EVALUATION OF PUBLIC KNOWLEDGE AND BELIEFS OF ADVERSE HEALTH EFFECTS OF UNHEALTHY FOOD AND KNOWLEDGE AND BELIEFS BASED INEQUALITIES AMONG VARIOUS SOCIO-DEMOGRAPHIC GROUPS IN LITHUANIA

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SUMMARY

Objectives: The availability of information on healthy products does not ensure the empowerment of people with the knowledge on how to choose or avoid food products or dishes depending on unhealthy factors. Public knowledge and beliefs of unhealthy food effects on health needs to be evaluated so that appropriate measures can be taken to properly inform people and relevant socio-demographic groups.

Methods: The original survey questionnaire containing questions about specific food groups and various health effects was compiled. A total of 1,007 respondents, Lithuanian residents aged 18–75 years, were surveyed in March 2019. Multilevel stratified probability sampling method was used for data representativeness.

Results: Almost half of respondents (46.2%) knew that deep-fried food could cause cancer. The majority of respondents (68.4%) were aware that sugar causes obesity and 61.7% were aware that sugar increases the risk of diabetes mellitus; 41.6% (more often those living in non-rural areas) know that grilled meat may cause cancer. More than half of respondents (57.2%) (more likely those living in non-rural areas and those with a university degree) were aware that smoked meat products may cause cancer. Only 46.4% were aware of the fact that salt raises blood pressure and the risk of cardiovascular diseases.

Conclusion: Only about half of Lithuanian residents aged 18–75 were aware of the scientifically proven harmful effects of unhealthy food groups. Socio-demographic factors influence the knowledge and beliefs of the population.

INTRODUCTION

Unhealthy food increases the risk of obesity, non-communicable diseases such as cancer, cardiovascular diseases, diabetes mellitus, and premature mortality. A wide range of popular food products and dishes may be unhealthy because their ingredients or the substances that form during the food production process may trigger non-communicable diseases (1–4).

Unhealthy foods are commonly considered to be deep-fried food, grilled food, smoked products, foods high in sugar and salt. Their negative effects on health are confirmed by various research results. Most food products for deep frying sold in shops and restaurants are starchy or with a starchy coating, such as fish fingers, chicken nuggets, French fries, potato chips, etc. Starchy food high in carbohydrates when deep-fried in high temperature forms acrylamide which is a carcinogen (5). Some researchers

have linked deep-fried food to diabetes mellitus, cardiovascular diseases, high blood cholesterol (6, 7), and obesity (8). Grilled foods contain polycyclic aromatic hydrocarbons (9) and heterocyclic aromatic amines (10), which are carcinogens (11). Carcinogenic substances (polycyclic aromatic hydrocarbons (benzo (a) pyrene) is released by smouldering wood to food when meat, fish or other products are smoked (11, 12). However, it is worth noting that benzo (a) pyrene is not associated with liver cancer (13). Salt raises blood pressure and the risk of cardiovascular diseases (14). It is known that high sugar intake is associated with obesity (15–19) and diabetes mellitus (20). Scientists also associate sugar consumption with liver damage and liver diseases (21–23). Some studies show that people who like salty foods have a higher risk of stomach cancer (24–26) although some research reviews deny this claim (27). The influence of salt on gastric cancer is related to the influence of H. pylori on gastric cancer (26) and

therefore this study only considers it as an indirect effect of salt on gastric cancer.

Non-communicable diseases prevention, health promotion, educational programmes, social networks, and media highlight information on what healthy food and healthy nutrition is, what to eat and what to avoid, or how to cook healthy meals (1–3). Informing the public about healthy nutrition usually does not overlook what food products and dishes are unhealthy, however, there is a lack of emphasis on how and why such food products are likely to cause non-infectious diseases. Without getting sufficient information why certain foods are unhealthy, on the one hand, people tend to be afraid or avoid particular food products, on the other hand, they may select food products by themselves by labels and substances or ingredients they are composed of, what may pose risks to their health and trigger non-infectious diseases.

Unfortunately, no recent studies have been found that would investigate the public knowledge and beliefs on the negative health effects of popular food products and dishes which contain ingredients or substances that form during the production process and that may be a cause of non-communicable diseases. Due to a lack of information or its diversity in the society, myths are formed and the society focuses only on specific groups of generic foods (generic names of dishes and products) and not on the ingredients or production technology of a particular product. Without knowing the public knowledge and beliefs about the risk of unhealthy food products and without knowing the knowledge and beliefs differences between the different socio-demographic groups, it would be wrong to implement health and educational programmes or media campaigns. It is important to know and take into account relevant socio-demographic groups, their specific knowledge and beliefs of unhealthy food products, and their impact on health in order to achieve the results of the targeted campaign and programme. Such information will enable the development of appropriate and effective nutrition policies in countries, educational and informative programmes and campaigns that can, in the long term, adequately enable the people to select foods based on their ingredients and production technologies. The lack of such information determined the purpose of the study – to evaluate knowledge and beliefs of adverse health effects of unhealthy food and knowledge- and beliefs-based inequalities among various socio-demographic groups in Lithuania.

MATERIALS AND METHODS

The original survey questionnaire with questions about specific food groups and various health effects was compiled. Unhealthy foods were divided into five groups according to their composition and adverse health effects (deep-fried food, sugar and sweet pastry, grilled food, smoked products, salt and salty food). Such food groups are often selected in Lithuania when conducting research on unhealthy food consumption habits. A total of 1,007 respondents, Lithuania's residents aged 18–75 years, were surveyed in March 2019. The survey was conducted by a professional market and public opinion research company using a multilevel stratified probability sampling method that provides data representativeness, i.e. each household in the country has an equal opportunity to be surveyed and the target population corresponds to the target population according to target criteria. The results of the study represent the knowledge and beliefs of all regions of the country and the population within the age range of 18–75.

Stata and WinPepi statistical programs were used for statistical processing of the data. 95% CIs were calculated for prevalence estimates. To find out what socio-demographic factors have a significant impact on the respondents' knowledge and beliefs of the health effects of various unhealthy foods, the Pearson Chi square test was used to analyze the data. The difference was considered statistically significant at $p \leq 0.05$.

The respondents were grouped by gender, age, education, income, and place of residence (Table 1).

RESULTS

Knowledge and Beliefs about Unhealthy Food

The results of the study show that more than half of those surveyed (55.9%) knew that deep-fried food is the reason of overweight and obesity, 50% of the respondents claim that these products increase blood cholesterol, and 46.2% believe that deep-fried food can cause cancer. The results of the survey also reveal that the majority of the population knew that sugar and sweet pastry increase the risk of diabetes mellitus and cause overweight and obesity (68.4% and 61.7%, respectively). Nearly half of the respondents (46.4%) were aware that salt and salty foods increase blood pressure and can cause cardiovascular diseases. According to the respondents, grilled meat and smoked products are associated with cancer (41.6% and 57.2%, respectively) (Table 2).

Table 1. *Characteristics of respondents (N = 1,007)*

	n	%
Gender		
Male	476	47.3
Female	531	52.7
Age		
Less than 45 years	517	51.3
45 years and more	490	48.7
Place of residence		
Rural area (up to 500 residents)	297	29.5
Small town (between 500 and 100,000 residents)	276	27.4
Big city (more than 100,000 residents)	434	43.1
Education		
No university degree	629	62.5
University degree	378	37.5
Income (netto) per month		
700 € and less	574	57.0
More than 700 €	433	43.0

Table 2. *Distribution of respondents according to their knowledge and beliefs of effects of unhealthy food on people's health (N = 1,007)*

Food group	Increases blood cholesterol % 95% CI	Increases blood pressure, can cause cardio-vascular diseases % 95% CI	Increases risk of diabetes mellitus % 95% CI	Causes over-weight and obesity % 95% CI	Increases risk of cancer % 95% CI	May cause liver damage % 95% CI	Has no nega-tive effects on health % 95% CI	Unaware of effects on health % 95% CI
Deep-fried food	50.0 47.0–53.1	38.1 35.2–41.2	26.0 23.4–28.8	55.9 52.8–59.0	46.2 43.1–49.3	40.3 37.3–43.4	1.9 1.2–2.9	4.7 3.5–6.2
Sugar, sweet pastry	33.0 30.1–35.9	24.9 22.4–27.7	68.4 65.5–71.2	61.7 58.6–64.6	23.3 20.8–26.1	21.3 18.8–23.9	1.8 1.1–2.8	4.2 3.1–5.6
Grilled food	30.9 28.1–33.8	26.1 23.5–28.9	9.9 8.2–11.9	17.6 15.4–20.1	41.6 38.6–44.7	30.6 27.8–33.5	12.5 10.6–14.7	8.6 7.1–10.5
Smoked products	33.6 30.7–36.5	40.4 37.4–43.5	11.9 10.1–14.1	24.1 21.6–26.9	57.2 54.1–60.2	33.6 30.7–36.5	5.4 4.1–6.9	6.1 4.7–7.7
Salt, salty products	15.7 13.6–18.1	46.4 43.3–49.5	9.3 7.7–11.3	14.1 12.1–16.4	9.3 7.7–11.3	16.2 14.1–18.6	10.5 8.8–12.6	12.5 10.6–14.7

Knowledge and Beliefs among Various Socio-demographic Groups

When evaluating the distribution of respondents according to their knowledge and beliefs of the effects of deep-fried food on health, statistically significant differences were found between men and women across socio-demographic groups. More women than men indicated that those products increased the levels of cholesterol, blood pressure and diabetes mellitus, could cause cancer, liver damage, and obesity. Significantly more respondents with a university degree knew and indicated that deep-fried food caused overweight and obesity (60.6% and 53.1%, respectively), while more respondents without university degree associated deep-fried food with the increased blood pressure and cardiovascular diseases (40.7% and 33.9%, respectively) (Table 3).

The analysis of the distribution of respondents according to their knowledge and beliefs of the effects of sugar and sweet pastry products on people's health showed significant differences between men and women: more women (35.8%) than men (29.8%) believed that those products increased cholesterol levels, caused overweight and obesity (67.4% and 55.3%, respectively) or could cause cancer (26.2% and 20.2%, respectively). We also found that a significantly higher proportion of younger respondents thought that the use of those products increased blood pressure and the risk of cardiovascular diseases (27.7% and 22.0%, respectively) (Table 3).

The evaluation of the distribution of respondents based on their knowledge and beliefs of the impact of grilled food on people's health in different socio-demographic groups, significant differences were found between males and females (a statistically significant difference was observed between gender groups – more females than males believed that consumption of grilled food increased blood cholesterol (33.7% and 27.7%, respectively) and could lead to liver damage (33.7% and 27.1%, respectively). More respondents with non-university degree claimed that grilled food increased blood cholesterol levels and the risk of diabetes mellitus. Also, significantly more respondents with higher education (47.4%) were aware of the association of the consumption of grilled food and the risk of cancer compared to respondents without a university degree (38.2%) (Table 3).

A statistically significant relationship was found between the respondents' knowledge that smoked products are likely to increase blood pressure and cause cardiovascular diseases, and their gender, place of residence, age and income (positive responses were given by significantly more women, residents of small cities, and those older than 45 years and with a lower income). We also found that the respondents' knowledge that smoked products could cause cancer was significantly associated with the place of residence. The proportion of residents who were aware that smoked products may increase the chance of cancer was significantly higher in small towns (64.1%) and in large cities (56.5%) than in rural areas (51.9%) (Table 3).

Statistically significant differences were found between different age groups in evaluating the distribution of respondents based on their knowledge and beliefs of the effect of salt on health. The respondents over the age of 45 knew that salt and salty foods could increase blood pressure and cause cardiovascular diseases than the respondents younger than 45 years of age (52.4% and 40.6%, respectively). More of the younger respondents (16.6%) were unaware of the health effects of salt compared to older respondents (8.2%). Significantly more respondents without a university degree believed that salt could cause cancer, liver damage, increased risk of diabetes mellitus, overweight and obesity compared to those with a university degree (Table 3).

DISCUSSION

This was the first study in Lithuania that aimed to evaluate knowledge and beliefs of adverse health effects of unhealthy food and knowledge- and beliefs-based inequalities among various socio-demographic groups. The results of this study showed that it is necessary to provide people more information about adverse health effects of unhealthy food.

Table 3. *Distribution of respondents according to their knowledge and beliefs of effects of various unhealthy food products and socio-demographic characteristics (N = 1,007)*

Effects on health	Food products*	Socio-demographic characteristics																
		Gender			Age			Place of residence				Education			Income (netto) per month		
		Male	Female	p-value	Less than 45 years	45 years and more	p-value	Rural area	Small town	Big city	p-value	No university degree	University degree	p-value	700 € and less	More than 700 €	p-value
Increases blood cholesterol, %	F	43.7	55.7	<0.01	47.8	52.4	0.14	50.2	51.8	48.8	0.74	51.0	48.4	0.42	51.9	47.6	0.17
	SW	29.8	35.8	0.04	32.5	33.5	0.74	35.4	36.2	29.3	0.09	34.3	30.7	0.23	33.1	32.8	0.92
	GR	27.7	33.7	0.04	29.4	32.4	0.30	32.0	34.4	27.9.	0.16	34.2	25.4	<0.01	32.4	28.9	0.23
	SP	27.3	39.2	<0.01	36.0	31.0	0.10	32.3	37.0	32.3	0.38	35.5	30.4	0.10	34.3	32.6	0.56
	S	12.8	18.3	0.02	15.3	16.1	0.71	15.8	18.5	13.8	0.25	16.7	14.0	0.26	17.4	13.4	0.08
Increases blood pressure, can cause cardiovascular diseases, %	F	34.9	41.1	0.04	40.2	35.9	0.16	41.1	38.8	35.7	0.33	40.7	33.9	0.03	38.9	37.2	0.59
	SW	23.3	26.4	0.27	27.7	22.0	0.04	28.6	22.5	24.0	0.20	26.2	22.8	0.22	24.9	24.9	0.99
	GR	25.4	26.7	0.63	25.0	27.3	0.39	25.6	29.3	24.4	0.34	28.1	22.8	0.06	27.7	24.0	0.19
	SP	36.1	44.3	0.01	37.3	43.7	0.04	42.8	46.4	35.0	<0.01	41.0	39.4	0.62	44.4	35.1	<0.01
	S	43.3	49.2	0.06	40.6	52.4	<0.01	45.5	50.7	44.2	0.22	44.2	50.0	0.07	46.7	46.0	0.82
Increases risk of diabetes mellitus, %	F	22.3	29.4	0.01	27.1	24.9	0.43	31.0	25.0	22.3	0.06	26.9	24.6	0.43	28.0	23.3	0.09
	SW	66.2	70.4	0.15	69.1	67.8	0.66	65.7	72.1	68.0	0.24	68.4	68.5	0.96	69.3	67.2	0.47
	GR	9.9	10.0	0.96	9.3	10.6	0.48	13.1	10.1	7.6	0.05	12.1	6.3	<0.01	11.1	8.3	0.14
	SP	10.3	13.4	0.13	13.3	10.4	0.15	12.8	11.2	11.8	0.84	14.0	8.5	0.01	12.4	11.3	0.61
	S	9.2	9.4	0.93	9.9	8.8	0.55	11.4	9.8	7.6	0.21	11.6	5.6	<0.01	9.9	8.5	0.45
Causes overweight and obesity, %	F	48.7	62.3	<0.01	58.2	53.5	0.13	52.5	56.5	57.8	0.36	53.1	60.6	0.02	54.2	58.2	0.20
	SW	55.3	67.4	<0.01	62.1	61.2	0.78	56.2	64.5	63.6	0.07	59.9	64.6	0.15	61.8	61.4	0.89
	GR	18.1	17.1	0.70	19.0	16.1	0.24	19.5	17.4	16.4	0.54	18.6	15.9	0.27	17.8	17.3	0.85
	SP	21.2	26.7	0.04	25.3	22.9	0.36	24.2	23.9	24.2	0.99	24.3	23.8	0.85	24.4	23.8	0.83
	S	13.2	14.9	0.46	13.7	14.5	0.73	16.5	13.4	12.9	0.36	15.9	11.1	0.04	14.6	13.4	0.58

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Effects on health	Food products*	Gender			Age			Place of residence				Education			Income (netto) per month		
								Socio-demographic characteristics									
		Male	Female	p-value	Less than 45 years	45 years and more	p-value	Rural area	Small town	Big city	p-value	No university degree	University degree	p-value	700 € and less	More than 700 €	p-value
Increases risk of cancer, %	F	43.1	49.0	0.06	47.4	44.9	0.43	42.1	51.8	42.1	0.06	46.9	45.0	0.55	45.5	47.1	0.61
	SW	20.2	26.2	0.02	24.0	22.7	0.62	23.6	21.7	24.2	0.75	26.1	18.8	0.01	23.5	23.1	0.88
	GR	39.3	43.7	0.16	39.5	43.9	0.16	37.7	48.9	39.6	0.01	38.2	47.4	<0.01	40.6	43.0	0.45
	SP	54.2	59.9	0.07	56.1	58.4	0.47	51.9	64.1	56.5	0.01	54.7	61.4	0.04	56.8	57.7	0.77
	S	10.3	8.5	0.32	10.3	8.4	0.30	9.4	10.5	8.5	0.68	11.6	5.6	<0.01	10.5	7.9	0.16
May cause liver damage, %	F	35.5	44.6	<0.01	41.2	39.4	0.56	43.8	45.3	34.8	<0.01	42.9	36.0	0.03	45.6	33.3	<0.01
	SW	19.3	23.0	0.16	20.9	21.6	0.77	26.9	19.9	18.2	0.02	24.5	15.9	<0.01	22.8	19.2	0.16
	GR	27.1	33.7	0.02	28.0	33.3	0.07	29.3	35.5	28.3	0.11	32.4	27.5	0.1	32.8	27.7	0.09
	SP	29.6	37.1	0.01	31.7	35.5	0.20	38.0	36.2	28.8	0.02	37.8	26.5	<0.01	37.3	28.6	<0.01
	S	17.2	15.3	0.40	16.6	15.7	0.69	16.5	16.3	15.9	0.98	18.0	13.2	0.05	17.6	14.3	0.16
Has no negative effects on health, %	F	2.5	1.3	0.16	1.7	2.0	0.73	1.3	1.4	2.5	0.42	2.4	1.1	0.13	1.7	2.1	0.70
	SW	2.9	0.8	0.01	1.5	2.0	0.56	1.3	1.4	2.3	0.56	2.2	1.1	0.18	1.6	2.1	0.55
	GR	15.1	10.2	0.02	12.6	12.4	0.95	13.8	10.9	12.7	0.56	14.5	9.3	0.02	12.0	13.2	0.59
	SP	8.2	2.8	<0.01	4.1	6.7	0.06	5.1	4.0	6.5	0.35	6.2	4.0	0.13	4.4	6.7	0.10
	S	11.1	10.0	0.55	9.3	11.8	0.19	10.8	11.6	9.7	0.71	12.1	7.9	0.04	11.1	9.7	0.49
Unaware of effects on health, %	F	6.9	2.6	0.01	5.4	3.9	0.25	3.4	4.3	5.8	0.31	4.3	5.3	0.47	3.5	6.2	0.04
	SW	5.7	2.8	0.02	5.6	2.7	0.02	2.4	3.6	5.8	0.07	3.8	4.8	0.47	2.6	6.2	<0.01
	GR	9.9	7.5	0.19	11.0	6.1	0.01	4.7	8.0	11.8	<0.01	7.3	10.8	0.05	7.1	10.6	0.05
	SP	8.0	4.3	0.02	7.5	4.5	0.04	4.4	5.4	7.6	0.18	5.6	6.9	0.40	4.5	8.1	0.02
	S	15.3	10.0	0.01	16.6	8.2	<0.01	8.1	8.7	18.0	<0.01	10.5	15.9	0.01	10.5	15.2	0.02

*F – deep-fried food; SW – sugar and sweet pastry; GR – grilled food; SP – smoked products; S – salt and salty food

The study showed that only 46.2% of the respondents knew that deep-fried food could cause cancer. These results may have been due to a lack of knowledge about what deep-fried food may contain. It is possible that people do not know that deep-fried food almost always has starch and when the starch is cooked in high temperatures the acrylamide may form.

Surprisingly, more than half of those surveyed knew that sugar and sweet pastry contributes to overweight and obesity (61.7%,) and increases the risk of diabetes mellitus (68.4 %). The fact that a large percentage of people know that sugar consumption is related to weight gain and risk of diabetes mellitus was also found by other researchers (28). Women were significantly more aware of the influence of sugar and sweet pastry on overweight and obesity. This may be due to the fact that women are more inclined to take care of their appearance and therefore know about food that increase the risk of overweight and obesity. The results of a study in India also confirmed that women have better knowledge about the health effects of fast food consumption (29).

It is important to note that although more than 40% of respondents knew that grilled food could cause cancer and that salt raises blood pressure and the risk of cardiovascular diseases, more than one in ten respondents was mistakenly convinced that grilled food and salty food has no negative effects on health. Such research results demonstrate the need to educate people about the negative health effects of grilled food and salty food. According to other researchers, a significantly higher proportion of people were aware of the effects of salt on hypertension and cardiovascular diseases (30).

Despite the constant media coverage of the carcinogenic effects of substances in smoked foods, only 57.2% of respondents were aware of the fact. There were significantly more individuals with this knowledge among respondents with higher education. Such results can be explained by the fact that respondents with higher education tend to take more care of their health.

Limitations

The survey was conducted under varying conditions: some respondents were surveyed by a professional interviewer, while the rest filled out the questionnaires independently. Some respondents may have wanted to appear "better" and seek information on the negative health effects of unhealthy foods while completing questionnaires on their own. The analysis of the knowledge and beliefs of different groups of respondents about the various health effects of unhealthy foods did not take into account the influence of other socio-demographic factors. These factors could have had a slight influence on the results of the study.

CONCLUSIONS

The results of this study are an important source of information that reveals an acute issue in Lithuanian public health: only about half of Lithuanian residents aged 18–75 years were aware of the scientifically proven adverse health effects of a variety of unhealthy foods. The results also revealed that some socio-demographic factors exert a significant influence on populations knowledge about adverse health effects of unhealthy foods. We believe that the results of this study send a clear message to the policy makers: there is a need to find effective ways of raising public awareness of the scientifically based specific adverse health effects of unhealthy foods and products and that socio-demographic factors must be taken into account when planning public health intervention measures.

Conflict of Interests
None declared

REFERENCES

1. Evans AE, Dave J, Tanner A, Duhe S, Condrasky M, Wilson D, et al. Changing the home nutrition environment: effects of a nutrition and media literacy pilot intervention. Fam Community Health. 2006;29(1):43-54.
2. Tobey LN, Manore MM. Social media and nutrition education: the food hero experience. J Nutr Educ Behav. 2014;46(2):128-33.
3. Wakefield MA, Loken B, Hornik RC. Use of mass media campaigns to change health behaviour. Lancet. 2010;376(9748):1261-71.
4. Cecchini M, Sassi F, Lauer JA, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: health effectsand cost-effectiveness. Lancet. 2010;376(9754):1775-84.
5. Abramsson-Zetterberg L. Strongly heated carbohydrate-rich food is an overlooked problem in cancer risk evaluation. Food Chem Toxicol. 2018;121:151-5.
6. Cahill LE, Pan A, Chiuve SE, Sun Q, Willett WC, Hu FB, et al. Fried-food consumption and risk of type 2 diabetes and coronary artery disease: a prospective study in 2 cohorts of US women and men. Am J Clin Nutr. 2014;100(2):667-75.
7. Gadiraju TV, Patel Y, Gaziano JM, Djoussé L. Fried food consumption and cardiovascular health: a review of current evidence. Nutrients. 2015;7(10):8424-30.
8. Guallar-Castillón P, Rodríguez-Artalejo F, Fornés NS, Banegas JR, Etxezarreta PA, Ardanaz E, et al. Intake of fried foods is associated with obesity in the cohort of Spanish adults from the European Prospective Investigation into Cancer and Nutrition. Am J Clin Nutr. 2007;86(1):198-205.
9. Masuda M, Wang Q, Tokumura M, Miyake Y, Amagai T. Simultaneous determination of polycyclic aromatic hydrocarbons and their chlorinated derivatives in grilled foods. Ecotoxicol Environ Saf. 2019;178:188-94.
10. Viegas O, Novo P, Pinto E, Pinho O, Ferreira IM. Effect of charcoal types and grilling conditions on formation of heterocyclic aromatic amines (HAs) and polycyclic aromatic hydrocarbons (PAHs) in grilled muscle foods. Food Chem Toxicol. 2012;50(6):2128-34.
11. Diggs DL, Huderson AC, Harris KL, Myers JN, Banks LD, Rekhadevi PV, et al. Polycyclic aromatic hydrocarbons and digestive tract cancers: a perspective. J Environ Sci Health C Environ Carcinog Ecotoxicol Rev. 2011;29(4):324-57.
12. Gomaa EA, Gray JI, Rabie S, Lopez-Bote C, Booren AM. Polycyclic aromatic hydrocarbons in smoked food products and commercial liquid smoke flavourings. Food Addit Contam. 1993;10(5):503-21.
13. Warshawsky D. Polycyclic aromatic hydrocarbons in carcinogenesis. Environ Health Perspect. 1999;107(4):317-9.
14. Meneton P, Jeunemaitre X, de Wardener HE, MacGregor GA. Links between dietary salt intake, renal salt handling, blood pressure, and cardiovascular diseases. Physiol Rev. 2005;85(2):679-715.
15. Alexander Bentley R, Ruck DJ, Fouts HN. U.S. obesity as delayed effect of excess sugar. Econ Hum Biol. 2020 Jan;36:100818. doi: 10.1016/j. ehb.2019.100818.
16. de Ruyter JC, Olthof MR, Seidell JC, Katan MB. A trial of sugar-free or sugar-sweetened beverages and body weight in children. N Engl J Med. 2012;367(15):1397-406.
17. Twarog JP, Peraj E, Vaknin OS, Russo AT, Woo Baidal JA, Sonneville KR. Consumption of sugar-sweetened beverages and obesity in SNAP-eligible children and adolescents. Prim Care Diabetes. 2020;14(2):181-5.
18. Grummon AH, Smith NR, Golden SD, Frerichs L, Taillie LS, Brewer NT. Health warnings on sugar-sweetened beverages: simulation of impacts on diet and obesity among U.S. Adults. Am J Prev Med. 2019;57(6):765-74.
19. Anari R, Amani R, Veissi M. Sugar-sweetened beverages consumption is associated with abdominal obesity risk in diabetic patients. Diabetes Metab Syndr. 2017;11 Suppl 2:S675-8.

20. Malik VS, Popkin BM, Bray GA, Després JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. Circulation. 2010;121(11):1356-64.

21. Shimony MK, Schliep KC, Schisterman EF, Ahrens KA, Sjaarda LA, Rotman Y, et al. The relationship between sugar-sweetened beverages and liver enzymes among healthy premenopausal women: a prospective cohort study. Eur J Nutr. 2016;55(2):569-76.

22. Jensen T, Abdelmalek MF, Sullivan S, Nadeau KJ, Green M, Roncal C, et al. Fructose and sugar: a major mediator of non-alcoholic fatty liver disease. J Hepatol. 2018;68(5):1063-75.

23. Ma J, Fox CS, Jacques PF, Speliotes EK, Hoffmann U, Smith CE, et al. Sugar-sweetened beverage, diet soda, and fatty liver disease in the Framingham Heart Study cohorts. J Hepatol. 2015;63(2):462-9.

24. Strumylaite L, Zickute J, Dudzevicius J, Dregval L. Salt-preserved foods and risk of gastric cancer. Medicina (Kaunas). 2006;42(2):164-70.

25. D'Elia L, Rossi G, Ippolito R, Cappuccio FP, Strazzullo P. Habitual salt intake and risk of gastric cancer: a meta-analysis of prospective studies. Clin Nutr. 2012;31(4):489-98.

26. Peleteiro B, Lopes C, Figueiredo C, Lunet N. Salt intake and gastric cancer risk according to Helicobacter pylori infection, smoking, tumour site and histological type. Br J Cancer. 2011;104(1):198-207.

27. Wang XQ, Terry PD, Yan H. Review of salt consumption and stomach cancer risk: epidemiological and biological evidence. World J Gastroenterol. 2009;15(18):2204-13.

28. Park S, Lundeen EA, Pan L, Blanck HM. Impact of knowledge of health conditions on sugar-sweetened beverage intake varies among US adults. Am J Health Promot. 2018;32(6):1402-8.

29. Khongrangjem T, Dsouza SM, Prabhu P, Dhange VB, Pari V, Ahirwar SK, et al. A study to assess the knowledge and practice of fast food consumption among pre-university students in Udupi Taluk, Karnataka, India. Clin Epidemiol Global Health. 2018;6(4):172-5.

30. Cheikh Ismail L, Hashim MH, Jarrar AN, Mohamad MT, Saleh S, Jawish N, et al. Knowledge, attitude, and practice on salt and assessment of dietary salt and fat intake among University of Sharjah Students. Nutrients. 2019;11(5):941. doi: 10.3390/nu11050941.