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Potential Association between Vitamin K Intake and the Severity of COVID-19 in Adults; Case-Control Study

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Abstract

Thrombosis associated with COVID-19 has been observed to influence the affected individuals' prognosis negatively. Vitamin K can activate both pro-coagulant and anti-coagulant factors in the liver and the external protein S, thereby inhibiting the formation of blood clots in specific areas. This case-control study aimed to investigate the potential relationship between vitamin K status and clinical outcomes of COVID-19 in adult individuals. The study randomly recruited 180 participants from Menoufia Governorate (120 verified COVID-19 and 60 non Covid-19) aged 18 or older. A special questionnaire collected socioeconomic, health, anthropometric, and nutritional information. A vitamin K-based food frequency questionnaire was also utilized to obtain information about the amounts and habitual consumption of vitamin K-containing foods. Results showed the infection odds ratio for COVID-19 (OR=2.6) among obese participants; obese people had 2.6 times the risk of infection susceptibility. In the study population, behaviors that substantially increased the probability of infection have been discovered. Poor water, soft drinks, vegetable and postprandial sleep habits are among these. The consumption of parsley, spinach, and watercress has been associated with vitamin K intake and COVID-19 infection. The COVID group ate more vitamin K from plums, pears, and grapes than the control group. When age is taken into account, the vitamin K consumption of the two groups differs. People under 35 consumed more vitamin K-rich vegetables and fruits, particularly in the control group. In conclusion, an adequately balanced diet encompassing appropriate quantities of vitamin K may protect adults from COVID-19 and other communicable ailments.

Keywords: Vitamin K, Corona virus, Diet, Vegetables, Infection, Fruits, Food Habits

1. Introduction:

COVID-19 is an infectious disease caused by the SARS-CoV-2 virus, belonging to the family of severe acute respiratory syndrome coronaviruses.

The COVID-19 virus, which emerged in Wuhan, China, was initially detected in December 2019 and has since evolved into a persistent global pandemic [1]. The disease is characterized by clinical symptoms such as fever, cough, fatigue, acute respiratory distress syndrome, anorexia, and dyspnea [2].

Most individuals who contract the virus will encounter a range of respiratory symptoms that are generally mild to moderate in severity. These individuals typically recuperate without necessitating any specialized medical intervention [1]. Nevertheless, some individuals will experience severe illness and necessitate medical intervention. The third point of discussion is as follows. The elderly population and individuals with chronic noncommunicable diseases can exacerbate inflammatory processes, potentially resulting in mortality [3].

Research has demonstrated that adhering to a nutritious dietary regimen can enhance the immune system's functionality and mitigate the risk of developing severe infections [4]. The impact of nutritional deficiency on the immune system and its susceptibility to infections has been widely recognized.

Vitamin K is a crucial nutrient, classified as a fat-soluble vitamin, which occurs naturally in specific food sources and can also be obtained as a dietary supplement [5]. Food sources of vitamin K1, also known as phylloquinone, encompass a variety of vegetables, particularly those of the green leafy variety, vegetable oils, and select fruits. Meat, dairy products, and eggs have been found to possess relatively low concentrations of phylloquinone [6].

Vitamin K serves as a co-factor and acts as a coenzyme in the process of hemostasis, facilitating the synthesis of proteins and performing various other physiological functions [7]. Coagulation factors are predominant over extrahepatic factors during inadequate hepatic factor vitamin K. Matrix Gla protein (MGP) is a protein dependent on vitamin K and is an inhibitor of soft tissue mineralization and degradation of elastic fibers. In order to safeguard the pulmonary extracellular matrix against degradation caused by inflammation, an upregulation in the production of Matrix Gla protein (MGP) occurs within the lungs of individuals infected with SARS-CoV-2. This upregulation facilitates the utilization of vitamin K derived from extrahepatic vitamin K reservoirs [8].

The potential impact of COVID-19 on venous and arterial thromboembolic disease is believed to be attributed to factors such as heightened inflammation, hypoxia, immobilization, and the occurrence of diffuse intravascular coagulation (DIC). Additionally, it can induce thrombosis and deteriorate elastin fibers within the pulmonary system. Vitamin K1 has been observed to play a role in activating hepatic coagulation factors, thereby contributing to the mitigation of thrombotic complications in individuals affected by COVID-19 [9]. This study aimed to assess the significance of vitamin K status in relation to COVID-19 patients and its potential influence on the severity of the disease.

2. Subjects and Methods

2.1. Participants:

A sample of adults who had contracted and recovered from the coronavirus (COVID-19) was chosen from the National Liver Institute at Menoufia University in Shibin El Kom, Egypt. The selection of subjects was conducted using a random sampling method.

The study cases encompassed a diverse group of patients, including male and female individuals diagnosed as adults with COVID-19. These participants consisted of 120 hospitalized patients and those receiving care at home, and they were all residents of the Menoufia Governorate. On the contrary, individuals who (1) were administered vitamin K supplements, (2) were pregnant, lactating, or post-menopausal women, and (3) experienced significant exposure to COVID-19 infection were excluded from the study.

The control group consisted of 60 adults who were not COVID-19 and were selected from the free-living population at Menoufia Governorate. Individuals who (1) were administered vitamin K supplements, (2) were pregnant, lactating, or post-menopausal women, and (3) suffered from diseases that could affect vitamin K status (i.e., liver diseases) had been excluded from the study.

2.2 Methodology:

2.2.1 COVID-19 Diagnosis

The definitions presented in the National Institutes of Health (NIH) COVID-19 Treatment Guideline were used for defining the severity of COVID-19 (2021) [10]. The eligible patients were RT-PCR positive for COVID-19, had SpO2 <94% on room air at sea level, a ratio of arterial partial pressure of oxygen to fraction of inspired oxygen (PaO2/FiO2) <300 mm Hg, a respiratory rate >30 breaths/min, or lung infiltrates >50%. In addition to the severe symptoms mentioned by the National Institutes of Health, all patients in this study suffered from common symptoms of COVID-19, including cough, fever, sore throat, and loss of smell.

2.2.2 Experimental Design:

The present study adopts a retrospective, cross-sectional, case-control design to investigate the research question. The study included all eligible subjects and classified as outlined below:

1- Control group: A cohort of 60 adult individuals who remained uninfected by the COVID-19 virus.

2- The COVID-19 cohort consisted of 120 individuals who had contracted the COVID-19 virus.

2.2.3 Data Collection

Specific forms were employed to collect the subsequent data:

2.2.3.1 Demographic data

Data on demographic variables, including age, gender, level of education, occupation, monthly income, family size, housing status, social status, and place of residence, were collected.

2.2.3.2 Health History

Data about various factors such as disease, eating disorders, disabilities, medications, supplementations, and other relevant variables were gathered concerning obesity.

2.2.3.3 Anthropometric measurements:

The measurement of body height in centimeters was conducted with a non-stretchable meter, with precision to the nearest 0.1 cm. Furthermore, body weight (expressed in kilograms) was measured using a portable scale with a precision of 0.1 kg. Body mass index (BMI) was calculated using body height and weight measurements. The Body Mass Index (BMI) was employed to categorize all participants into the subsequent groups: (1) thinness (16.5 kg/m2), (2) underweight (16.5-18.5 kg/m2), (3) healthy weight (18.5-25 kg/m2), (4) overweight (25-30 kg/m2), (5) obesity grade II (30-35 kg/m2), (6) obesity grade III (35-40 kg/m2), and (7) morbid obesity (≥40 kg/m2).

2.2.3.4 Food habits

Data about meal patterns, cooking methods, fast food consumption, and specialized dietary choices were collected.

2.2.3.5 Food Consumption Pattern

The researchers employed a fully quantitative Food Frequency Questionnaire (FFQ) for data collection. The FFQ was structured according to the categorization of foods based on their vitamin K content, specifically rich, moderate, and low vitamin K foods. Participants were asked about the quantities (serving size and grams) and frequency of consumption (daily, weekly, monthly, infrequent, or abstained) for each category. Next, the quantities ingested from each food item and vitamin K were determined by multiplying the frequency of consumption by the grams of each serving size and the amount of vitamin K that occurred in each food item.

2.2.4 Statistical Analysis:

The SPSS Windows version 28 program was used in this study to analyze the data. Data were expressed in numbers and percentages; for qualitative nonparametric variables, the median percentiles were used, while in quantitative parametric data, the mean ± standard deviation (SD) was used, as well as the median with non-parametrical data. To test the significance of our study, the Chi-square test was also used for categorical values, the T-test, and the Mann-Whitney U Test for quantitative variables according to statistical groups and normality of the data. Suppose nonparametric and Pearson correlation tests were also used. Significant statistical correlations between different variables were detected, and the statistical significance correlation was reached if the P value was less than 0.05. The odd was calculated to determine the estimated risk between the two groups of the study and detected the association measures.

2.2.5 Ethical considerations:

Respondents participated voluntarily and were well-informed of the study's objectives and methods. The questionnaires contained no derogatory, discriminatory, or improper language that could offend participants. No private or personal questions were included in the questionnaire, designed to collect data relevant to the study questions. Subjects who refused to sign the consent form were excluded from the study. The Institutional Review Board in the Faculty of Home Economics at Menoufia University, Egypt, approved this research (04-SREC-03-2021).

3. Results

One hundred eighty participants were included in final analysis, 120 with covid-19 infection and 60 healthy controls. Table (1) showed the demographic characteristics of the whole participants in the study.

The age distribution among the study groups which one of risk factors that play an important role as risk factor for COVID -19 infection and compactions our study including all age groups to be representative for general population and keeping the external validity of the study in our study there is no effect for age as confounder the spearman test for correlation (=0.047 with p –value 0.08).

The 76.2% of the participant in our study were females and only 23.8% were males the percent of sharing in each group almost equal to avoid the gender as a confounder in the study.

About 80.5% of the sample was high educated between the universal education and the postgraduate but also the other educational levels represented in the study by 20%.

The occupation one of risk factors matched among the groups of the study which play role as risk of infection by COVID in some conditions so to remove the confounder effect was matched between the groups

There was relation between the marital status and infection of COVID cases (p-value 0.03) that seemed logic due to increase the area of susceptible infection

The chi –test explain the significance relation between the residence distribution and COVID infection where urban higher in infection rate than rural chi2= 12.17 with significance p-value =0.001 also, the OR =1.7 that can be interpret as the urban population have risk 1.7 time more urban in COVID -19 infection

The infection was higher among families with 5 members , or 6 members that due space of droplet infection more higher there is significance relation with big families as partial person correlation indicate significance with p –vale =0.000

The family size one of the risk factor in our study so we try to explain its effect among the groups to give more power in our study by avoiding bias also the same with the financial income which reflect the socio economic status among our groups with OR =1.5 which explain that the infection level among the low socio economic status was more 1.5 times.

Table (1): The demographic characteristics of the whole participants in the study

	Have COVID-19 Frequency (Percent)	No COVID-19 Frequency (Percent)
Age		
age from 15 to 25 y	31 (25.8%)	17 (28.3%)
age from 25 to 35 y	42 (35.0%0	16 (26.7%)
age from 35 to 45 y	14 (11.7%)	8 (13.3%)
age from 45 to 55 y	19 (15.8%)	5 (8.3%)
more than 55 y	14 (11.7%)	14 (23.3%)
Total	120 (100.0%)	60 (100.0%)
Gender		
Male	22 (18.3%)	21 (35.0%)
Female	98 (81.7%)	39 (65.0%)
Total	120 (100.0%)	60 (100.0%)
Education Level		
Illiterate	8 (6.7%)	2 (3.3%)
Read& Write	6 (5.0%)	3 (5.0%)
Primary	1 (0.8%)	1 (1.7%)
Secondary	3 (2.5%)	0 (0.0%)
Intermediate (2 years)	6 (5.0%)	5 (8.3%)

	Have COVID-19 Frequency (Percent)	No COVID-19 Frequency (Percent)
University Graduate	54 (45.0%)	25 (41.7%)
Postgraduate Degree	42 (35.0%)	24 (40.0%)
Total	120 (100.0%)	60 (100.0%)
Job		
Housewife/ Non-Working	50 (41.7%)	28 (46.7%)
Unskilled Manual Worker	2 (1.7%)	1 (1.7%)
Skilled Manual Worker	2 (1.7%)	2 (3.3%)
Trades /Business	5 (4.2%)	6 (10.0%)
Semi-Professional /Clerk	61 (50.8%)	23 (38.3%)
Total	120 (100.0%)	60 (100.0%)
Marital Status		
Single	48 (40.0%)	26 (43.3%)
Married	72 (60.0%)	33 (56.7%)
Total	120 (100.0%)	60 (100.0%)
Residency		
Rural	41 (34.2%)	28 (46.7%)
Urban	79 (65.8%)	32 (53.3%)
Total	120 (100.0%)	60 (100.0%)
Family size		
less than 4 members	29 (24.2%)	14 (23.3%)
from 4 to 6 members	82 (68.3%)	38 (63.3%)
from 6 to 8 members	6 (5.0%)	7 (11.7%)
above 10 members	3 (2.5%)	1 (1.7%)
Total	120 (100.0%)	60 (100.0%)

The odds ratio of healthy and obese COVID cases in our study (OR=2.6) (Table 2) that approves with many previous studies about the relation between the obesity and risk of infection which increase 2.6 time among the obese population. The Pearson –chi test was significance among the groups = 15.89 with p value 0.01 which explains the relation between the BMI and COVID -19 infection

Table (2): BMI of study groups:

		BMI GROUPS			Total	chi2	P-value
		Healthy weight	Overweight	Obese			
Covid_19 infection	Have COVID-19	35 (29.7%)	40 (%33.9)	43 (%36.4)	118 (100.0%)	5.89	0.01
	No COVID-19	27 (%45.0%)	20 (33,3%)	13 (%31.7)	60 (100.0%)		

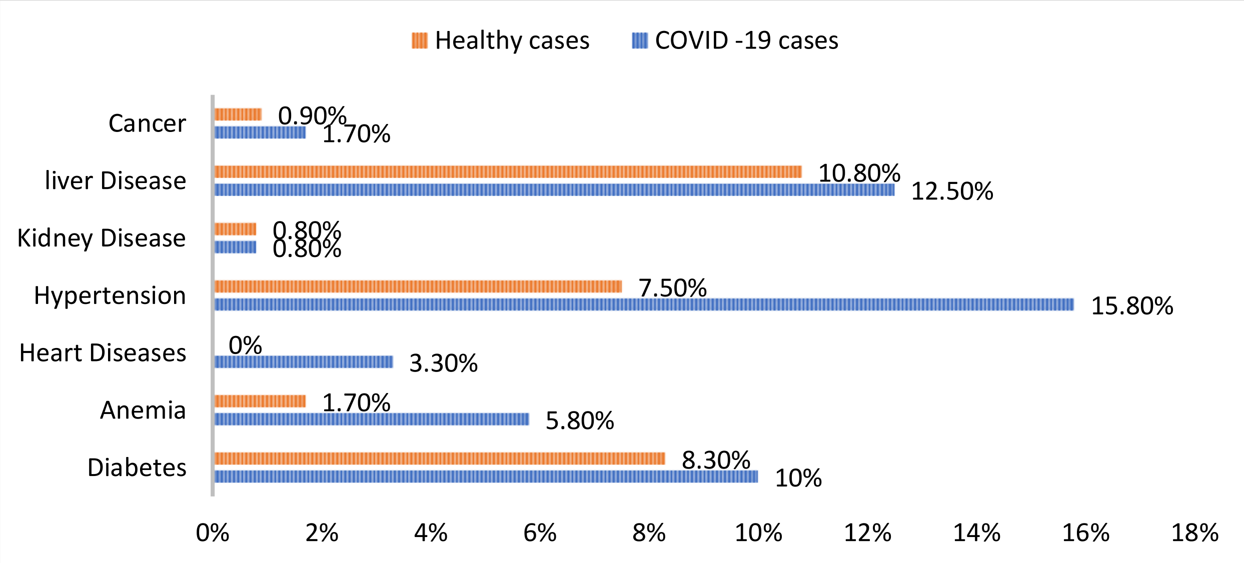
In our study the risk of COVID infection increase with some dietary habits our results show some of this habits with increase the risk of infection nearly the double among our participants as low water intake (OR=3.3) ,soft drink intake (OR=1.7) , low vegetables intake (OR=2.1) and sleeping after eating with (OR=2.4) . This risk explains the strong relation between some dietary habits and rate of infections. The other habits show no relation with COVID infection as drink of tea and eating a lot of sweets that have physiological logic.

Table (3): The Lifestyle food habits among the two study groups

	Have COVID-19 Frequency (Percent)	No COVID-19 Frequency (Percent)	OR	chi^2	P-value
Soft Drinks					
No	84 (70.0%)	48 (80.0%)	1.7	2.04	0.153
Yes	36 (30.0%)	12 (20..0%)			
Total	120 (100.0%)	60 (100.0%)			
Intake of fresh vegetables					
Sufficient	61 (50.8%)	41 (%)	2.1	4.98	0.026
Low	59 (49.2%)	19 (%)			
Total	120 (100.0%)	60 (100.0%)			
Drinking tea after eating					
No	69 (57.5%)	32 (%)	0.9	0.28	0.58
Yes	51 (42.5%)	28 (%)			
Total	120 (100.0%)	60 (100.0%)			
Amount of drinking water					
Sufficient	57 (47,5%)	45 (%)	3.3	12.3	0.001
Low	63 (52.5%)	15 (%)			
Total	120 (100.0%)	60 (100.0%)			
Eating a lot of sweets					
No	96 (80.0%)	48 (%)	1.0	0.00	1.00
Yes	24 (20.0%)	12 (%)			
Total	120 (100.0%)	60 (100.0%)			
Eating a lot of fast food					
No	96 (80.0%)	53 (88.3%)	1.9	2.0	0.163
Yes	24 (20.0%)	7 (11.7%)			
Total	120 (100.0%)	60 (100.0%)			

Among the group of COVID -19 patients were selected with chronic condition to compare with the other group to compare the vitamin K status and the severity of COVID infection, 5.8% have anemia with COVID infection and others have Diabetes Mellitus, Hypertension, liver diseases , and heart diseases with 10%,15.8%,12.5%, & 0.8% respectively (Figure 1). The NCDs play an important role in the severity of COVID infection as proved in many studies so in our study to explain the relation we support by cases: controls ratio 1:1 by choosing COVID groups and healthy adults to make the sample representative and increase the statistical power in cases control study

Figure (1): The prevalence of non-communicable diseases (NCDs) among studied subjects



AS the study depend on the relation between the vitamin K level and the COVID-19 infection among the two groups. We measure the daily intake on vitamin k by food frequency questionnaire to compare the different intake between the two groups. And also, the different concentration among some of green vegetables (Table 4). The total intake explain the significance relation between good intake of vitamin k and the COVID infection where is significance important in intake amount among the two groups.

Table (4): Amount of vitamin k intake in from some green leafy vegetables (mg/day) and the difference effect between the two groups

	Have COVID-19	No COVID-19	Mann-Whitney U Test	
	Median (mg/d)+_(IQR)	Median (mg/d)	Test	Sig.
Parsley	20.5 ±(3.9-105.5)	35.2 ±(8.1-246.0)	2674	0.004
Spinach	1.8 ±(0.9-15.3)	5.4 ±(0.9-15.6)	2985.5	0.050
Green onion	0.1 ±(0.1-3.5)	0.3±(0.14-8.5)	3335.5	0.400
Watercress	10.6 ±(1.0-42.5)	39.5 ±(6.1-51.6)	2686.0	0.005
Cabbage	4.0±(1-8.6)	4.2±(1.5-8.6)	3634.5	0.800
Lettuce	2.3 ±(0.8-8.7)	7.4 ±(0.8-26)	3116.5	0.100
Iceberg lettuce	0.6 ±(0.6-16.1)	1.9 ±(0.5-17.4)	3023.0	0.070
Mulukhiyah	8.0 ±(3.8-11.0)	8.3 ±(2.1-10.5)	3420.5	0.600
Total	88.1 ±(38.5-210.4)	137.8±(74.9-318.9)	2839	0.021

Some of vegetables have higher concentration of vitamin k and also, higher consumption with significance difference between the two groups as carrot, green bell –pepper and sweet potato (Table 5).

Table (5): Amount of vitamin k intake in from some starchy & vegetables (mg/day) and the difference effect between the two groups

	Have COVID-19	No COVID-19	Mann-Whitney U Test	
	Median (mg/d) ±(IQR)	Median (mg/d) ±(IQR)	Test	Sig.
Green beans	0.97±(0.3-5.6)	1.3±(0.3-5.6)	3423.5	0.600
Broad beans	0.1±(0.0-0.13)	0.0±(0.0-0.8)	3467.0	0.700
Peas	1.0±(0.3-1.9)	1.5±(0.3-1.9)	3412.0	0.600
Okra	1.4±(0.5-3.0)	2.1±(0.5-3.0)	3458.0	0.700
Cucumber	14.6±(6.4-17.0)	17±(8.5-34.0)	3092.5	0.100
Carrot	2.0±(0.9-3.5)	2 ±(0.9-3.5)	2859.0	0.2
Green bell _pepper	2.8±(0.8-2.8)	2.7±(1.2-2.8)	2948.0	0.04
French fries	2.6±(0.9-13.6)	4.2±(0.9-13.7)	3342.0	0.4
Sweet potato	0.6±(0.04-1)	0.3 ±(0.08-0.2)	2663.5	0.004
Zucchini	0.21 ±(0.08-0.45)	0.3 ±(0.08-0.45	3274.0	0.31
Amount of vitamin K from starchy and other vegetables (mg/day)	31.8 ±(20.7-52.8)	33.7 ±(20.5-57.6)	3434.0	0.6

The vitamin k intake from some fruits also make different as higher intake from plum, pears and grapes among the control groups and that intake is much lower in the COVID ones with explain by the present of significance difference between the two groups (Table 6).

Table (6): Amount of vitamin k intake in from some fruits (mg/day) and the difference effect between the two groups

	Have COVID-19	No COVID-19	Mann-Whitney U Test	
	Median (mg/d) ±(IQR)	Median (mg/d) ±(IQR)	Test	Sig.
Plum	0.04 ±(0.01-0.9)	0.2 ±(0.01-1.7)	2877.5	0.020
Mango	2.9 ±(1.3-6.8)	3.4 ±(1.3-6.8)	3197.0	0.210
Pears	0.05 ±(0.01-0.8)	0.2 ±(0.04-1.5)	2413.5	0.000
Grapes	4.7 ±(1.04-28.7)	7.2 ±(1.03-13.9)	2940.0	0.040
Amount of vitamin k from fruits (mg/day)	31.8 ±(20.7-52.8)	14.9±(6.1-29.9)	3390	0.520

The consumption of lipid (Table 7) even among different sources not explain any effect on COVID infection or make any change among the groups may need more sample size or effect by indirect ways

Table (7): Amount of vitamin k intake in from some lipid sources (mg/day) and the difference effect between the two groups

	Have COVID-19	No COVID-19	Mann-Whitney U Test	
	Median (mg/d) ±(IQR)	Median (mg/d) ±(IQR)	Test	Sig.
Margarine	0.12 ±(0.1-6.4)	0.12±(0.1-6.4)	3555.0	0.800
Corn oil	17.7 ±(2.5-26.5)	17.7±(2.5-26.6)	3579.0	0.900

	Have COVID-19 Median (mg/d) ±(IQR)	No COVID-19 Median (mg/d) ±(IQR)	Mann-Whitney U Test Test	Sig.
Lipids	17.8 ± (2.9-35.5)	17.8±(6.7-35.5)	3590.5	1.000
Amount of vitamin k from lipid sources (mg/day)	184.6 ± (106.6-335.2)	211.0±(119-442.3)	3107.0	0.100

In our study there are clear cut point between the two groups related to intake of vitamin k as the participant have vitamin k intake less than 160 mg per day have risk 1.5 times than the participants with more intake. That confirms the relation between vitamin k status and COVID infection and effect of vitamin k enough requirement on the healthy lung (Table8).

Table (8): Intake of vitamin k according 160 mg/day cutoff point:

Vitamin K intake	Have COVID-19	No COVID-19	Total	OR ±CI
Less than 160mg per day	58 (48.3%)	23 (38.3%)	81 (45.0%)	1.5±(0.8-2.8)
More than 160 mg per day	62 (51.7%)	37 (61.7%)	99 (55.0%)	
Total	120 (100.0%)	60 (%100.0)	180 (%100.0)	

4. Discussion

The COVID-19 pandemic has had a significant impact on people worldwide, with over 600 million cases and 6 million deaths reported as of September 16, 2023 [11, 12]. The prevalence of the virus varies among different populations, including males and females, people living in different types of residences, family sizes, education levels, and occupations. Most studies agree that male gender is associated with a higher risk of COVID-19 infection, severity, ICU admission, and death. Patients aged 70 years and older have a higher infection risk, severe disease, need for intensive care, and death compared to patients younger than 70 years [12]. Male gender is also an independent risk factor for mortality in patients with COVID-19. In this case-control study, 120 participants were included, with the majority being female (81.7%), highly educated (80.5%), and having a job (58.3%). The study found that the highest number of cases and deaths were reported in urban governorates, especially Cairo, Giza, and Qalyubia, due to their densely populated and high mobility and interaction among people.

The study found that urban areas have a higher infection rate than rural areas, with a 1.7-time higher risk of infection [13]. Conducted a cross-sectional survey of 1,000 households in Cairo and Giza governorates, identifying several factors associated with increased household transmission. The study also found that the infection was higher among families with 5 or 6 members (68.3%), with a significant relation with big families.

Obesity doubles the risk of death from COVID-19, as a large meta-analysis published in JAMA in 2020 found that people with a BMI of 30 or above had a 113% higher risk of hospitalization, a 74% higher risk of ICU admission, and a 48% higher risk of death from COVID-19. The odds ratio of healthy and obese COVID cases in the study (OR = 2.6) agrees with many previous studies about the relation between obesity and the risk of infection, which increased by 2.6 times among the obese population [14].

A prospective cohort study analyzed data from 592,571 participants on diet quality and COVID-19 symptoms, finding that higher diet quality, as measured by the Healthy Eating Index (HEI), was associated with a lower risk and severity of COVID-19, independent of BMI and other confounders [15].

On the other hand, some studies found that higher intakes of plant foods, fish, omega-3 fatty acids, probiotics, vitamins C and K, beta-carotene, lutein and zeaxanthin, magnesium, selenium, and zinc were associated with a lower risk or severity of COVID-19 [15, 16]. However, diet quality may modulate the immune response to SARS-CoV-2 infection.

As fact, the Obesity is a risk factor for severe COVID-19 infection and an indicator of poor nutritional habits for vitamin and mineral deficiency. Vitamin K is an important micronutrient involved in blood clotting, bone health, and vascular calcification, all of which are affected by dietary habits and lifestyle factors [17]. In current study, many Egyptian dietary habits showed a significant relationship with the rate of infection by COVID, with the risk of infection nearly doubled among participants, however this results are in good agreement with that obtained by Ismail et al., [18]. This is supported by previous studies on the relation between soft drink consumption and COVID-19 infection, which have been associated with obesity, diabetes, and cardiovascular diseases [19].

The same study [19] directly examined relation between low water intake and low vegetables and COVID-19 infection and found that it was not clear. Information published by World Health Organization [20] suggest that water intake and vegetable consumption may be important for supporting immune systems and preventing dehydration, which are essential for fighting infections. The World Health Organization [20] article provided some tips for maintaining a healthy diet during the COVID-19 pandemic, emphasizing the importance of drinking enough water to prevent dehydration and support the immune system.

Some studies suggest that vitamin K deficiency may worsen the outcomes of COVID-19 patients, as it can increase the levels of interleukin-6 (IL-6), a pro-inflammatory cytokine associated with lung damage and mortality. However, the evidence is not conclusive and more research is needed to confirm the causal role of vitamin K in COVID-19.The study suggests that vitamin K may modulate the inflammatory response in COVID-

19 and proposes an intervention trial to test its effect on clinical outcomes [21]. The study used a 24-hour recall analysis to assess the dietary intake of vitamin D and K among patients, finding an average intake of 138.5 μg/day among patients. The median intake among cases was 168.1 μg/day, while among healthy controls; it was 213.9 μg/day. These values were lower than the recommended dietary allowances (RDAs) of 120 μg/day for men and 90 μg/day for women [22].

The study found that the main sources of vitamin K in the patients' diet were dairy products, eggs, fish, and green leafy vegetables. However, the intake of these foods was not sufficient to meet the optimal level of this vitamin for immune function and health. There was high variability in the intake of vitamin K among the patients, depending on their age, gender, and dietary preferences. The results suggested that the patients may benefit from increasing their intake of vitamin K-rich foods or supplements to improve their vitamin status and reduce the risk or severity of COVID-19 infection [22].

Our study also revealed different intakes of vitamin K among the two groups and the different concentrations of vitamin K among some green vegetables. The total intake explains the significance of the relationship between good intake of vitamin K and the COVID infection. There is a significant difference between the two groups in total intake of vitamin K from green vegetables, with the median intake among cases being 88.1±IQR = (38.5-210.4), and among the control being 137.8±IQR = (74.9-318.9), with a significance difference of p value of 0.02.

The current study analyzed vitamin K (vitamin K) consumption among different age groups and fruit. It found that the median intake was higher in young adults under 35 years old than elder age, supporting previous studies [21]. Vitamin K intake from certain fruits was also different, with higher intake from plum, pears, and grapes among control groups and lower intake among COVID cases. However, no difference was found in vitamin K consumption from lipid sources.

Another study found that both vitamin K and vitamin D deficiency were independently associated with worse COVID-19 disease severity, as measured by the need for oxygen therapy, intensive care unit admission, or death. Participants who were vitamin D deficient had the worse vitamin K status and experienced the most severe COVID-19 outcomes. This suggests a potential synergistic interplay between these two vitamins in COVID-19 [23]. The study agrees with ours by matching the present non communicable diseases (NCDs) in our groups and the vaccine status to detect the severity among COVID cases due to vitamin K deficiency. Among COVID-19 patients, those with chronic conditions were selected to compare with the other group to compare the vitamin K status and the severity of the COVID infection. 5.8% of COVID-19 patients had anemia with a COVID infection, while others had DM, hypertension, liver diseases, and heart diseases.

Also, current study supports the relation between vitamin K and COVID infection and the effect of adequate intake on healthy lung health. The AI level for vitamin K is set at 90 µg/day for women and 120 µg/day for men, which aligns with our findings. The AI level for vitamin K intake is also based on the average intake of vitamin K from food sources in healthy populations.

5. Conclusion:

The COVID-19 pandemic has had a big influence on people all around the world; the virus has affected some groups more than others, like obese people, people who don't get enough vitamin K, and people who eat poorly. Our research showed that unhealthy eating patterns, insufficient vitamin K consumption, and obesity were all linked to a higher risk of COVID-19 infection and severity. Other research that have demonstrated that obesity, vitamin K insufficiency, and improper diets are all risk factors for increasing the likelihood of COVID 19 and severity confirm these findings. Additionally, our research revealed that patients with COVID-19 may benefit from consuming more vitamin K in the form of food or pills.

An essential nutrient, vitamin K is involved in the immune system, bone health, and blood coagulation processes. According to certain research, patients with COVID-19 may experience worse outcomes if they are vitamin K deficient. To confirm the causal involvement of vitamin K in COVID-19 and to establish the ideal level of vitamin K intake for COVID-19 patients, more research is required.

Overall, our study offers significant new information about the connection between diet, vitamin K status, COVID-19 infection, and the severity of the illness. Our research indicates that keeping a healthy weight, eating a balanced diet, and increasing intake of foods high in vitamin K may all assist to lower the likelihood and severity of COVID-19 infection. Additional investigation is required to support these findings and create efficient preventive measures.

6-Recommendations

(a) Considering vitamin K supplementation, especially for those who are at high risk of COVID-19 infection or severe illness; (b) Maintaining a healthy weight and reducing obesity (c) Eating a healthy diet rich in fruits, vegetables, and whole grains; and (d) Increasing intake of vitamin K-rich foods, such as green leafy vegetables, dairy products, and eggs

7-Limitations

The study was observational, so it cannot prove a causal relationship between the factors studied and COVID-19 infection and severity. The study was also conducted in Egypt, so the findings may not be generalizable to other populations. Overall, the study provides important insights into the relationship between diet, vitamin K status, and COVID-19 infection and severity. More research is needed to confirm the findings and to develop effective interventions to prevent and treat COVID-19.

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Conflict of interest

The authors of this article has indicated that they has no conflicts of interest to disclose.

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