Clinical Nutrition ESPEN 42 (2021) 280–285

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

Are history of dietary intake and food habits of patients with clinical symptoms of COVID 19 different from healthy controls? A case–control study

Houra Mohseni [a], Shirin Amini [b, *], Behnaz Abiri [a], Mojtaba Kalantar [c], Masoumeh Kaydani [c], Barat Barati [d], Elham Pirabbasi [b], Faezeh Bahrami [b]

[a] School of Para-medicine Sciences, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran
[b] Department of Nutrition, Shoushtar Faculty of Medical Sciences, Shoushtar, Iran
[c] Department of Occupational Health, Shoushtar Faculty of Medical Sciences, Shoushtar, Iran
[d] Department of Radiologic Technology, Shoushtar Faculty of Medical Sciences, Shoushtar, Iran

ARTICLE INFO

Article history:
Received 23 December 2020
Accepted 18 January 2021

Keywords:
Symptoms of COVID 19
Food group's intake
Food habits

SUMMARY

Background: Coronavirus disease 2019 (COVID-19) is an infectious disease that put unprecedented significant strain on clinical services and healthcare systems. The aim of the present research was to assess dietary food groups and also food habits of patients with clinical symptoms of COVID 19 and healthy controls.

Methods: This case–control research was carried out on 505 participants (279 subjects with clinical symptoms of COVID-19 and 226 controls), in age 18–65 years. Dietary food group's intake last year was investigated by a food frequency questionnaire. Food habits were asked by a general information questionnaire. The strength of the association between food group's intakes with the odds ratios (ORs) of COVID-19 was assessed using Logistic regression models.

Results: After adjusting for physical activity in the logistic regression models, intake of *dough* and yogurt had a significantly protective role on occurrence of COVID19 (OR = 0.62; 95% confidence interval (CI) = 0.44–0.87; $P = 0.006$) (OR = 0.74; 95% CI = 0.56–0.98; $P = 0.044$), respectively. No significant differences were seen in food habits between the two groups in the last year ago.

Conclusions: High risk population for COVID19, advised to consume enough amount of yogurt and dough at the time of this pandemic.

1. Background

Coronavirus disease 2019 (COVID-19), that puts unprecedented significant strain on clinical services and healthcare systems, is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first human cases of COVID-19 were identified in China in late December 2019 [1]. The ongoing pandemic has resulted in more than 17.5 million confirmed cases and 677, 000 deaths worldwide and there have been almost 92, 000 deaths in the Asia Region up to 1 August 2020 [2,3]. Coronaviruses belong to β-coronaviruses and are transmitted through secretions of infected people such as saliva and respiratory secretions or their respiratory droplets [4,5]. The severity of clinical symptoms in positive COVID-19 patients is varied, ranging from asymptomatic to acute respiratory distress syndrome and multi-organ dysfunction [6]. Previous researches reported male sex, older age, and chronic diseases such as diabetes, hypertension, and obesity as the risk factors for severe clinical symptoms of COVID-19 [7,8].

After infection with SARS-CoV-2, the uncontrolled response of the immune system against the virus causes damage of pulmonary tissue, functional impairment, and restricted lung capacity. Apart from pneumonitis in the early phase, 10–14 days after the virus infection, sudden reduction of lymphocytes like natural killer (NK) cells in blood along with severe inflammatory reaction happened that is called cytokine storm. In the critical condition, spleen and

* Corresponding author. Assistant professor of Nutrition, Department of Nutrition, Shoushtar Faculty of Medical Sciences, Shoushtar, Iran
E-mail addresses: amini-sh@shoushtarums.ac.ir, aminishirin83@yahoo.com (S. Amini).

https://doi.org/10.1016/j.clnesp.2021.01.021
2405-4577/

lymph nodes are atrophied and number of lymphocytes decrease drastically which leads the patient to hypercoagulability, thrombosis, and multi-organ damage [9].

Evidence demonstrated that appropriate nutrition plays a role in the improvement of the immune system and malnutrition resulted in increased rate of infections [10,11].Nutrients requirements are provided by dietary sources or body stores. Subclinical deficiencies of micro and macro nutrients may have a negative effect on body immune responses [11]. It is proposed dietary intake of some bioactive foods may enhance immune System to fight against COVID19 [12]. A recent review has emphasized on optimum nutrition status as important factor for a well-functioning of immune system against viral infections [13] and another review study has highlighted critical role of diet and relevant nutrients to effectively diminish inflammation and oxidative stress, consequently reinforcing the immune system during the COVID-19 crisis [14]. A new invitro study that assessed the effects of coronavirus on lung tissues suggested those nutrition recommendations have an important role in reducing damages of coronavirus to the lungs [15]. Up to now, no research study has been carried out to evaluate the dietary intakes of COVID19 patients. Hence, the aim of the present research was to assess and compare history of dietary food group's intake and also food habits between patients with clinical symptoms of COVID 19 and healthy controls.

2. Methods

2.1. Study design and participants

In the present retrospective case–control research, totally 505 participants (279 patients with clinical symptoms of COVID-19 and 226 exposures to virus and healthy controls), in age 18–65 years, were investigated. Participant with positive nasopharyngeal swab testing for SARS-CoV-2, hospitalized and/or referring to the outpatient clinic of Khatam Al-Anbia Hospital, in Shoushtar city and Razi Hospital, in Ahvaz, Khuzestan province, in Iran, were considered for the case group, between June and August 2020. The COVID19 clinical symptoms in the case group were confirmed by a physician according to clinical symptoms and laboratory and radiographic findings, by referring to patients' medical records. The telephone number of the subjects was taken from the hospital and contacted them. Patients were asked to participate in the study after recovery if they wished. In cases that they may have not been able to answer that questions honestly, we asked from near family members of patients to assist the subjects in completing the questionnaires.

Participants in the control group was exposure to the virus, but asymptomatic and with negative nasopharyngeal swab testing for SARS-CoV-2. Participants in both case and control groups were selected from general populations, physicians, nurses, midwives and staff working in hospitals and medical centers, from June to August 2020. Both the case and the control groups were matched in terms of gender, age, and body mass index (BMI), and job.

Inclusion criteria were the positive result of nasopharyngeal swab testing of SARS-CoV-2, with known clinical symptoms of COVID19, in recent months and, in cases, encounter with the SARS-CoV-2, asymptomatic and with negative nasopharyngeal swab testing for SARS-CoV-2 for the controls, and BMI <35. The exclusion criteria included incomplete answers to questionnaires, dietary under and/or over-reporting (energy intake outside the range of 800–4200 kilocalories per day), pregnancy, lactation, having diabetes, blood pressure, endocrine disorder, renal or cardiovascular diseases, malignancies, using immunosuppressive medicines and history of smoking.

The protocol of study was approved, by the Medical Ethics Committee at the Shoushtar faculty of medical science according to the 2013 Helsinki Declaration (Registration No: IR.SHOUSHTAR.-REC.1399.015). All participants read and signed the consent form before their inclusion in the study.

2.2. Demographic measurements

Demographic data including gender, age, educational levels, employment and economic status, marital status, history of smoking, history of chronic diseases and history of nutritional supplements intake were collected by questionnaire. Anthropometric measurements including weight and height were also measured with an accuracy of 0.5 kg and 0.1 cm, respectively. BMI was calculated based on the following formula: body weight (kilogram) divided by squared height (meter^2).

The physical activity level was investigated by the short form of the international physical activity questionnaire (IPAQ).The total metabolic equivalent (METs) calculated via usual physical activity of participants. Then participants, based on the levels of activity, were classified into three groups: 1- active, 2- minimally active and 3- inactive. The validity and reliability of IPAQ have been confirmed in 12 countries [16]. Its reliability and validity have also been confirmed in Iran [17].

2.3. Dietary assessment

A food frequency questionnaire (FFQ) which was designed and validated for Iranian population [18] and used in Iranian studies, previously [19,20] was used, and participants' foods that were consumed, in a last year asked by a trained interviewer. The portion sizes for units of each food group were defined according to the USDA portion sizes in the questionnaire [21]. The frequency of units consumed from each food group (based on the food pyramid) was recorded in forms of daily, weekly, monthly, yearly or never and then converted to a unit per day. The groups of foods included: cereals and breads (including rice, pasta and bread), dairy (including milk, yogurt, fermented dairy drink (*doogh*), cheese and ice cream), meat and alternatives (including all kinds of meat, legumes, and eggs), fruits and vegetables. Also, the amount of consumption of fatty foods, the type of dairy (low-fat dairy with less than 1.5% fat, medium-fat dairy with 2.5% fat, high-fat dairy with more than 2.5% fat), and the type of oils (Animal oil, olive, canola, sunflower and corn, olive and frying oil) that were consumed were asked. Amount of consumption of cakes and biscuits, soft drinks and fast foods was also recorded in forms of daily, weekly, or monthly in this questionnaire and then reported qualitatively (low, medium, and high).

2.4. Statistical analysis

The Kolmogorov–Smirnov test was used to the evaluate normality distribution of all variables. Data with normal or non-normal distribution were reported as mean ± standard deviation (Mean ± SD) and median (25th, 75th percentiles), respectively. Independent *t*-test in the data with normal distribution and Mann–Whitney U in the data with non-normal distribution were used to compare the differences between the case and control groups. The residual method was used for adjusting the total energy intake [22]. Categorical variables were also compared using Chi-squared test. Logistic regression models were used to estimate the strength of the association between food group intakes and the odds ratios (ORs) of COVID19. The associations were assessed in crud OR and then, were corrected with effects of factors, including BMI, energy intake, taking nutritional supplements and physical activity in two additional models. The statistical analysis was carried out using SPSS version 17.0 (SPSS Inc, Chicago, IL, U.S.A.). Two-sided *P*-values with $P < 0.05$ was considered statistically significant.

3. Result

Of the 517 enrolled subjects, 7 subjects (4 in the control and 3 in the case groups) were excluded from the study due to incomplete reporting by the questioner. In addition, 2 subjects from the controls and 3 from the cases were also excluded due to over-reporting in food groups. Eventually, the data of 505 subjects (226 controls and 279 cases) were analyzed.

The demographic characteristics are shown in Table 1. The median age and BMI of all participants was 35.88 (range, 18–65 years) and 27.08 (17.30–34.14) kg/m^2. 29.3% of the participants were male and 70.7% were female. Cases had higher physical activity than the controls ($p = 0.02$).There were no significant differences between the subjects with clinical symptoms of COVID-19 and asymptotic controls with the median age, weight and BMI, mean height and also gender, educational level, marital status, income and intake of nutritional supplements.

There was no significant difference in the median energy intake between COVID19 and the control groups [2541.7 (1426.3, 3875.2) kcal vs. 2653.7 (1185.7, 3976.4) kcal; respectively, $p = 0.47$]. As shown in Table 2, there were significant differences in the mean dietary intakes of dough between the COVID19 and the controls ($P = 0.012$). Cases had lower doogh intake than the controls.

Table 3 described the results of the logistic regression models about the relation between food intakes and COVID19, with OR and 95% confidence intervals (CI). Effect of BMI, nutritional supplement and energy assessed in Model 1, and physical activity investigated in Model 2. After entering physical activity by the logistic regression, in Model 2, intake of doogh and yogurt had a significant protective role on the occurrence of COVID19 (OR = 0.62; 95% CI = 0.44–0.87; P = 0.006) (OR = 0.74; 95% CI = 0.56–0.98; P = 0.044), respectively. As indicates in Table 4, most participants consumed low numbers of biscuits and cakes, soft drinks and fast foods, and there were no significant differences between the patients with clinical symptoms of COVID19 and controls in the consumption of these terms. Furthermore, there were no significant differences between the dairy type, the amount of fat in foods and usual types of used oils between the case and control groups (Table 5).

4. Discussion

In the present study, we aimed to compare dietary food groups, and nutritional habit in patients with clinical symptoms of COVID 19 and healthy controls. Moreover, we assessed the associations between dietary intake of food groups and the incidence of clinical symptoms of COVID 19. To the best of our knowledge, this is the first case–control study in this area.

We observed an effect for the adequate consumption of doogh and yogurt, last year and occurrence of COVID19 clinical symptoms. In the more population, due to lactose intolerance, milk consumption is low and yogurt and fermented dairy are mainly used as sources of dairy products. Dairy products are a good source of high quality protein, B2 and probiotics. The probiotics in yogurt and

Table 1
Comparison of basic characteristics and anthropometric measures between exposure to virus and asymptotic (Controls) and COVID-19 positive with clinical symptoms (Cases) groups.

Characteristics	Exposure to virus and asymptotic (Controls) n = 226	COVID-19 positive with clinical symptoms (Cases) n = 279	*P*-value
Age (years)[b]	36.15 (19, 65)	35.61 (18, 65)	0.44
Weight (kg)[b]	74.08 (47.50, 124.50)	75.96 (45.50, 120.0)	0.10
Height (cm)[a]	166.12 ± 9.71	166.62 ± 9.94	0.26
BMI (kg/m^2)[b]	26.80 (17.30, 34.42)	27.31 (17.36, 34.12)	0.14
BMI category[c] (kg/m^2) n (%)			0.25
BMI<25	87 (38.5)	89 (31.89)	
25 < BMI<29.9	85 (37.61)	112 (40.16)	
BMI>30	54 (23.89)	78 (27.95)	
Gender[c] n (%)			0.72
Female	158 (69.9)	199 (71.3)	
Male	68 (30.1)	80 (28.7)	
Physical activity[c] n (%)			**0.02**[a]
Active	19 (8.4)	35 (12.5)	
Minimally active	131 (58)	178 (63.8)	
Inactive	76 (33.6)	66 (23.7)	
Educational level[c] n (%)			0.24
Elementary	11 (4.9)	24 (8.6)	
Diploma	36 (15.9)	40 (14.3)	
College	179 (79.2)	215 (77.1)	
Income[c] n (%)			0.58
Upper-middle	34 (15)	47 (16.8)	
Middle	96 (42.5)	126 (45.2)	
Lower-middle	96 (42.5)	106 (38)	
Marital status[c] n (%)			0.52
Married	152 (67.3)	195 (69.9)	
Single	74 (32.7)	84 (30.1)	
Nutritional supplement consumption in last 6 month			0.26
No	96 (42.5)	122 (43.7)	
Yes	130 (57.5)	157 (56.3)	

P-value <0.05 was considered significant.*p < 0.05. BMI: body mass index.
[a] Data are expressed as mean ± standard deviation (mean ± SD), and measured by *Independent t*-test.
[b] Data are expressed as median (25 th, 75 th percentiles) and analyzed by *Mann–Whitney U* test.
[c] Data are expressed as n (%), and analyzed by *chi-squared* test.

Table 2
Comparison of daily food intake (per unit) from different food groups between exposure to virus and asymptotic (Controls) and COVID-19 positive with clinical symptoms (Cases) groups.

Daily food intake (per unit)	Exposure to virus and asymptotic (Controls) n = 226	COVID-19 positive with clinical symptoms (Cases) n = 279	P-value[b]
Rice[b]	2.54 (0.10, 5.50)	2.48 (0.14, 4.51)	0.87
Pasta[b]	0.21 (0.01, 2.57)	0.19 (0.01, 1.14)	0.31
Bread[b]	4.77 (1.0, 7.0)	4.65 (1.0, 7.0)	0.35
Milk[b]	0.28 (0.0, 3.0)	0.25 (0.0, 3.0)	0.74
Yogurt[a]	1.702 ± 0.69	1.503 ± 0.57	0.08
Doogh[b]	0.486 (0.0, 3.6)	0.250 (0.0, 2.8)	**0.046***
Cheese[b]	0.88 (0.0, 4.5)	1.02 (0.0, 4.5)	0.06
Ice cream[b]	0.31 (0.0, 3.0)	0.25 (0.0, 3.0)	0.71
Fish[b]	0.23 (0.0,0.85)	0.27 (0.0,0.85)	0.89
Chicken[b]	0.53 (0.0, 2.0)	0.55 (0.0,2.0)	0.76
Red Meat[b]	0.75 (0.0, 6.0)	0.64 (0.0, 6.0)	0.23
Legumes[b]	0.24 (0.0, 2.0)	0.23 (0.0, 2.0)	0.41
Egg[b]	0.43 (0.0, 2.0)	0.48 (0.0, 2.0)	0.29
Fruit[b]	1.78 (0.0, 4.5)	1.76 (0.0,4.5)	0.84
Vegetables[&]	1.29 (0.0, 6.0)	1.15 (0.0,6.0)	0.25

P-value <0.05 was considered significant. *p < 0.05, **p < 0.01.
[a] Data are expressed as mean ± standard deviation (mean ± SD), and measured by *Independent t*-test.
[b] Data are expressed as median (25 th, 75 th percentiles) and analyzed by *Mann–Whitney U* test.

Table 3
Odds ratios (ORs)[a] estimates and 95% confidence intervals (CIs) for COVID19 by intakes of food groups.

	Crude OR	P-value	Adjusted OR Model 1	P-value	Adjusted OR Model 2	P-value
Rice	0.96 (0.85, 1.09)	0.61	0.97 (0.85, 1.09)	0.64	0.96 (0.85, 1.09)	0.57
Pasta	0.57 (0.25,1.29)	0.18	0.65 (0.25, 1.64)	0.36	0.58 (0.25, 1.35)	0.21
Bread	0.94 (0.83, 1.06)	0.35	0.95 (0.83, 1.07)	0.43	0.95 (0.84, 1.08)	0.49
Milk	0.85 (0.57, 1.27)	0.44	0.84 (0.56, 1.25)	0.40	0.78 (0.52, 1.17)	0.78
Yogurt	078 (0.59, 1.03)	0.08	0.78 (0.58, 1.04)	0.10	**0.74(0.56,0.98)**	0.044*
Dough	0.65 (0.47, 0.90)	0.01*	0.68 (0.49, 0.94)	0.02*	**0.62(0.44, 0.87)**	0.006**
Cheese	1.18 (0.97, 1.44)	0.094	1.17 (0.96,1.43)	0.10	1.18 (0.97, 1.44)	0.094
Ice cream	0.74 (0.50, 1.08)	0.18	0.77 (0.52, 1.12)	0.17	0.76 (0.51, 1.11)	0.15
Fish	1.63 (0.85, 3.13)	0.13	1.55 (0.79, 3.00)	0.19	1.62 (0.84, 3.13)	0.14
Chicken	1.19 (0.69, 2.05)	0.52	1.22 (0.70, 2.11)	0.46	1.16 (0.67, 2.0)	0.59
Red Meat	0.82 (0.65, 1.04)	0.11	0.84 (0.66, 1.06)	0.15	0.82 (0.65, 1.04)	0.11
Legumes	0.80 (0.40, 1.60)	0.53	0.68 (0.33, 1.42)	0.31	0.79 (0.4, 1.59)	0.52
Egg	1.36 (0.85, 2.18)	0.18	1.27 (0.79, 2.05)	0.31	1.28 (0.80, 2.06)	0.29
Fruit	0.99 (0.86, 1.13)	0.87	0.99 (0.86, 1.13)	0.91	1.00 (0.87, 1.14)	0.99
Vegetables	0.92 (0.80, 1.05)	0.25	0.91 (0.79, 1.04)	0.19	0.92 (0.80, 1.05)	0.92

Model 1 Adjusted for BMI, energy intake and taking supplement. Model 2 Adjusted for physical activity as covariate; BMI, body mass index; *p < 0.05, **p < 0.01.
[a] OR calculated by *logistic regression* model. BMI, energy intake, taking supplement and physical activity was included in the model as covariate.

doogh and fermented milk may play a role in modulating the immune system against the virus. Some studies suggest the potential role for probiotics in the modulation of the immune system that can balance the inflammatory response and increase the response to viruses [23,24]. Another study suggested bioactive peptides derived from fermented milks with *Lactobacillus plantarum* strains disrupt viral spike protein [24]. Although, most of the findings suggest that SARS-Cov-2 virus is more likely transmitted through the respiratory route, but many data also suggest that the intestine could play an appropriate role in the pathogenetic evolution of this viral disease [23].

Rozga et al. (2020), in a review study suggested probiotics may improve clinical symptoms such as ventilator-associated pneumonia in patients infected with SARS-Cov-2 [25].

Table 4
Comparison of cakes and biscuits, soft drinks and fast food consumed between exposure to virus and asymptotic (Controls) and COVID-19 positive with clinical symptoms (Cases) groups.

Index		Total Number (%)	Exposure to virus and asymptotic (Controls) n = 226 Number (%)	COVID-19 positive with clinical symptoms (Cases) n = 279 Number (%)	*P*-value[a]
Cakes and biscuits	High	49 (9.7)	16 (7.1)	33 (11.8)	0.16
	Medium	203 (40.2)	97 (42.9)	106 (38)	
	Low	253 (50.1)	113 (50)	140 (50.2)	
Soft drinks	High	46 (9.1)	23 (10.2)	23 (8.2)	0.54
	Medium	131 (25.9)	54 (23.9)	77 (27.6)	
	Low	328 (65)	149 (65.9)	179 (64.2)	
Fast foods	High	16 (3.2)	4 (1.8)	12 (4.3)	0.25
	Medium	141 (27.9)	66 (29.2)	75 (26.9)	
	Low	348 (68.9)	156 (69)	192 (68.8)	

[a] Data are expressed as n (%), and analyzed by *chi-squared* test.

Table 5
Comparison of fatty foods, dairy and oil type consumed between exposure to virus and asymptotic (Controls) and COVID-19 positive with clinical symptoms (Cases) groups.

Index		Total Number (%)	Exposure to virus and asymptotic (Controls) n = 226 Number (%)	COVID-19 positive with clinical symptoms (Cases) n = 279 Number (%)	*P*-value[a]
Dairy type	Low fat	193 (38.2)	81 (35.8)	112 (40.1)	0.66
	Medium fat	129 (25.5)	59 (26.1)	70 (25.1)	
	High fat	183 (36.3)	86 (38.1)	97 (34.8)	
The amount of fat in food	High-fat and frying	59 (11.7)	25 (11.1)	34 (12.2)	0.75
	Medium fat	376 (74.4)	167 (73.9)	209 (74.9)	
	Low-fat and steamed	70 (13.9)	34 (15)	36 (12.9)	
The usual types of used oils	Animal oil	11 (2.2)	7 (3.1)	4 (1.4)	0.75
	Olive	18 (3.6)	8 (3.5)	10 (3.7)	
	Canola	17 (3.4)	8 (3.5)	9 (3.2)	
	Sunflower and corn	266 (52.6)	120 (53.2)	146 (52.3)	
	Olive and frying oil	193 (38.2)	83 (36.7)	110 (39.4)	

[a] Data are expressed as n (%), and analyzed by *chi-squared* test.

Although, further researches are needed to identify the mechanisms for our finding and assess the effect of yogurt and doogh on the subject at risk of COVID-19, it is safe and secure to advise that high risk population for COVID19, consume enough amount of yogurt and doogh at the time of the COVID-19 pandemic.

Our research did not find a significant difference in nutritional habit (consumption of biscuits, fast foods, soft drinks, fatty foods and the usual types of used oils) between the two groups. While dietary intake may have great promise for managing and preventing COVID-19, however, up to now, studies are not enough to recommend consumption of another food for the prevention of COVID19. Strong clinical studies are required to confirm any such claim. Otherwise, providing opinions and suggestions based on hypotheses and without strong data can lead to harm to the affected people.

In the present study, intake of meats, fruits and vegetables was low in both patients with clinical symptoms of COVID 19 and healthy controls. Inappropriate consumption of these groups as a good source of micro and macro nutrients may have damaging effects on the population at this time.

In our research, it remained uncertain that yogurt and doogh can reduce the occurrence of COVID 19 clinical symptoms through providing probiotics, calcium, B2, and/or high quality protein. Hence, more researches are needed to investigate the mechanisms of the effect of yogurt and doogh on the subject at risk of COVID19.

4.1. Strengths and limitations

To the best of our knowledge, this research was the first case–control study that assessed and compared history of food intakes of patients with symptoms of COVID 19 and healthy controls. Moreover, this research had a relatively large sample size. There are also two limitations in our research. Firstly, however; history of food group's consumption was asked by a validated FFQ, recall bias may not be exactly excluded. Secondly, in the present study the effects of potential confounders adjusted and minimized, but unmeasured or residual confounding factors may still be ignored. Finally, our study as a case–control research, is not able to strongly shown the causal relationship between dietary foods intakes and clinical symptoms of COVID19 and follow up study also would be proposed.

5. Conclusion

This research indicated that intake of *doogh* and yogurt had an effect on the occurrence of clinical symptoms of COVID19. While dietary intake may have great promise for managing and preventing COVID-19, however, up to now, studies are not enough to recommend consumption of another food for the prevention of COVID19.

Declaration of competing interest

The authors declare no conflict of interest.

Acknowledgements

The authors wish to thank all participants and the personnel of Khatam Al-Anbia Hospital. Special thanks to Vice-Chancellor for Research Affairs of Shoushtar faculty of Medical Sciences which financially supported the project.

Abbreviations

COVID-19 Coronavirus disease 2019
SARS-CoV-2 Severe Acute Respiratory Syndrome coronavirus 2
NK Natural Killer
IPAQ International Physical Activity Questionnaire
BMI body mass index
METs The total metabolic equivalent
FFQ food frequency questionnaire
ORs odds ratios
RDA Recommended Dietary Allowances

Ethics approval and consent to participate

The protocol of study was approved, by the Medical Ethics Committee at the Shoushtar faculty of medical science according to the 2013 Helsinki Declaration (Registration No: IR.SHOUSHTAR.REC.1399.015). All participants read and signed the consent form before their inclusion in the study.

Consent for publication

Not applicable.

Availability of data and materials

The data is available and if needed, provided by the corresponding author.

Funding

This research financially supported by the Vice-Chancellor for Research Affairs of Shoushtar faculty of Medical Sciences, Shoushtar, Iran (Grant number: 99000020).

Author contributions

H Mohseni and S Amini contributed significantly, in the conception and design of the research, analysis of data and interpretation, also, in the writing and critical revision of the manuscript. B Abiri, M Kalantar, B Barati and E Pirabbasi contributed to the critical revision of the manuscript. M Kaidani and F Bahrami contributed to the design of the research. All authors approved the final version of the manuscript before submitting it.

References

[1] Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. Acta Biomed: Atenei Parmensis. 2020;91:157–60.
[2] Tuli TC, Halima S, Ava AR, Islam QT. Unusual presentation of COVID 19-A case report. Bangladesh J 2020;31:102–6.
[3] Wang W, Tang J, Wei F. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. J Med Virol 2020;92:441–7.
[4] Ahirwar AK, Asia P, Sakarde A, Kaim K. COVID-19 outbreak–Diabetes aspect and perspective. Curr Med Res Pract 2020. https://doi.org/10.1016/j.cmrp.2020.05.005.
[5] To KK-W, Tsang OT-Y, Yip CC-Y, Chan K-H, Wu T-C, Chan JM-C, et al. Consistent detection of 2019 novel coronavirus in saliva. Clin Infect Dis 2020. https://doi.org/10.1093/cid/ciaa149.
[6] Zu ZY, Jiang MD, Xu PP, Chen W, Ni QQ, Lu GM, et al. Coronavirus disease 2019 (COVID-19): a perspective from China. Radiology 2020:200490. https://doi.org/10.1148/radiol.2020200490.
[7] Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. J Am Med Assoc 2020;323:2052–9. https://doi.org/10.1001/jama.2020.6775.
[8] Mohseni H, Amini S, Abiri B, Kalantar M. Do body mass index (BMI) and history of nutritional supplementation play a role in the severity of COVID-19? A retrospective study. Nutr Food Sci 2021. https://doi.org/10.1108/NFS-11-2020-0421. In press.
[9] Zabetakis I, Lordan R, Norton C, Tsoupras A. COVID-19: the inflammation link and the role of nutrition in potential mitigation. Nutrients 2020;12:1466.
[10] Salonen A, de Vos WM. Impact of diet on human intestinal microbiota and health. Annu Rev Food Sci Technol 2014;5:239–62.
[11] Jayawardena R, Sooriyaarachchi P, Chourdakis M, Jeewandara C, Ranasinghe P. Enhancing immunity in viral infections, with special emphasis on COVID-19: a review. Diabetes Metab Syndr 2020. https://doi.org/10.1016/j.dsx.2020.04.015.
[12] Galanakis CM, Aldawoud T, Rizou M, Rowan NJ, Ibrahim SA. Food ingredients and active compounds against the Coronavirus disease (COVID-19) pandemic: a comprehensive review. Foods 2020;9(11):1701.
[13] Calder PC, Carr AC, Gombart AF, Eggersdorfer M. Optimal nutritional status for a well-functioning immune system is an important factor to protect against viral infections. Nutrients 2020;12:1181.
[14] Iddir M, Brito A, Dingeo G, Fernandez Del Campo SS, Samouda H, La Frano MR, et al. Strengthening the immune system and reducing inflammation and oxidative stress through diet and nutrition: considerations during the COVID-19 crisis. Nutrients 2020;12:1562.
[15] Wu J, Zha P. Treatment strategies for reducing damages to lungs in patients with coronavirus and other infections. 2020. Available at SSRN 3533279.
[16] Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381–95.
[17] Vasheghani-Farahani A, Tahmasbi M, Asheri H, Ashraf H, Nedjat S, Kordi R. The Persian, last 7-day, long form of the International Physical Activity Questionnaire: translation and validation study. Asian J Sports Med 2011;2:106.
[18] Mirmiran P, Esfahani FH, Mehrabi Y, Hedayati M, Azizi F. Reliability and relative validity of an FFQ for nutrients in the Tehran lipid and glucose study. Publ Health Nutr 2010;13:654–62.
[19] Amini S, Jafarirad S, Mohseni H, Ehsani H, Hejazi L, Feghhi N. Comparison of food intake and body mass index before pregnancy between women with spontaneous abortion and women with successful pregnancy. Iran J Obstetr Gynecol Infertil 2017;20(10):35–42.
[20] Ghaderpour S, Baveicy K, Jafarirad S. Relationship of constipation and irritable bowel syndrome with food intake, anthropometric measurements and eating behaviors in male students. Nutr Food Sci Res 2015;2:3–9.
[21] Bodnar LM, Wisner KL. Nutrition and depression: implications for improving mental health among childbearing-aged women. Biol Psychiatr 2005;58:679–85.
[22] Willett W, Stampfer MJ. Total energy intake: implications for epidemiologic analyses. Am J Epidemiol 1986;124:17.
[23] Infusino F, Marazzato M, Mancone M, Fedele F, Mastroianni CM, Severino P, et al. Diet supplementation, probiotics, and nutraceuticals in SARS-CoV-2 infection: a scoping review. Nutrients 2020;12:1718.
[24] Rizou M, Galanakis IM, Aldawoud TMS, Galanakis CM. Safety of foods, food supply chain and environment within the COVID-19 pandemic. Trends Food Sci Technol 2020;102:293–9. https://doi.org/10.1016/j.tifs.2020.06.008.
[25] Rozga M, Cheng FW, Handu D. Effects of probiotics in conditions or infections similar to COVID-19 on health outcomes: an evidence analysis center scoping review. J Acad Nutr Diet 2020:1–14. https://doi.org/10.1016/j.jand.2020.07.016.