Public awareness of food and other lifestyle-related factors towards cancer development among adults in Slovakia: a pilot study

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Summary
Based on observational evidence, approximately 30–40 % of cancers could be prevented through introduction of healthier food, nutrition and other lifestyle habits and patterns. Knowledge of diet and lifestyle factors that modify cancer risks and prevention is an important tool to achieve appropriate behavioural changes. In USA and in some other countries, cancer awareness studies have been performed on regular basis. In Slovakia, evaluation of public awareness about cancer risk factors is rare. The main objective of this study was to evaluate modifiable cancer risk factors awareness among adults in a selected Slovakian region and to investigate what is the influence of body mass index and personal or family history of cancer on this knowledge. A cross-sectional survey was carried out and 234 randomly selected adult respondents were anonymously interviewed by a questionnaire on the awareness of 20 various diet and lifestyle factors, with a question, which of them represent risk for cancer. The results of the study showed low awareness of recognized cancer risk factors. Body weight and personal or family history of cancer did not substantially change this knowledge. The study confirms the need for targeted and continuous anticancer educational interventions in Slovakia, in particular in the high-risk population.

Keywords
cancer; awareness; food; lifestyle; risk factors

Cancer caused over 8 million deaths worldwide in 2013 and has moved from the third leading cause of death in 1990 to the second leading cause, behind cardiovascular diseases in 2013. According to incidence, mortality and DALYs (Disability-adjusted life-years), cancer represents global burden worldwide [1].

Negative trends of cancer disease in Slovakia are documented by the data of cancer incidence, mortality and prevalence. Cancer has, for a long time, been the the second largest cause of death in Slovakia with a share of approximately 25 %. While in men and women over 65 years of age, cardiovascular and oncological diseases dominated among the causes of death, cancer alone was the leading cause of death in the population under 64 years of age with a share of 29.2 % in men and 44.5 % in women [2].

Cancer incidence rates in Slovakia in 2008 indicated a rapid increase of cancer cases for both sexes, but mainly among females. While in 2007, 28 131 new cancer cases were notified, in 2008, the total number of registered cases reached as much as 30 144 new cancer cases. This rapid increase and large occurrence of cancer in males is caused mainly by colorectal, lung and prostate tumours. In females, the dramatic increase of overall number of cancer cases was primarily caused by breast cancer, non-melanoma skin cancer, female genital organs, colorectal and lung cancers and, to

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a lesser extent, by other cancer sites [3].

Significant progress has been made in recent years in the field of prevention and treatment for certain cancers. However, despite this progress, cancer burden has been increasing owing to a growing and aging global population as well as due to risk factors like smoking, obesity and dietary patterns [1]. Moreover, a determinant element in the process of behavioural change is knowledge of real cancer risk factors, which people can modify in their life. Several epidemiological studies have identified factors that show a causal relationship with cancer development. It has been estimated by various authorities that about one-third of cancers in Western high-income societies are due to factors relating to food, nutrition and physical activity. The international authorities WCRF (World Cancer Research Fund, London, United Kingdom) and AICR (American Institute for Cancer Research, Washington, D.C., USA) emphasize that cancer prevention is possible by behavioural changes, which include regular consumption of vegetables, daily physical activity and limited intake of red meat and alcoholic beverages [4]. There is also convincing evidence to indicate that physical activity decreases the risk of colon cancer. Factors which probably increase cancer risk include high dietary intake of preserved meats, salt-preserved foods and salt, as well as very (thermally) hot beverages and food. Probable protective factors are consumption of fruits and vegetables, as well as physical activity (e.g. for breast cancer). After smoking tobacco, overweight and obesity appear to be the most important known avoidable causes of cancer [5]. Adherence to the WCRF/AICR cancer prevention recommendations, developed to reduce incidence of common cancers, could substantially reduce cancer-specific mortality in older adults or in high-risk population [6, 7].

In 2001, AICR first commissioned a survey to gauge public awareness of various lifestyle-related cancer risk factors. The aim was to find out how well the American public was able to separate clearly established cancer risks from factors about which no such scientific consensus exists, but which many in the public believe cause cancer [8]. The evaluation of public knowledge about risk factors associated to cancer in Slovakia is rare [9].

Main objective of this study was to evaluate modifiable cancer risk factors awareness among adults in a selected Slovakian region. Further objective was to investigate what is the influence of body mass index (*BMI*) and personal or family history of cancer on this knowledge.

MATERIALS AND METHODS

Study design

A cross-sectional survey was carried out during October 2014 in the population of residents in the town Trnava (Western Slovakia) and surrounding areas aged 18 years and above. The random sample included 234 respondents in total. All subjects gave their voluntary consent before anonymously answering the survey.

The questionnaire of the survey contained twenty questions on the awareness of various cancer risk factors according to international literature [10] and the AICR 2013 Cancer Risk Awareness Survey Report [11], including 1) tobacco/smoking, 2) excessive sun exposure, 3) inherited predisposition/cancer genes, 4) stress, 5) industrial pollution, 6) alcohol, 7) overweight/obesity, 8) decreased immunity, 9) genetically modified foods, 10) diet low in vegetables and fruit, 11) hormones in animal meat, 12) insufficient physical activity, 13) viruses and bacteria, 14) cured and smoked meat, 15) artificial sweeteners, 16) mobile phones, 17) sugar, 18) diet high in red meat, 19) coffee, 20) milk.

Respondents had to express their awareness of these factors toward cancer for each of them by the answering the question: “Do you consider this

Tab. 1. Socio-demographic and clinical health characteristics of respondents (n = 234).

Parameter	Subgroup	Respondents	
		Number n	Percentage [%]
Gender	Men	72	30.8
	Women	162	69.2
Age in years	< 35	96	41.0
	35–50	39	16.7
	> 50	99	42.3
Region of residence	Rural	100	42.7
	Urban	134	57.3
Education	Basic	16	6.8
	Secondary	171	73.1
	High	47	20.1
Average monthly income in Euros	< 500	145	62.0
	500–1 000	69	29.5
	> 1000	20	8.5
Body mass index [kg·m^{-2}]	< 25	127	54.3
	≥ 25	107	45.7
Personal/family history of cancer	Yes	160	68.4
	No	74	31.6

Tab. 2. Study respondents' awareness of cancer risk factors (n = 234).

Risk factor		Respondents	
		N	[%]
1	Tobacco/smoking	217	92.7
2	Excessive sun exposure	212	90.6
3	Inherited predisposition/ cancer genes	201	85.9
4	Stress	197	84.2
5	Industrial pollution	192	82.1
6	Alcohol	136	58.1
7	Overweight/obesity	136	58.1
8	Decreased immunity	134	57.3
9	Genetically modified foods	113	48.3
10	Diet low in vegetables and fruit	111	47.4
11	Hormones in animal meat	108	46.2
12	Insufficient physical activity	103	44.0
13	Viruses and bacteria	94	40.2
14	Cured and smoked meat	91	38.9
15	Artificial sweeteners	86	36.8
16	Mobile phones	83	35.5
17	Sugar	73	31.2
18	Diet high in red meat	33	14.1
19	Coffee	24	10.3
20	Milk	14	6.0

N – the number of respondents, who considered the stated factor as a cancer risk factor and answered "Yes, it is the risk factor for cancer development".

factor as a risk for cancer development?" For each factor, three closed answers were defined: 1) "Yes, it is a risk factor", 2) "No, it is not a risk factor", 3) "I don't know".

For eight convincing or probable cancer risk factors [5], which were in our survey represented by items number 1, 2, 6, 7, 10, 12, 14, 18, we established three levels of awareness: high (more than 80 % of respondents consider them as a risk for cancer development), average (79–50 % of respondents consider them as a risk for cancer development) and insufficient (less than 50 % of respondents consider them as a risk for cancer development).

Independent variables (socio-demographic parameters such as age, gender, region of residence, education, average monthly income) were included into questionnaire. Respondents were further asked for their actual body weight and height in order to calculate their *BMI* and for their personal/family history of cancer (in this case "personal" history meant having been cancer patient in the past or being cancer patient at present; and "family" history meant cancer present in parents, children, husband/wife, and brother/sister). Respondents were subdivided into separated subgroups according to their *BMI* (< 25 kg·m^{-2}; ≥ 25 kg·m^{-2}) [12], and according to personal/family history of cancer (with personal/family history of cancer; without personal/family history of cancer).

The questionnaire's validity was at the beginning checked in a pilot study on 10 participants and its results showed that the questionnaire was acceptable and understandable.

Statistical analysis

All statistical analyses were conducted using Microsoft Excel (Microsoft, Redmond, Washington, USA) and statistical software R (R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics included frequency and percentages in various categories within our random sample [13]. The Pearson Chi-square test of independence was used to measure the association and dependence between the chosen subgroups. As the Pearson Chi-square test is based on the assumption of normality, we also performed Shapiro-Wilk normality tests [14]. As an alternative method, the distribution-free non-parametric Mann-Whitney U test (MW-test) was applied to identify the differences between probability distribution of our variables [13]. Results in all applied analyses were considered statistically significant when the p-value of the tests was lower than the chosen significance level $\alpha = 0.05$.

RESULTS

Of the total 234 respondents, 72 were men (30.8 %), 162 women (69.2 %) and 57.3 % were from urban areas near Trnava. The average age of the respondents was 43.5 years with a standard deviation (*SD*) of 19.2 years. A number of 160 respondents (68.4 %) had positive family history of cancer; 23 of them suffered directly from diagnosed cancer. The share of participants with *BMI* ≥ 25 kg·m^{-2} was 107 participants (45.7 %) (Tab. 1).

The results in Tab. 2 show how many of the respondents are aware of certain convincing cancer risk factors. The results showed that a significant majority of them correctly identified tobacco/smoking (92.7 %) and excessive sun exposure (90.6 %) as a cancer risk. The awareness level of these two factors may be considered as high (more than 80 % of respondents). Awareness of further

six clearly established food or lifestyle-related risk factor was following: the average awareness level (79–50 % of respondents) was achieved for alcohol (58.1 %) and overweight/obesity (58.1 %), insufficient awareness level (less than 50 % of respondents) was found for diet low in vegetables and fruit (47.4 %), insufficient physical activity (44.0 %), cured and smoked meat (38.9 %) and alarmingly low was awareness for diet high in red meat (14.1 %). More than 80 % of respondents perceived inherited predisposition/cancer genes, stress and industrial pollution as risk factors for cancer development. Nearly half of respondents believed that genetically modified food (48.3 %) and hormones in animal meat are related to cancer development. About one third of respondents connected artificial sweeteners (36.8 %) and sugar (31.2 %) with cancer risk. Shares of 10.3 % and 6 % of the respondents, respectively, believed that even drinking coffee and milk are cancer risk factors.

In our first analysis, we examined relationship between cancer risk awareness and history of cancer among respondents. Respondents were divided into two subgroups: with personal/family history of cancer and without personal/family history of cancer. The Mann-Whitney test (MW-test) detected no statistically significant differences (on the significance level $\alpha = 0.05$) between cancer risk awareness within these two groups of respondents (p-values of all MW-tests was greater than 0.05; Tab. 3). Using Pearson Chi-square test, we found statistically significant dependence between cancer risk awareness and history of cancer only for artificial sweeteners (38.8 % respondents with personal/family history of cancer; 32.4 % respondents without personal/family history of cancer; p-value of the Pearson Chi-square test $p_{Pe} = 0.049$). For the sake of completeness, we considered the results of the Pearson Chi-square test only as additional, because they had only a low information value. We found out that our data (in case of all

Tab. 3. Relationship between cancer risk awareness and history of cancer among respondents ($n = 234$).

Risk factor	Respondents with personal/family history of cancer ($n = 160$)		Respondents without personal/family history of cancer ($n = 74$)		p_{MW}	p_{Pe}
	N	[%]	*N*	[%]		
Tobacco/smoking	147	91.9	70	94.6	0.437	0.388
Excessive sun exposure	146	91.3	66	89.2	0.962	0.338
Inherited predisposition/cancer genes	140	87.5	61	82.4	0.334	0.404
Stress	136	85.0	61	82.4	0.402	0.600
Industrial pollution	131	81.9	61	82.4	0.780	0.179
Alcohol	94	58.7	42	56.8	0.936	0.731
Overweight/obesity	95	59.4	41	55.4	0.964	0.658
Decreased immunity	94	58.8	40	54.1	0.964	0.442
Genetically modified foods	83	51.9	30	40.5	0.189	0.406
Diet low in vegetables and fruit	79	49.4	32	43.2	0.389	0.677
Hormones in animal meat	77	48.1	31	41.9	0.287	0.526
Insufficient physical activity	72	45.0	31	41.9	0.722	0.551
Viruses and bacteria	70	43.8	24	32.4	0.259	0.182
Cured and smoked meat	62	38.8	29	39.2	0.652	0.659
Artificial sweeteners	62	38.8	24	32.4	0.829	0.049*
Mobile phones	58	35.3	25	33.8	0.372	0.213
Sugar	50	31.3	23	31.1	0.641	0.644
Diet high in red meat	20	12.5	13	17.6	0.179	0.380
Coffee	13	8.1	11	14.9	0.435	0.267
Milk	8	5.0	6	8.1	0.854	0.584

N – the number of respondents, who considered the stated factor as a risk factor and answered "Yes, it is a risk factor for cancer development", p_{MW} – the p-value of the Mann-Whitney U test, p_{Pe} – p-value of the Pearson Chi-square test.
* – results significant on a level of $\alpha = 0.05$.

variables) did not obey normal distribution, which caused violation of the assumptions of the Pearson test (*p*-values of Shapiro-Wilk normality test were in any case lower than 0.001).

Within the second analysis, we studied relationship between cancer risk awareness and overweight/obesity of respondents (Tab. 4). Respondents were divided into two groups: respondents with *BMI* < 25 kg·m^{-2} and *BMI* ≥ 25 kg·m^{-2}. With regard to respondents' *BMI*, according to Pearson Chi-square test on the significance level of 0.05, we found a statistically significant dependence between cancer risk awareness and overweight/obesity of respondents in four factors: industrial pollution (86.0 % respondents with *BMI* ≥25 kg·m^{-2}; 78.7 % respondents with *BMI* <25 kg·m^{-2}; p_{Pe} = 0.016), insufficient physical activity (53.3 % respondents with *BMI* ≥25 kg·m^{-2}; 36.2 % respondents with *BMI* <25 kg·m^{-2}; p_{Pe} = 0.031), sugar (39.3 % with *BMI* ≥25 kg·m^{-2}; 24.4 % respondents with *BMI* <25 kg·m^{-2}; p_{Pe} = 0.044) and coffee (15.9 % respondents with *BMI* ≥25 kg·m^{-2}; 5.5 % respondents with *BMI* <25 kg·m^{-2}; p_{Pe} = 0.020). Borderline statistical significance on the significance level $\alpha \in (0.050, 0.100)$ was recorded for consumption of cured and smoked meat (p_{Pe} = 0.071).

Mann-Whitney test showed statistically significant difference between the two groups of respondents only in one factor: insufficient physical activity (*p*-value of the Mann-Whitney U test p_{MW} = 0.012). In other four factors, only borderline statistical importance was found (industrial pollution p_{MW} = 0.096, viruses and bacteria p_{MW} = 0.085, cured and smoked meat p_{MW} = 0.066, sugar p_{MW} = 0.074).

DISCUSSION

Scientific evidence now confirms that cancer is a preventable disease and it requires major

Tab. 4. Relationship between cancer risk awareness and overweight/obesity of respondents (*n* = 234).

Risk factor	Respondents with *BMI* <25 kg·m^{-2} (*n* = 127)		Respondents with *BMI* ≥25 kg·m^{-2} (*n* = 107)		p_{MW}	p_{Pe}
	N	[%]	*N*	[%]		
Tobacco/smoking	118	92.9	99	92.5	0.936	0.595
Excessive sun exposure	117	92.1	95	88.8	0.418	0.328
Inherited predisposition/cancer genes	113	89.0	88	82.2	0.136	0.315
Stress	109	85.8	88	82.2	0.448	0.741
Industrial pollution	100	78.7	92	86.0	0.096	0.016*
Alcohol	76	59.8	60	56.1	0.482	0.638
Overweight/obesity	71	55.9	65	60.8	0.614	0.544
Decreased immunity	74	58.3	60	56.1	0.633	0.778
Genetically modified foods	63	49.6	50	46.7	0.671	0.908
Diet low in vegetables and fruit	55	43.3	56	52.3	0.453	0.111
Hormones in animal meat	58	45.7	50	46.7	0.778	0.909
Insufficient physical activity	46	36.2	57	53.3	0.012*	0.031*
Viruses and bacteria	56	44.1	38	35.5	0.085	0.192
Cured and smoked meat	41	32.3	50	46.8	0.066	0.071
Artificial sweeteners	49	38.6	37	34.6	0.994	0.378
Mobile phones	44	34.7	39	36.5	0.653	0.878
Sugar	31	24.4	42	39.3	0.074	0.044*
Diet high in red meat	18	14.2	15	14.0	0.856	0.814
Coffee	7	5.5	17	15.9	0.316	0.020*
Milk	4	3.2	10	9.4	0.552	0.106

N – the number of respondents, who considered the stated factor as a risk factor and answered "Yes, it is a risk factor for cancer development", p_{MW} – *p*-value of the Mann-Whitney U test, p_{Pe} – *p*-value of the Pearson Chi Square test.
* – results significant on a level of $\alpha = 0.05$.

lifestyle changes [15]. The fact that only 5–10% of all cancer cases are due to genetic defects and the remaining 90–95% are due to unhealthy environment and lifestyle, such as tobacco smoking, unhealthy diet, excessive alcohol consumption or physical inactivity, provides major opportunities for preventing cancer [16]. Observational evidence suggests that approximately 30% to 40% of cancer cases are potentially preventable via modification of nutritional factors and food consumption patterns [17].

Behaviour is a key determinant of people's health. Promoting healthy lifestyles is a complex and long term process requiring changes of behavioural habits of people. The knowledge of awareness of the links between various diseases and lifestyle, including risk and protective factors, is a necessary prerequisite of peoples' healthy behaviour. We also agree that correct information alone is rarely sufficient to change individual's behaviour, and a mix of individual, social and environmental cognitive interventions, together with personal motivation, are needed [18].

Sanderson presented that awareness of lifestyle risk factors in United Kingdom was low for circulatory diseases and cancer, while it was higher for heart disease than for cancer [19]. Several surveys showed high public awareness of the links between smoking and cancer, but considerably lower awareness of the impact of other lifestyles factors, such as diet or physical inactivity [10, 20]. Ryan et al. in 2015 reported poor awareness of risk factors for cancer in Irish adults and warned that a sizable portion of the population was misinformed about cancer risk [21].

The results of our study indicated that public awareness of food and lifestyle-related factors towards cancer among Slovak adults is low except for tobacco/smoking (92.7%) and excessive sun exposure (90.6%). Antismoking campaigns and legislative measures are those measures that are probably responsible for this high knowledge level and a decline in the number of daily smokers mainly in older people [22]. Further actions, such as graphic warnings on the cigarette labels, and more attention targeted on the younger generation are needed. AICR 2015 Cancer Risk Awareness Survey Report also stated that majority of Americans correctly identify tobacco (94%) and excessive sun exposure (84%) as cancer risks [8].

According to the above-mentioned AICR Report, 52% Americans know that there is relationship between overweight/obesity and cancer and 43% believe that alcohol is a carcinogen. In contrast to the American survey, our respondents were more familiar with the awareness that alcohol (58.1%) and overweight/obesity (58.1%) are cancer risks. We consider the awareness of these two risk factors as average. A share of 4–25% of the disease burden due to specific cancers is attributable to alcohol worldwide [23]. Despite better knowledge, the consumption of alcoholic beverages in Slovakia is still higher compared to European average consumption. Probably most people still underestimate alcohol as a general risk factor for various diseases.

The awareness of other convincing lifestyle-related cancer risk factors in our study remained very low. Less than a half of the respondents were aware about the links between diet low in vegetables and fruit (47.4%), insufficient physical activity (44.0%), cured and smoked meat (38.9%) with respect to cancer development. We found extremely low awareness of the diet high in red meat (14.1%) despite the fact that heavy consumption of red meat is a risk factor for several cancers, especially those of the gastrointestinal tract (mainly colorectal cancer), but also for prostate, bladder, breast, pancreas and oral cancers [15]. Significant association with processed meat intake was observed for cardiovascular diseases, cancer, and "other causes of death". The European Prospective Investigation into Cancer and Nutrition (EPIC) study estimated that 3.3% of deaths could be prevented if all participants had a processed meat consumption of less than 20 g daily [24]. According to published data, the consumption of meat in Slovakia is lower than the recommended intake in the European Union. Rather than quantity, from our point of view, the problem is connected with their choices and preferences. In Slovakia, mainly pork meat is consumed, while the share of fish meat consumption is very low. High prices of "healthier" kinds of meat and low financial income of a large part of the population are frequently given as arguments to explain this phenomenon. Vegetables and legumes belong to the low-price foods and, due to their health benefits, increased consumption of both is recommended. By contrast, their real consumption is also insufficient [25].

Another EPIC study revealed that the risk of colorectal cancer was inversely associated with intake of fruits, vegetables and total fibre [26]. Across 19 European Union (EU) member states providing data, an average 63% of adults ate fruits daily, women generally more than men. According to these data, 74% females and 54% males in Slovakia ate fruits daily. Daily vegetable consumption ranged from around 50% in Estonia, Germany, Malta and the Slovakia to 75% in France and Slovenia, with highest consumption in Bel-

gium and Ireland at 85 % and 95 %, respectively. The average consumption of vegetables across 18 EU countries was the same as for fruit, i.e. 63 %. Daily consumption of vegetables in Slovakia is even lower than that of fruits, as only 58 % Slovak females and 44 % males consume vegetables daily [27].

A particular problem seems to be the insufficient physical activity of the inhabitants of Slovakia. According to Eurobarometer focused on sport and physical activity, 41 % of people older than 15 years never do any exercise or sport and another 25 % practice it only occasionally (less than once a week) [28]. The evidence for decreased risk with increased physical activity is classified as convincing for breast and colon cancers, probable for prostate cancer, possible for lung and endometrial cancers and insufficient for cancers at all other sites [29]. Except for cancer prevention, exercise can decrease side effects of anticancer therapy, and it also can aid in recovery and rehabilitation following chemotherapy, radiation and surgery. Observational studies of breast, colon and prostate cancer survivors show robust associations between post diagnosis exercise and decreased cancer [30]. Based on existing evidence, some public health organizations have issued physical activity guidelines for cancer prevention, generally recommending at least 30 min of moderate-to-vigorous intensity physical activity on more than or 5 days weekly.

Our study results showed that high percentage of the respondents had inaccurate information about real cancer risks, while a large part of them trusted and overrated the unconvincing or even mythic factors as cancer causes. In this study, a lot of respondents believed that cancer is caused by industrial pollution (82.1 %), decreased immunity (57.3 %), genetically modified foods (48.3 %), hormones in animal meat (46.2 %), artificial sweeteners (36.8 %), mobile phones (35.5 %) or coffee (10.3 %). On the other hand, only 6 % of respondents considered milk as a risk factor of cancer. Milk and dairy products have preventive effects with regard to colon cancer, but at the same time it may probably raise the risk of prostate cancer. Anyway, the evidence indicating health-promoting effects of milk and milk product consumption on prevention of cancers is considerably greater than that representing harmful impacts [31].

Epidemiological studies showed that obesity is a risk factor for post-menopausal breast cancer, cancers of endometrium, colon and kidney, malignant adenomas of oesophagus. Obese subjects have an approximately 1.5–3.5-fold increased risk of developing these cancers compared with normal-weight subjects, and it has been estimated that between 15 % and 45 % of these cancers can be attributed to overweight and obesity in Europe. More recent studies suggest that obesity may also increase the risk of other types of cancer, including pancreatic, hepatic and gallbladder cancer [32].

According to a nationally representative survey EHES (European Health Examination Survey) carried out in 2011 among Slovak individuals aged 18–64 years, 61.8 % were overweight, from them 36.2 % were pre-obese and 25.6 % were obese (based on measured weight and height). Overweight prevalence estimates for men and women were 69.6 % and 56.0 %, respectively. The prevalence of obesity for men and women was 25.9 % and 25.4 %, respectively [33]. Approximately 45 % of our respondents had $BMI \geq 25$ kg·m^{-2}. It should be taken into account that actual body height and weight of respondents were not directly measured and the reality can be different. A total of 58.1 % of all respondents mentioned obesity as a risk factor for cancer development. The survey of awareness of obesity as a risk factor for cancer of the digestive system and other organs in Slovakia revealed a surprisingly high level of general knowledge (73.8 %) [9]. This finding strongly contrasts with other published data: 62.7 % in Moroccan population [10], 52 % American [8] and only 33 % Irish adults presume obesity/overweight as a risk factor for cancer [21].

We were interested, if there is some relationship between awareness levels of respondents with respect to their *BMI*. The presence or absence of overweight or obesity could influence people to find relevant data on the impact of body weight on health and disease, or even implement actions for maintenance of healthy weight. Although there were only four statistically significant differences in awareness of respondents with respect to their *BMI* by using two statistical tests, respondents with overweight/obesity showed better awareness of two important cancer risk factors: insufficient physical activity (53.3 % versus 36.2 %; $p_{Pe} = 0.031$) and sugar (39.3 % versus 24.4 %; $p_{Pe} = 0.044$).

In USA, cancer affects approximately three out of four families; in the Western world it touches one in every three families [34]. A portion of 68.4 % of our respondents reported personal/family history of cancer. They represent a special "risk" population, which needs greater attention on cancer-preventing lifestyle. It is also known that majority of cancer survivors do not adopt optimal protective health behaviours (e.g. smoking cessation, physical activity) that are known to prevent new or recurrent cancer disease, despite their

increased risks for future illness. Some researchers accent the necessity of developing educational strategies to inform cancer patients and their families and to encourage active participation of cancer survivors in prevention and care [35].

Our results showed no differences of knowledge between respondents with or without personal/family history of cancer. We summarize that respondents with cancer experience have the same low awareness of cancer risk and preventive factors (diet, food, physical activity) as responders without cancer in their personal or family history. Their chances for cancer protective behaviour are therefore limited. Usually, high-risk populations have tended to have stronger beliefs that hereditary, genetic or biological factors cause their disease rather than lifestyle [19, 36].

The development of cancer does not mean that it is too late to make lifestyle changes, which can reduce the risk of the disease progressing or recurring after remission. Indeed, lifestyle refers to personal choices that can impact health and well-being, as well as it can improve an individual‘s chance of disease-free survival and overall survival [37]. Raising awareness is important, being the basic strategy to improve cancer prevention and control. People, and mainly high-risk population, need to be guided and educated in effective protective behaviour in their daily life. Development and implementation of a nationwide cancer prevention and control strategy therefore must use targeted models to be comprehensive and must include all stakeholders and participants, especially health professionals, public health institutions, politics and public [38].

Limitation of this study is in its local character and unrepresentative sample. The results therefore cannot be automatically applied to the general population in Slovakia. The evaluated awareness involved some selected food and lifestyle factors. There still exist further factors, such as salt consumption, fat distribution or consumption of organic products. Awareness of these factors may be also important for building good cancer risks-related knowledge. Use of open-end questions for better and more precise expression of respondents can be recommended. Our results suggest that people suffering from cancer, or with cancer in their families, even if they are obese, do not have better knowledge. Education and age can be most important factors of this knowledge [9], but we did not evaluate these demographic variables in this study.

As far as we know, this study can be seen as a first attempt to evaluate general awareness of cancer risk factors in Slovakia. Identification of insufficient level of some of the well-known cancer-related factors is balanced with study limitations and may be a subject to further research.

CONCLUSION

Good public awareness about the link between diet, food, physical activity and other risk and preventive factors with respect to cancer can lead to positive changes in the prevention of malignant tumours. The results of our study indicate that:

1. The sample of our study respondents has low awareness of recognized cancer risk factors. Satisfactory amount of respondents was aware only of the well-known and long discussed cancer risk factors (namely, tobacco/smoking and excessive sun exposure).
2. Respondents overestimated risk of genetics, stress, immunity or industrial pollution, and underestimated the protective role of vegetables and fruits in diet or physical activity.
3. There was an extremely low awareness of red meat as a cancer risk.
4. The awareness levels of respondents with high and low *BMI*, or positive and negative personal/family history of cancer, were generally comparable.
5. A statistically significant dependence was found in the respondents with overweight/obesity for awareness of insufficient physical activity ($p_{Pe} = 0.031$) and for sugar ($p_{Pe} = 0.044$) as risk factors.

The study confirmed the need for targeted and continuous anticancer educational interventions. High-risk population groups (such as cancer survivors, cancer patients and their families, or people with overweight/obesity) do not have better knowledge, and therefore it cannot be expected that a high percentage of individuals from these groups will practise rational anti-cancer lifestyle. Because health knowledge is a strong determinant of lifestyle behaviours, our data may be useful tool to enhance the promotion of cancer awareness in Slovakia.

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