–
Erythritol	5 (1.0)	5 (1.2)	–
Steviol glycosides	4 (0.8)	1 (0.2)	3 (3.5)
Neohesperidin	1 (0.2)	1 (0.2)	–
Thaumatococin	–	–	–
Neotame	–	–	–
Cyclamic acid	–	–	–
Lactitol	–	–	–
TOTAL	503	418 (83.1)	85 (16.9)

Note: One product can contain more than one NNS, NNS: non-nutritive sweeteners.

the most used NNS, however, it was the third most used sweetener in beverages. The reason may be that it's inexpensive in addition to being a stable structure. Moreover, compared to other types of NNS, acesulfame potassium is considered to be an enhanced choice as it prevents reactions with other elements of a product while protecting its nutritional values and shelf life [36].

There are some differences in NNS content in reference to sugar policies across these countries. Some countries have implemented policies like sugar-sweetened beverages and junk food taxes or front-of-package warning labels to reduce sugar intake. Due to these policy initiatives, it would be expected that the food and beverage industry may replace added sugars with NNS. The US, Mexico, Australia, and New Zealand have used similar regulations on NNS, however, Mexico was found to have the highest proportion of products containing NNS compared to the US, Australia, and New Zealand [23]. A reason for this inconsistency may be due to the reformulation being undertaken by the Mexican food industry in response to regulatory changes. For example, Mexico has implemented sugar-sweetened beverages and junk food taxes [37,38]. The Chilean government implemented a new Law of Food Labeling and Advertising for fighting growing sales of sugar-sweetened beverages and junk foods. However, NNS content in packaged products, actually, increased after regulations on sugar content were introduced in the country [24,39,40]. In Brazil, a cooperation agreement was signed between the National Health Surveillance Agency (ANVISA) and the Brazilian Food Industry Association with targets for reducing sugar in packaged products (eg, processed cakes, cake mix, dairy products, chocolate, sugary beverages, and baked goods) [41], but it was found a high prevalence of packaged products contain NNS, especially in food groups that form the basis of the Brazilian diet [22]. In Spain, the Ministry of Health, Consumption and Social Welfare and the Spanish Agency for Consumer Affairs, Food Safety and Nutrition (AECOSAN) have issued the “Collaboration Plan for the improvement of the composition of foods and beverages and other measures 2017–2020” for decreasing added sugar contents of key food groups such as sugar-sweetened beverages, bakery products, breakfast cereals, fruit nectars, and dairy products [42]. Therefore, NNS have acquired a pivotal role as an alternative to added sugars in Spain [3].

In Turkey, there are no tax policies or warning labels. Additionally, packaged products are given in only the amount of added sugars in nutritional contents but not given the amount of added sugars, or NNS. Therefore, the current study provides information

on the use of added sugars or NNS in packaged foods and beverages. Considering the study results, it is important to know the amount of free sugars, added sugars, or NNS since 1647 (65.5%) of all products containing added sugars or NNS. Additionally, products containing both added sugars and NNS were mostly in the “snack foods” group, followed by the “sugars, sweets and other deserts” group and the “non-alcoholic beverages” group. The “sugars, sweets and other deserts” group had the most products containing only NNS, followed by the “non-alcoholic beverages” group. All of these products are highly consumed across all age groups, especially among children. Many studies have shown that when consumption of NNS exceeds certain doses, it causes diseases such as obesity, diabetes, CVD, and metabolic syndrome [10–14,17,18]. Research conducted in the form of our current study can enable consumers' awareness about the content of added sugars or NNS, and be helpful for developing practical policy recommendations or voluntary policies.

Food labeling is very important that enables consumers to make more healthful choices by providing information at the point of purchase. In a study on the use of nutrition labels in Turkey, consumers stated that terms, symbols, and values could not be understood. The information was poorly presented and concerns about the accuracy of the information in packaged products were questionable [43]. Therefore, as in other countries, a standard, and understandable nutritional label should be applied for packaged products that both added sugars and NNS are mandatory to be declared in the nutrition facts panels in Turkey. The contents of packaged products and the amount of these contents should be monitored regularly through studies or practices. Additionally, new strategies and educational programs can be organized to encourage the consumers to read the nutrition labels on food packaging and to raise awareness of health safety related to food choices.

4.1. Strength and limitations

While the study has some strengths and limitations, it is the first to identify the major types of added sugars and NNS in a sample of packaged Turkey foods and beverages in the Republic of Turkey. We collected the nutritional ingredient lists from supermarkets. Data were entered into spreadsheets. After that, we coded and classified the products and used a double filter for all sweeteners. Although a double filter is a manual process, it is an accurate way to identify added sugars and NNS on ingredient lists. Next, we transferred data from Excel to the SPSS program for analyzing data. However, although extreme care was taken, human error may still have occurred. Additionally, the analyses for this study relied on nutritional values and ingredient lists reported on product labels that may not accurately represent what is in the foods. Another limitation of the study is that the amount of added sugars was calculated according to the previously published methodology. For this reason, it does not give the exact amount of added sugars content in packaged products. However, since it is not obligatory to specify the amount of added sugar on the labels of packaged products in Turkey, this study is a guide for further studies. The sample size is small as three supermarkets in the middle-income areas were visited once. Therefore, they may not reflect all samples of packaged foods and beverages. Moreover, the brands/types of products available in middle-income areas may differ from those in low- and high-income areas.

5. Conclusion

Almost a third of packaged products had added sugars or NNS, and white sugar being the most prevalent added sugar in the Turkish food supply. The implications of these could affect public

health due to the concern that high sugar intake can cause obesity and other chronic diseases. Our findings involve an updated comprehensive identification and assessment of the main added sugars and NNS declared in packaged foods and beverages sold in Turkey. There is a lack of information about the knowledge of added sugars and NNS in packaged foods and beverages for consumers. Thus it may be important to start monitoring the prevalence of products containing added sugars and NNS. As we created the first database of its kind in Turkey to analyze the types of added sugars and NNS used in each of the food and beverage subgroups; we can now track these changes should their use increase or decrease in the future. In conclusion, such investigations in Turkey could increase the overall consumer understanding of the most common types of added sugars and NNS in Turkish packaged foods and beverages.

Authorship statement

Hatice Merve BAYRAM and Arda OZTURKCAN: Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing - review & editing. Hatice Merve BAYRAM: Investigation, Software. Arda OZTURKCAN: Project administration, Supervision.

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Declaration of competing interest

The authors have a conflict of interest to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clnesp.2022.03.006>.

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