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SAUDI COMMUNITY CARE AWARENESS FOOD FACTS, NUTRIENTS, IMMUNE SYSTEM AND COVID-19 PREVENTION IN TAIF CITY AMONG DIFFERENT AGE CATEGORIES

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ABSTRACT

In December 2019, a new coronavirus was discovered in China, sparking a serious pandemic of human acute respiratory syndrome which spread worldwide at a fast rate. Public health knowledge and awareness is required on food facts, nutrients and immune system for coronavirus prevention. The study designed to investigate COVID-19 impact on dietary intake, knowledge, habits, activities and lifestyle among the people in Taif City. Data collection was conducted from the 4th to the 29th of June 2020. A total of 312 respondents, aged from ≤ 12 to ≥ 65 years were involved in the survey. About 81% of the respondents were with high education level (bachelor's degree or higher). Results show that the most frequent diseases in descending order of magnitude were obesity, dental problems, high blood pressure, diabetes, low immunity and colon problems. Data collected showed an increase in food intake frequency during the epidemic except for (4.44, 41.82,12.86, and 30.51 %), like fish, bread, pasta and fast food, respectively. Two hundred and eight (208) of the respondents preferred to use olive oil in their diet due to its several benefits. The majority of the respondents preferred star anise (124) followed by sagebrush (44) as herbal drinks in descending order, respectively. During the COVID-19 pandemic, the study population reported to eat more herbs such as garlic (169), ginger (152) and curcuma (103) to enhance the immune system. Multivitamin (66) and vitamin D intake were reported as the highest, while vitamin B^{Group} and ascorbic acid recorded similar intakes values. Mineral supplement intake in descending order were reported as calcium (57), iron (37) zinc (29) and selenium (5). Around 119 of the respondents had no knowledge on the exact source of COVID-19, while 113 reported as an infection from a bat to humans. The respondents recognized the symptoms as fever (270) and shortness of breath (249). Observing social distance and hand washing were chosen by most respondents (301) as a way of preventing the infection. Two cases of smokers quit the smoking habit; a minor increase rate of training activity was reported; almost all of the respondents embraced the consumption of functional foods, oils, herbs, roots, colored fruits and vegetables and special supplements during COVID-19. Knowledge on covid-19 had significant positive impact on the respondents' healthy eating habits, physical exercise, water intake and reduced smoking. Findings recommended intensifying efforts in sensitizing the public to a better understanding of the COVID-19 pandemic and strengthening the immune system.

Key words: COVID-19, Prevention, Food Facts, Nutrients, Immune System, Survey

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INTRODUCTION

Coronavirus, which was newly exposed as novel coronavirus or even COVID-19 can cause serious illness in humans as respiratory infections vary from ordinary flu to more severe diseases that may lead to mortality due to careless treatment that is carried out [1]. The infection has no known vaccine and the medical treatments are limited to symptoms relief. There were 170,639 established cases, 117,882 recoveries and 1,428 deaths in Saudi Arabia as of 25th June, 2020 [2]. To prevent further spread of the COVID-19, government agencies embarked on sensitization of the members of public on the need for observing social distance, good hygiene, wearing of face masks, temperature screening everywhere, closing of airspace, national borders, schools, public places and self-isolation of travelers returning from other countries [3]. The public knowledge level of infectious disease can prevent spread of infections [4]. On the other hand, some social media platforms spread fear, unverified news and suggest unconfirmed cures [5]. Additionally, work routine interruption might result in boredom, which results in a larger intake of simple carbohydrates [6]. Stress as a result of reading or hearing continuously about new infection rates leads toward simple carbohydrates intake, which can encourage serotonin production and reduce stress. On the other hand, these foods can cause cardiovascular diseases, obesity, and enhance inflammation, which can cause more severe complications than coronavirus [7,8]. Moreover, diet and smoking may influence sleep quality due to pro-inflammatory cytokines [9]. Improving on nutrition status by changing lifestyle and eating habits is needed, especially in the COVID-19 period as the immune system could fight back. The immune system is dependent on adequate amounts of nutrients (carbohydrates, fats and proteins, as well as water and micronutrients such as vitamins and minerals) [10]. The immune system is comprised of B cells, T cells, phagocytosis and the complement system [11]. It is the body's basic defense against foreign infections [12]. It has been documented that a "well-fed" immune system can help to defend against pathogenic organisms [13]. Anti-viral food items are recommended to boost the immune system and protect from the infectious COVID-19[14].

This study sought to explore the Saudi Community care awareness, food facts, nutrients, immune system and COVID-19 prevention in Taif City among different categories of people/individuals as well as their perceptions on the pandemic.

MATERIALS AND METHODS

Design and subjects

Data collection was conducted from the 4th to the 29th of June 2020. A total of 312 randomly selected respondents, aged from ≤ 12 to ≥ 65 years were involved in the survey in Taif City. The questionnaire included four different sections: (1) socio-demographic characteristics such as age; gender, hometown, education and disease history, (2) lifestyle habits such as smoking, sleep hours, drinking water, training activity and eating junk food frequency before and during COVID-19 pandemic period, (3) nutritional status such as foods consumed before and during COVID-19, functional foods intake for the immune system such as oils, herbs, roots, colorful fruits and vegetables and special supplements. (4) COVID-19 knowledge such as source, transmission, symptoms, prevention, hygiene and COVID-19 information sources.

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Statistical analysis

The respondents's replications categorical data were used as frequency and the percentages, calculated, analyzed as mean and standard deviations and evaluated with Cronbach's alpha coefficient and by one-way ANOVA. Various dimensions were presented the satisfaction influence by multiple linear regression analysis. Statistical software (SPSS), Version 20.00, was used for correlations between different categories.

RESULTS AND DISCUSSION

To enhance the immune system viz a viz the coronavirus pandemic, a multi-level of COVID-19 prevention actions is presented (Fig. 1).

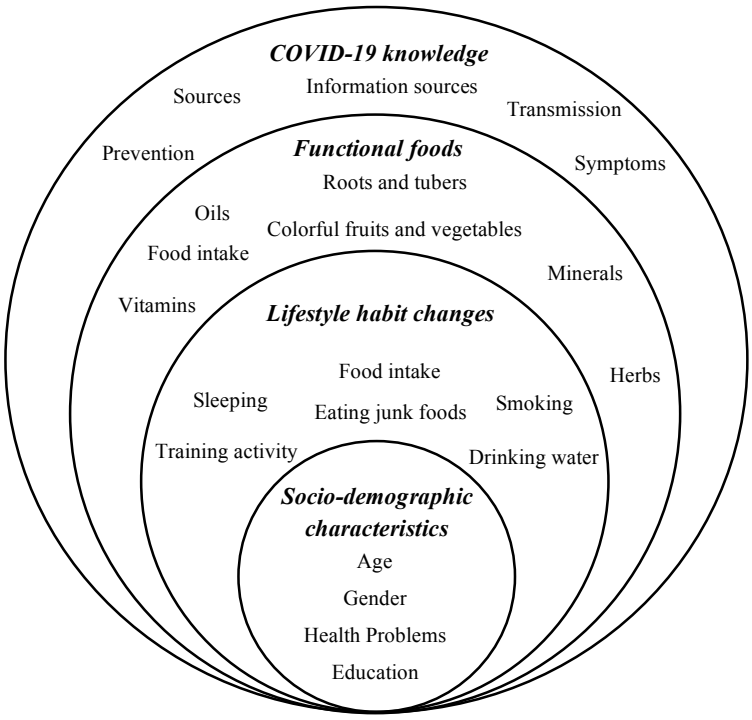

Figure 1: A multi-level of COVID-19 prevention actions

Socio-demographic characteristics

The established responses from 312 respondents in Taif City who had effectively completed the questionnaires, as on the 29th of June 2020, that was the data deadline collection for this *online*-survey. Table (1) shows the population with the socio-demographic characteristics of the study (n = 6 children ≤ 12 years; n = 118 adolescents 13-21 years; n = 149 adults 22-64 years; n = 39 elderly ≥ 65 years). There were 206 female respondents (66%), and more than three-quarters (81%) of the respondents were with high education level (bachelor's degree or higher). Table (2) indicates widespread self-reported health problems. Results show that the most frequent diseases in descending order of magnitude were obesity, dental problems, high blood pressure, diabetes, low immunity and colon problems. Obesity is the key to low-grade inflammation due to the adipokine secretion of the adipose tissue with the

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immunomodulatory effects [8], as it can contribute to other diseases such as diabetes, dyslipidemia, hypertension or even respiratory viral infections and failure [15].

Lifestyle changes before and during COVID-19

Most of the respondents (96%) reported to have changed their lifestyles during the COVID-19 lockdown period. Table (3), the frequency the number of and of smoking smokers have been reduced during the epidemic. Sleeping hours were increased due to work turn off and boredom. It is exciting to notice that the number of respondents who smoked ≥10 cigarettes/day decreased by one percent. This phenomenon might explain the smokers' fear of the increase of respiratory risks and mortality associated with COVID-19 [16]. A higher frequency of training activity during the pandemic was detected as compared to the pre- COVID-19 period. Those respondents who did not exercise before the pandemic, started training with a rate of 1.3%. Training type frequency data is presented in Fig. 2 as X axis refers to the number of the respondents. A minor increase in all categories for training activity was detected, especially for home training and bodyweight. Eating junk food also decreased as almost all of the respondents reported to have changed their food choices. Drinking water frequency was also improved during the pandemic. Chi- square test recorded 10.50 values at a significant level ($P \leq 0.005$). Increasing water drinking frequency works on the mucous membranes sedimentation of lining in the respiratory tract, which can help in white blood cells, antibodies production and enhance the immune system [17].

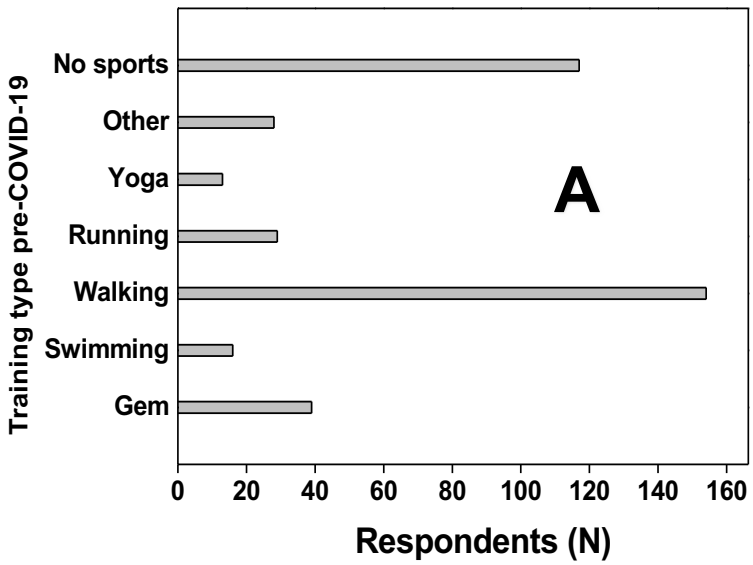

Figure 2A: Training activity types of respondents pre-COVID-19

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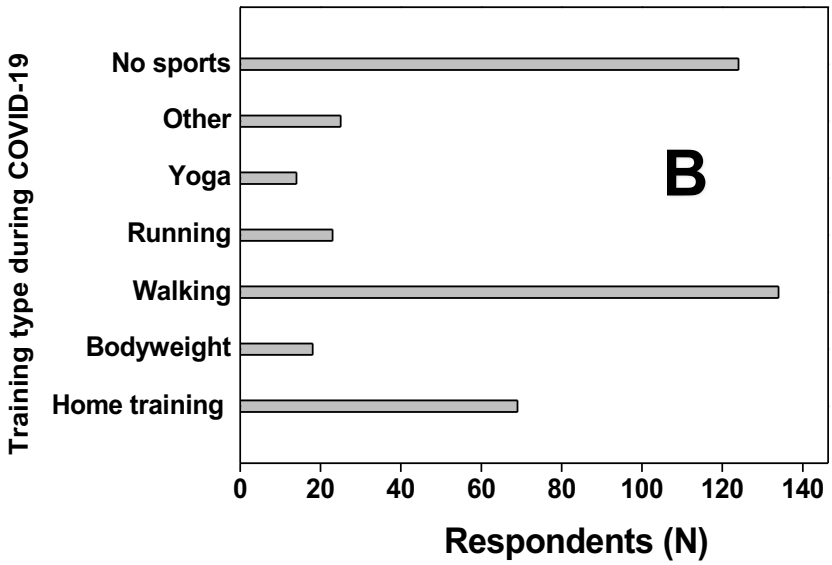

Figure 2B: Training activity types of respondents during COVID-19

Nutritional status and functional food intake results

The *online*-survey reported the food intake frequency correlation before and during the COVID-19 pandemic (Table 4). Data showed an increase in almost all food items types during the pandemic except for (4.44, 41.82,12.86, and 30.51 %), like fish, bread, pasta and fast food, respectively. Strong immune system can be achieved as a result of regular intake of a group of functional foods such as oils, herbs, roots, supplements, colored fruits and vegetables.

Oils

Figure 3A, in detail, 208 of the respondents recommended olive oil in their diet due to its high benefits for some inflammatory diseases like sepsis syndrome implicate and fever due to the phenolic acid and flavonoids bioactive [18]. *Nigella sativa* seed and argan oils had the second and third choices, respectively. Thymoquinone, carvacrol, dithymoquinone, nigellicine, nigellimine-N-oxide, and alpha-hederinthymol in *Sativa* seed oil can cure intermittent fever, nasal congestion, dyspnea and headache. Besides, it can reduce the lipoxygenase and cyclooxygenase activities [19]. Biochemical reports exposed that argan fatty acids may modify the immune responses effectively due to g-tocopherol which prevents plasma reactive oxygen species [20].

Herbs and spices

The majority of the respondents preferred star anise (124) followed by sagebrush (44) as herbal drinks in descending order, respectively (Fig. 3B). Frankincense (32) and clove (36) received similar values. Flavonoid quercetin and shikimic acid present in star anise are effective for treating respiratory tract blockage, flu and whooping cough and swelling bronchitis [21]. Sagebrush in small amounts can act as anti-bacterial, anti-parasitic and anti-fungal activities [22]. Frankincense as a drink is recommended daily due to its active antifungal, antiseptic and antibiotic activities to treat flu, phlegm, asthma and larynx against COVID-19 symptoms. Clove is a rich source of antimicrobial and antioxidant

activity due to the presence of phenolic compounds such as eugenol, gallic acid and eugenol acetate which possess great potential for applications in pharmaceutical, agricultural and cosmetic industries [23].

During the COVID-19 pandemic the study population declared to eat more herbs like garlic (169), ginger (152) and curcuma (103) to enhance the immune system (Fig. 3C). Garlic is used as an antibiotic, against blood clots formation and anti-viral expectorants that help in reducing fevers and promote mucus in the respiratory tract [24]. Ginger is a potential herb that can improve body functions such as blood circulation, lowering cholesterol, combating heart problems, and eliminate toxins from the body due to the antimicrobial activities [25]. Rhizomes of curcuma are used in traditional medicines for cough, sinusitis, common cold, asthma and bronchitis due to the high immunostimulant activities [26].

SUPPLEMENTS

Vitamins

Nobody denies the effect of supplements like vitamins and minerals to clean up the body and boost the immune system functions. Multivitamins (66) and vitamin D intakes reported the highest, while vitamin B^{Group} and ascorbic acid recorded similar intakes values (Fig. 3D). Vitamins intake can protect the body from respiratory viruses and raise the antiviral defenses. Reports recorded that COVID-19 patients almost have an unsatisfactory vitamin D level, as a result, vitamin D supplements can be used for coronavirus treatments by getting 10 µg daily [27]. Riboflavin is necessary against MERS-CoV for cell energy metabolisms [28]. Niacin can inhibit neutrophil infiltration in ventilator-induced lung injury [29]. Pyridoxine is important due to the protein metabolism for the immune system [30]. Folic acid can enhance the production of white blood cells. Cobalamin facilitates the production of (T-lymphocytes cells) in a normal range [31]. As a result, the Vitamin B^{Group} can be used effectively in (COVID-19) treatment. Vitamin C is beneficial in cellular functions, collagen synthesis in connective tissues, pneumonia treatment, immune support against oxidative stress and antihistamine [32].

Minerals

Mineral supplement intake in descending order reported that calcium was the highest (57), followed by iron (37), zinc (29) and selenium (5) (Fig. 3E). Calcium helps lymphocytes to maintain Ca^{2+} in low levels and adjust the immune system responses [33]. Iron salts as lactoferrin and catalase are necessary to improve the immune system. Respiratory infections are clear syndromes for iron deficiency [34]. Zinc supplements (25 mg/day) can prevent pneumonia, inflammatory response and are pathogen-eliminating. Besides, pyrithione and low zinc concentrations intake may inhibit (SARS-CoV) [35]. Selenium can be used for bronchitis coronavirus successfully, while low intake may weaken the immune system [36].

Colored fruits and vegetables

The power of colors or chromotherapy is the use of color in preserving health as every color has its function and related to one of the antioxidant components [37]. Fig. (3F)

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presents the respondent's colorful choices values. The yellow color is a stimulant to the brain and effective against throat infections, recorded the highest intake (713), followed by green color (649) which is widely known for fever, influenza and colds. Although markets are full of blue fruits and vegetables such as fig, grapes, blueberries and pears, it recorded the lowest score (202).

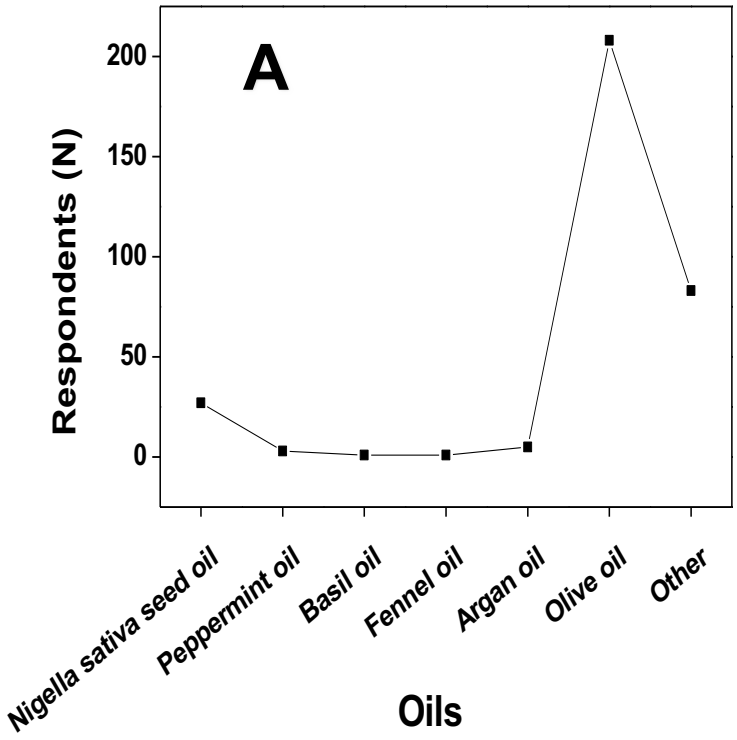

Figure 3A: Oils as functional foods against COVID-19

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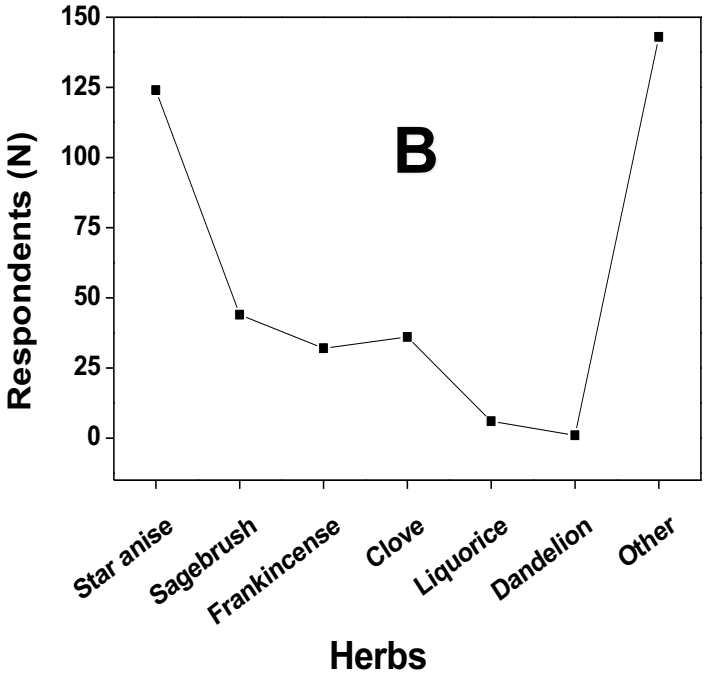

Figure 3B: Herbs as functional foods against COVID-19

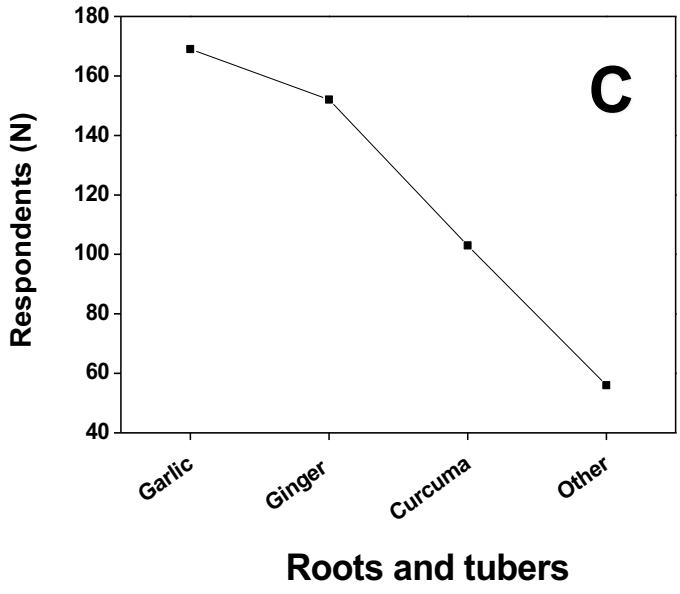

Figure 3C: Roots and tubers as functional foods against COVID-19

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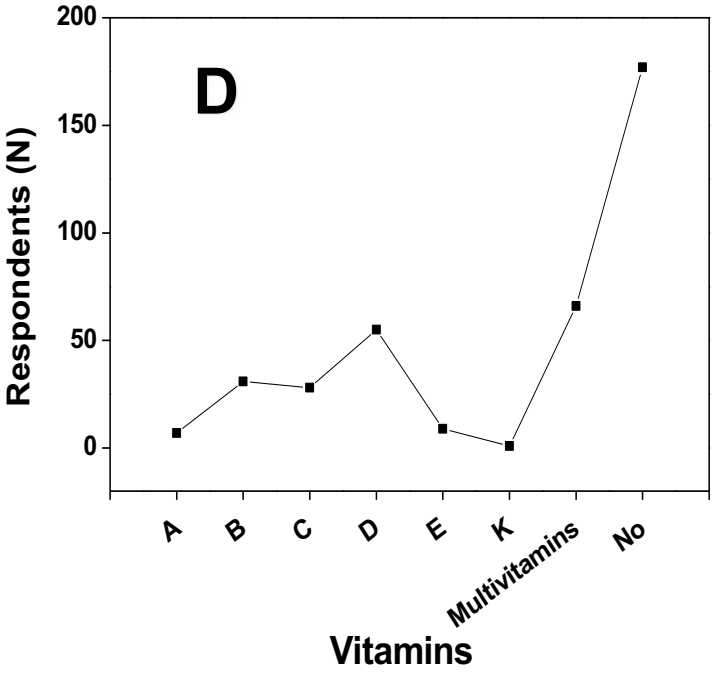

Figure 3D: Vitamins as functional foods against COVID-19

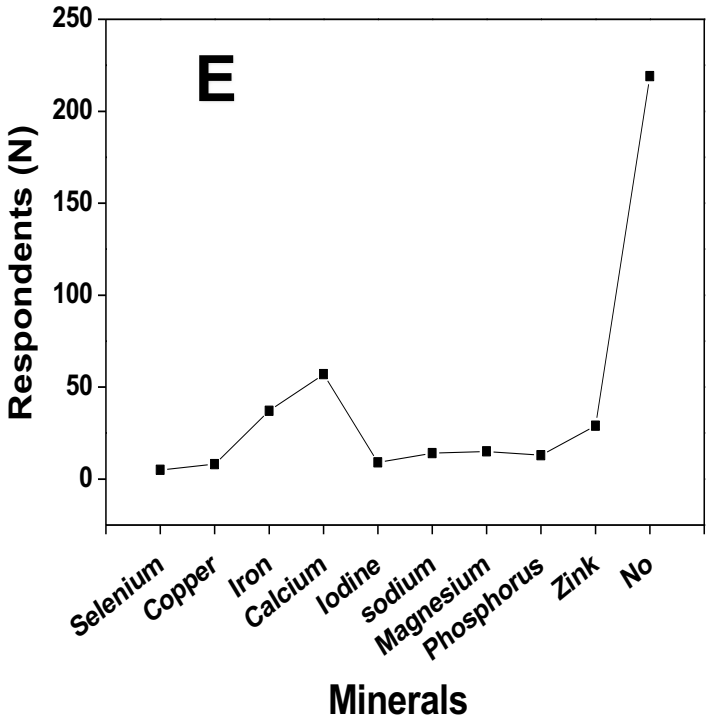

Figure 3E: Minerals as functional foods against COVID-19

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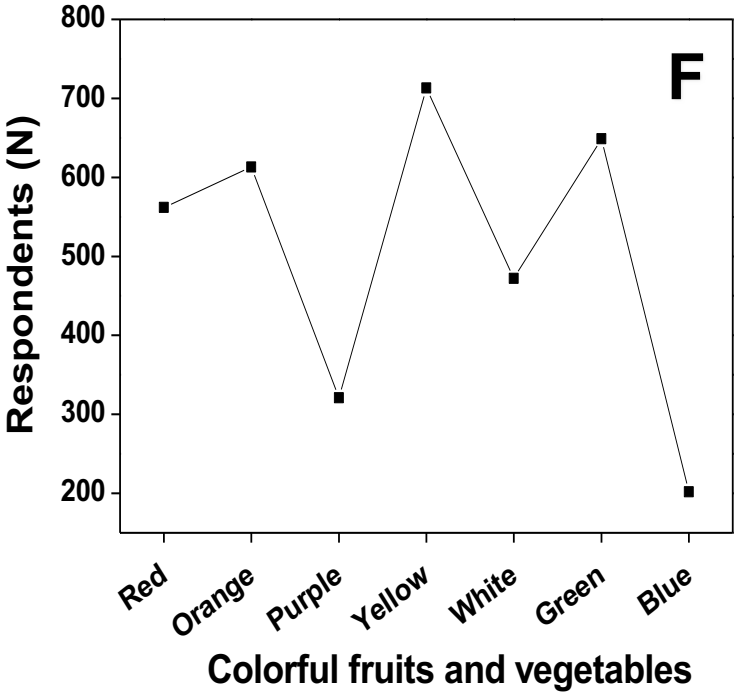

Figure 3F: Colorful fruits and vegetables as functional foods against COVID-19

Knowledge on COVID-19

Around 119 of the respondents did not know the exact source of COVID-19, while 113 reported as an infection from bat to human (Table 5). Concerning knowledge about the transmission method, almost all respondents (249) selected infected droplets from an infected person or even organism by breathing, coughing or sneezing, while some of the respondents (33) believed that contaminated foods and drinks were the means of transmitting the virus. The respondents recognized COVID-19 syndromes as fever (270), shortness of breath (249) and cough (204), while (5) claimed to have no idea on COVID-19 symptoms. Observing social distance and handwashing were chosen by the most respondents (301) as a way of preventing the infection while about more than half (193) preferred disinfecting contaminated surfaces and (137) supported consuming functional foods to prevent against COVID-19. Washing hands for 20 seconds is vital as germs/ viruses can be killed [38]. Table 5 depicts that 44 % of respondents mentioned 30 seconds of washing hands, 34 % for 20 seconds and 10 % for 10 seconds and 1 min. The suggested hand washing duration should be at least 20 seconds for obviously soiled hands [38]. The most common information sources about COVID-19 were from the government reports (222) followed by the media (174) and the internet (166).

Correlations

As shown in Table 6, the higher the education level of the respondent, the higher intake of oils especially olive oil (0.130). On the other hand, higher education level can negatively affect intake of herbs, roots and tubers as few respondents preferred the regular intake (-0.066 and -0.402). Besides, the highly educated respondents suggested daily supplements intake such as multivitamins (D, C, B) and minerals (calcium, iron,

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zinc). Regretably the higher education respondents had not varied their choice in colorful fruits and vegetables (0.055). The more the age increase, the more concentration on oils, herbs, vitamins, colorful fruits and vegetables. Minerals, roots and tubers recorded negative values (-0.215 and -0.433, respectively).

CONCLUSION

Knowledge on COVID-19 had significant positive effects on frequency of intake of functional foods, water, frequency of physical activity and reduced frequency of smoking by respondents. Almost all of the respondents turned to the functional foods, oils, herbs, roots, colored fruits and vegetables and special supplements during COVID-19 period. Findings recommended intensifying efforts in sensitizing the public to a better understanding of the COVID-19 pandemic and strengthening the immune system.

Disclosure

The authors declared no conflicts of interest.

Ethical statements

The study achieved approval (No: 1 - 441 - 28) from the ethical committee of College of Science, Department of Food Science and Nutrition of the University of Taif, using an *online* survey to obtain the data, during COVID-19 pandemic. The *online*-survey form was sent to 402 respondents in different age categories of both sexes from 4th to the 29th of June 2020 in Saudi Arabia. A total of 312 respondents completed the online-survey efficiently from Taif City.

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Table 1: Socio-demographic characteristics

	(N)	(%)	X^2 Statistic[a]	*P*-Value
Age (year)				
≤12	6	1.9		
13-21	118	38	171.1	0.00**
22-64	149	48		
≥65	39	13		
Gender				
Male	106	34	32.0	0.000**
Female	206	66		
Education				
Illiterate	7.00	2		
Primary school	6.00	2		
Secondary school	5.00	2		
High school	29.00	9		
Diploma	12.00	4	534.6	0.000**
Bachelor degree	158.00	51		
Master degree	39.00	13		
Doctoral degree	18.00	6		
degree Post-doctoral	38.00	12		

**Means significant difference between categories at $P \leq 0.05$

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Table 2: Widespread health problems

Health Problems	(N)	(%)
Diabetes	19	6
High Pressure	30	10
Dysentery	3	1
Constipation	2	1
Obesity	57	18
Slim	8	3
Alzheimer's	2	1
Kidney Problems	7	2
Liver Problems	3	1
Colon Problems	10	3
Dental Problems	46	15
Anemia	9	3
Heart Disease	6	2
Osteoporosis	1	0
Cancer	3	1
Immunity	17	5
Respiratory	6	2
Good health	81	26

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Table 3: Lifestyle habit changes before and during COVID-19

Smoking	**Smoking pre-COVID-19**	**Smoking during COVID-19**	**X^2 Statistic [a]**	***P*-Value**
No	280 (90 %)	282 (90 %)	0.42 ns	0.936
< 5 cigaretes/day	9 (3 %)	10 (3 %)		
5-10 cigaretes/day	9 (3 %)	9 (3 %)		
> 10 cigaretes/day	14 (5 %)	11 (4 %)		
Sleeping	**Sleeping pre-COVID-19**	**Sleeping during COVID-19**	**X^2 Statistic [a]**	**P-Value**
< 7 h/day	131 (42 %)	109 (44 %)	13.017	0.001**
7-9 h/day	170 (55 %)	170 (55 %)		
> 9 h/day	11 (4 %)	33 (11 %)		
Drinking water	**Drinking water pre-COVID-19**	**Drinking water during COVID-19**	**X^2 Statistic [a]**	**P-Value**
<1 L/day	124 (40 %)	86 (28 %)	10.496	0.005**
1-2 L/day	150 (48 %)	177 (58 %)		
> 2 L/day	38 (12 %)	49 (16 %)		
Eating junk foods	**Eating junk foods pre-COVID-19**	**Eating junk foods during COVID-19**	**X^2 Statistic [a]**	**P-Value**
No	48 (15%)	134 (43 %)	73	0.000**
1/week	92 (30 %)	93 (30 %)		
2/week	86 (28 %)	45 (15 %)		
3-4/week	65 (21 %)	36 (12%)		
> 5/week	21 (7 %)	4 (1 %)		
Training activity	**Training activity pre-COVID-19**	**Training activity during COVID-19**	**X^2 Statistic [a]**	**P-Value**
No training	145(46 %)	141(45 %)	5.1	0.164 ns
1-2/week	106(34 %)	112(36 %)		
3-4/week	43(14 %)	30(9 %)		
> 5/week	18(6 %)	29(10 %)		

**Means significant difference between categories at $P \leq 0.05$, Ns; non-significant

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Table 4: Food intake frequency correlation before and during COVID-19

	Pre-COVID-19	During COVID-19	(%) Changes between pre and during COVID-19
Fruits	91	130	42.86
Vegetables	88	105	19.32
Nuts	53	66	24.53
Cereals	32	42	31.25
Dairies	78	100	28.21
Bread	55	32	*41.82*
Eggs	73	95	30.14
Fish	45	43	*4.44*
Poultry	114	121	6.14
Red meat	35	50	42.86
Preserved meat	4	6	50
Sweeteners	57	59	3.51
Pasta	70	61	*12.86*
Rice	90	91	1.11
Honey	45	68	51.11
Fast foods	59	41	*30.51*

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Table 5: COVID-19 knowledge

	N	X^2 Statistic [a]	*P*-Value
COVID-19 Sources			
A biological weapon	58	9.1	0.011**
An infection from bat to human	113		
A way to reduce population	24		
A way to refresh pharmaceutical industry	53		
Media trick to cause fear	8		
Don't know	119		
COVID-19 Transmission			
Infected droplets	249	4.00	0.406
Surface contact	171		
Kisses, hugs, and sex	159		
Contaminated foods and drinks	33		
Don't know	20		
COVID-19 Symptoms			
Muscle pain	151	13.3	0.001**
Fatigue	153		
Sore throat	176		
Fever	270		
Sneezing	128		
Shortness of breath	249		
Cough	204		
Don't know	5.0		
COVID-19 Prevention			
Taking antibiotics	52	14.8	0.002**
Consuming functional foods	137		
Closing schools and public places	124		
Disinfecting contaminated surfaces	193		
Social distancing and handwashing	301		
Don't know	6		
Handwashing for COVID-19 Prevention			
10 sec	9.6	12.5	
20 sec	34		
30 sec	44.2		0.002**
1 min	9.6		
Don't know	2.6		
COVID-19 Information Sources			
Media	174	7.16	0.006**
Internet	166		
Government reports	222		
Family and friends	57		
Don't know	2		

**Means significant difference between categories at $P \leq 0.05$

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Table 6: Correlations between the study variables (*n*=312)

Functional foods	Age	Education
Oils	0.447*	0.130
Herbs	0.041	-0.066
Roots and tubers	-0.433	-0.402
Vitamins	0.259	0.126
Minerals	-0.215	0.274
Colorful fruits and vegetables	0.400	-0.055

*Correlation is significant at the 0.05 level (2-tailed)

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