



Impact of the Emerging COVID-19 Pandemic on the Consumption of Multivitamins (C, D and Zinc) by the Saudi Arabian Population

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Authors' contributions

This work was carried out in collaboration between both authors. Authors DMB and AB had substantially contributed to the conduction of this study. The work was carried out in collaboration among all authors. Author DMB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author AB managed the analyses of the study, the survey and managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Background: On March 11, 2020, the World Health Organization (WHO) announced the Coronavirus outbreak officially as a pandemic. This pandemic has led to new measurements to prevent viral spread. The measures included decreasing the person's mobility outside homes with subsequent changes in the lifestyles, particularly in physical activity and eating habits. It has been noticed that consumption of some vitamins may help in preventing or reducing the symptoms of viral infection. Those vitamins include vitamin C, D and zinc. There is a common observation that the general public believes that the use of vitamins, especially vitamins C, D and zinc, reduces the chance of acquiring COVID-19.

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Objectives: The aim of this study was to determine the impact of COVID-19 pandemic on taking vitamins supplements by the Saudi general population in order to explore their believes regarding the protective value of these vitamins against COVID-19 infection.

Subjects and Methods: This cross-sectional study was conducted using a self-administrated questionnaire that was designed, uploaded to the Google form and distributed online to the general Saudi population through the social media (Whatsapp, Twitter) as well as through email between August and December 2020. Statistical Packaged of Social Sciences program (SPSS) for Windows (version 17.0., Chicago: SPSS Inc) was used to analyze the data. A significant difference was considered when the p value is < 0.05. Student t-test and Chi-square (χ^2) test were used to compare the studied variables as appropriate.

Results: A total of 1043 participants were included in this study (64.9% females, 35.1% males). The mean age for them was 35.3 ± 14.78 years. Only 9.3% (97 participants) were diagnosed to have COVID-19. About 28% of the participants were in contact with COVID-19 cases. Among participants diagnosed to have COVID-19 infection, (13% versus 29%) were taking vitamin C and (2% versus 15%) were taking zinc supplements daily during the 6 months before and after the pandemic, respectively, while (20% versus 25%) were taking vitamin D supplements weekly during the 6 months before and after the pandemic, respectively. Among participants who were in contact with COVID-19 cases, (8% versus 20%) and (3% versus 11%) were taking vitamin C and zinc supplements daily during the 6 months before and after the pandemic, respectively, while (14% versus 16%) were taking vitamin D supplements weekly during the 6 months before and after the pandemic

Conclusion: The interest of taking multivitamin by Saudi population, such as vitamins C and D, zinc increased during and after the pandemic compared to that before it. There is no scientific evidence based on previous studies confirmed the role of dietary supplementation and multivitamins in preventing COVID-19 infection, therefore, effective education on the rationale use of vitamins during COVID-19 pandemic should be emphasized at local and/or national levels.

Keywords: COVID-19; nutrition; vitamins; protection; Arabic Gulf-citizens.

1. INTRODUCTION

During March, 2020, the World Health Organization (WHO) announced the Coronavirus outbreak officially as a pandemic. A pandemic is a disease that is spreading in multiple countries around the world at the same period of time. The WHO encouraged nations to take "urgent and aggressive actions" to alter the course of the outbreak [1,2]. The current pandemic led to new measurements in to prevent viral spread. The measures included decreasing the people mobility outside homes with subsequent changes in the lifestyles, particularly in physical activity and eating habits [3].

As regards the current situation, maintaining a balance in lifestyle is crucial to safe the mental and physical health. In this concern, the Italian Ministry of Health publicized a specified page on coronavirus that focused on the lifestyles during COVID-19 to afford citizens with simple and useful behavior procedures [4].

It is important to feed a balanced diet to guarantee supplying all the essential nutrients for the proper function of body. Daily food intake

should include all food groups; fruit, vegetables, meat, fish, cereals, pulse, tubers and dairy products. The calories of the day should be properly divided on many meals; breakfast 20%, morning snack 5%, lunch 40%, afternoon snack 5% and dinner 30% [1]

It has been noticed that consumption of some vitamins may help in prevention or reducing the symptoms of viral infection. Those vitamins include vitamin C, D and zinc [5]. Increased intracellular Zn concentration powerfully hinders many RNA viruses replication e.g influenza and poliovirus virus. It was reported that the combination of Zn and pyrithione prevent the replication of SARS-coronavirus and equine arteritis virus in cell culture [6].

Vitamin C is considered an essential factor in the process of healing as well as a critical cofactor for the formation of collagen in cartilage, muscle, bone and blood vessels [7]. As an antioxidant, the vitamin could preserve against cellular damage induced by chemical free radicals which are implicated in in cancer, heart disease and other diseases. It has also been shown that regular vitamin C supplementation reduces the

duration of the common cold in the general population [8]. Similarly, vitamin D in the last few years has shown significant change in our understanding of the health benefit of this vitamin [9]. It also plays a key role regulating the immune system, and it also showed a role in regulating viral infection. Studies provide evidence that vitamin D deficiency may increase the risk of getting influenza and respiratory tract infection [10].

It was said that to stay healthy, you need to "move", that is, walk, dance, play, etc. Scientific evidence shows that men and women of all ages may gain great benefit from 30 minutes of moderate daily exercise. Especially in the current situation, a little bit of exercise every day, even at home, becomes fundamental not only for our health, but also for our psychological well-being. Physical activity reduces stress and anxiety and improves mood and sleep quality [11].

There is a common observation that the general public believes that the use of vitamins, especially vitamins C, D and zinc, reduces the chance of acquiring COVID-19. Therefore, we wanted to explore more about this pandemic. This new COVID-19 pandemic has no background knowledge regarding prevention, protection, factors leading to increase the susceptibility. The study tries to explore the current knowledge and practice of people toward vitamin usage [12]. The aim of this study was to determine the impact of COVID-19 pandemic on taking vitamins supplements by the Saudi general population in order to explore their beliefs regarding the protective value of these vitamins against COVID-19 infection.

2. SUBJECTS AND METHODS

A self-administrated questionnaire was designed to assess the self-reported use of vitamins C, D, zinc and multivitamins by the general Saudi population during the 6 months before and after occurrence of COVID-19 pandemic.

A section of the questionnaire was asking about the demographic characteristics of the participants, which included; Gender, Age, information about the income and the educational level. The participants were asked if they were diagnosed to have COVID-19 infection or they were in contact with COVID-19 cases in order to identify if the use of the studied vitamins between them was significantly differed or not.

The questionnaire was uploaded to the Google form and was distributed online through the

social media (Whatsapp, Twitter) as well as through email between August and December 2020. An informed consent to participate in the study as well as a statement declared the study objective was included in the first part of the questionnaire. The questionnaire was anonymous and was supplied with Arabic and English based on the participant choice. Inclusion criteria of the study were residing in Saudi Arabia, being 18 years or older, ability to read either Arabic or English. Questionnaire with missing or incomplete data were excluded.

The collected data was exported, saved as Excel file, then it was transformed to the Statistical Packaged of Social Sciences program (SPSS) for Windows (version 17.0., Chicago: SPSS Inc). Results were presented in the form of means \pm standard deviations (SD). Student t-test and Chi-square (χ^2) test were used to compare the studied variables as appropriate. A significant difference was considered when the p value is < 0.05 .

3. RESULTS

A total of 1043 participants were included in the study (64.9% females, 35.1% males). The mean age of the participants was 35.3 ± 14.78 years. It was found that 710 (68.1%) of the participants had fixed income with more than half of them (51.2%) had income less than 4000 Saudi Arabia Riyal (SAR). In addition, 55.5% of them had university education. Only 9.3% were diagnosed to have recent COVID-19 virus infection and about 28% of them were in contact with COVID-19 positive cases Fig. 1.

3.1 Use of Vitamins Supplements among the Saudi General Population

Among all participants, 64% did not take vitamin C supplements during the 6 months before the pandemic; however this percent decreased to 50% after the pandemic. Only 7.7% and 5.6% of the participants were taking vitamin C supplements on daily and weekly base, respectively, during the 6 months before the pandemic, however they significantly increased ($p < 0.001$) to 16.4% and 9.1% after the pandemic (Table 1).

It was found that, 55.6% of the participants did not take vitamin D supplements during the 6 months before the pandemic; however, this percent decreased to 51.5% after the pandemic. On the other hand, 10% and 12.7% of the

participants were taking vitamin D supplements either daily or weekly during the 6 months before the pandemic, however, they were significantly increased ($p < 0.001$) to 11.8 and 15.1%, respectively, after the pandemic (Table 1).

taking zinc supplements either daily or weekly during the 6 months before the pandemic, however they were significantly increased ($p < 0.001$) to 8.8 and 5%, respectively, after the pandemic (Table 1).

Regarding supplementation of Zinc, it was observed that, 83.5% of the participants did not take zinc supplements during the 6 months before the pandemic; however this percent decreased to 74.4% after the pandemic. On the other hand, 4% and 2.9% of the participants were

When it came to the multivitamin supplements, it was noticed that there was no big difference between those taking them before and after the pandemic. On the other hand, 16.3% and 5.3% of the participants were taking multivitamins supplements either daily or weekly during the 6



Fig. 1. Demographical characteristics of the participants (n = 1043)

Table 1. vitamins use before and during pandemic among all participants (n = 1043)

	During the 6 months before pandemic		During pandemic		Z	P-value
	N	%	N	%		
Vitamin c						
No	668	64.0%	522	50.0%	-10.379	p<0.001
Occasionally / multiple time per month	237	22.7%	255	24.4%		
Yes every day	80	7.7%	171	16.4%		
Yes every week	58	5.6%	95	9.1%		
Vitamin D						
No	580	55.6%	537	51.5%	-4.001	p<0.001
Occasionally / multiple time per month	227	21.8%	225	21.6%		
Yes every day	104	10.0%	123	11.8%		
Yes every week	132	12.7%	158	15.1%		
ZINC						
No	871	83.5%	776	74.4%	-8.076	p<0.001
Occasionally / multiple time per month	100	9.6%	123	11.8%		
Yes every day	42	4.0%	92	8.8%		
Yes every week	30	2.9%	52	5.0%		
Multi vitamins						
No	670	64.2%	665	63.8%	-2.034	p=0.04
Occasionally / multiple time per month	148	14.2%	125	12.0%		
Yes every day	170	16.3%	189	18.1%		
Yes every week	55	5.3%	64	6.1%		

Results were presented in the form of number (N) and percentage (%). Wilcoxon signed ranks test was used to compare the studied variables.

months before the pandemic, however, they were significantly increased ($p=0.04$) to 18.1 and 6.1%, respectively, after the pandemic (Table 1).

3.2 Use of Vitamin Supplements among Participants Diagnosed to have COVID-19

It was noticed that 62% of the participants who diagnosed to have COVID-19 did not take vitamin C supplements during the 6 month before the pandemic, while 31% of them reported they did not receive vitamin C after the pandemic. On the other hand, only 13% and 3% were taking vitamin C supplements either daily or weekly during the 6 months before the pandemic, however, they significantly increased ($p<0.001$) to 29% and 11%, respectively, after the pandemic (Table 2).

Regarding D, 2% and 20% of the participants diagnosed to have COVID-19 were taking vitamin D supplements for daily and weekly 6 months before the pandemic. Their percentages were significantly increased ($p=0.003$) to 8 and 25% respectively, after the pandemic. It was found that only 2% and 6% of participants diagnosed to have COVID-19 did not take zinc supplements during the 6 months on daily or weekly base before the pandemic, however this percentage increased to 15% and 11%, respectively, after the pandemic (Table 2).

Regarding multivitamins there was non-significant difference ($p=0.130$) observed between the participants diagnosed to have COVID-19 participants and were taking them before and after the pandemic (Table 2).

Table 2. Vitamins use before and during pandemic among participants diagnosed with COVID-19 infection (n= 97, 9.3%)

	During the 6 months before pandemic		During pandemic		Z	P-value
	N	%	N	%		
Vitamin c						
No	60	62%	30	31%	-5.027	p<0.001
Occasionally / multiple time per month	21	22%	28	29%		
Yes every day	13	13%	28	29%		
Yes every week	3	3%	11	11%		
Vitamin D						
No	55	57%	43	44%	-2.935	p=0.003
Occasionally / multiple time per month	21	22%	22	23%		
Yes every day	2	2%	8	8%		
Yes every week	19	20%	24	25%		
ZINC						
No	78	80%	46	47%	-5.016	p<0.001
Occasionally / multiple time per month	11	11%	25	26%		
Yes every day	2	2%	15	15%		
Yes every week	6	6%	11	11%		
Multivitamins						
No	57	59%	54	56%	-1.516	p=0.130
Occasionally / multiple time per month	18	19%	13	13%		
Yes every day	15	15%	23	24%		
Yes every week	7	7%	7	7%		

Results were presented in the form of number (N) and percentage (%). Wilcoxon signed ranks test was used to compare the studied variables.

Table 3. Vitamins use before and during pandemic among participants who were in contact with COVID-19 cases (n= 291, 28%)

	During the 6 months before pandemic		During pandemic		Z	P-value
	N	%	N	%		
Vitamin c						
No	190	65%	116	40%	-7.736	p<0.001
Occasionally / multiple time per month	61	21%	79	27%		
Yes every day	23	8%	58	20%		
Yes every week	17	6%	38	13%		
Vitamin D						
No	168	58%	153	53%	-2.121	p=0.034
Occasionally / multiple time per month	60	21%	63	22%		
Yes every day	23	8%	28	10%		
Yes every week	40	14%	47	16%		
ZINC						
No	247	85%	204	70%	-6.078	p<0.001
Occasionally / multiple time per month	23	8%	33	11%		
Yes every day	9	3%	33	11%		
Yes every week	12	4%	21	7%		
Multi vitamins						
No	185	64%	181	62%	-1.760	p=0.08
Occasionally / multiple time per month	41	14%	33	11%		
Yes every day	49	17%	57	20%		
Yes every week	16	5%	20	7%		

Results were presented in the form of number (N) and percentage (%). Wilcoxon signed ranks test was used to compare the studied variables.

3.3 Use of Vitamin Supplements among Participants Who were in Contact with COVID-19 Cases

Only 8% and 6% of the participants who were in contact with COVID-19 cases were taking vitamin C supplements for daily and weekly base during 6 months before the pandemic, however, they were significantly increased (**p<0.001**) to 20% and 13% after the pandemic, respectively.

It was observed that 8% and 14% of participants who were in contact with COVID-19 cases did not take vitamin D supplements during the 6 months on daily and weekly base before the pandemic, however, they significantly increase (**p<0.001**) to 10% and 16%, respectively, after the pandemic (Table 3).

Regarding zinc supplements, 3% and 4% of participants who were in contact with COVID-19 cases were taking them during the 6 months before the pandemic either daily or weekly, however they significant increased (**p<0.001**)

to 11% and 7% after the pandemic, respectively.

When it came to multivitamin supplements, little change was observed between the percentage of participants who were in contact with COVID-19 cases and were taking them before and after the pandemic with no significant difference between them (**p=0.078**) (Table 3).

3.4 Use of Vitamin Supplements during Pandemic, According to the Demographic Characteristics of Participants

It was noticed that intake of vitamin C was significantly higher (**p=0.001**) among those with education less than high school and those with higher education (70% and 60% respectively). Regarding vitamin D intake, it was significantly higher (**p=0.001**) among females than males (53% versus 41%) (Table 4).

It was noticed that intake of zinc and multi-vitamins use were significantly higher

Table 4. Use of Vitamins during pandemic according to the demographic characteristics of participants

	Vitamin C			Vitamin D			Zinc			Multi-vitamins		
	N	%	P-value	N	%	P-value	N	%	P-value	N	%	P-value
Age												
Less than 35 years (n= 550)	238	43%	0.09	212	39%	0.06	121	22%	0.01	160	29%	<0.001
More than or equal 35 years (n= 493)	283	57%		294	60%		146	30%		218	44%	
Gender												
Female (n= 677)	347	51%		357	53%		175	26%	0.81	262	39%	0.06
Male (n= 366)	173	47%	0.28	149	41%	0.001	92	25%		116	32%	
Educational level												
Less than high school (n= 10)	7	70%	0.001	6	60%	0.09	5	50%	0.103	6	60%	0.003
High school (n= 111)	49	44%		48	43%		32	29%		34	31%	
Diploma (n= 29)	13	45%		14	48%		7	24%		13	45%	
University education (n= 579)	264	46%		266	46%		131	23%		187	32%	
Higher education (n= 313)	187	60%		172	55%		92	29%		138	44%	

Results were presented in the form of number (N) and percentage (%) or means \pm standard deviations (SD). Student t-test and Chi-square (χ^2) test were used to compare the studied variables.

($p=0.01$ and $p<0.001$, respectively) among participants who were 35 or more years old. Intake of multi-vitamins were also significantly higher ($p=0.003$) among those with education less than high school (Table 4).

4. DISCUSSION

Unfortunately, little is known about prevention, protection, and factors associated with or leading to increased susceptibility to COVID-19 pandemic. It was believed that the use of vitamins such as C, D and zinc decrease the risk of catching COVID-19 infection [12]. Therefore, this study tries to explore the current knowledge and practice of Saudi population about vitamin supplement before and after COVID-19 pandemic.

This cross-sectional study included 1043 participants from Saudi Arabia. This study assesses the impact of the emerging corona virus pandemic on consumption of multivitamin (Vitamin C, D and Zinc) by the Saudi Arabian population. This study showed that there is an increase in the use of vitamins, especially vitamin C, D and zinc after the spread of the COVID-19 pandemic.

COVID-19 pandemic is considered an international concern including the Middle

Eastern countries. The SARS-coronavirus (SARS-CoV-2) high infectivity rate has been established regardless of the appearance of symptoms, which may extend to 14 days [13]. Recently, it has been revealed that COVID-19 virus is transmitted through respiratory droplets or touching the buccal, nasal or eye mucous with contaminated hands.

These modes of infection with COVID-19 in addition to absence of efficient vaccines or adequate treatment obligated the health authorities to adopt various multiple preventive measures to hinder viral spread like minimizing people mobility outside their homes with subsequent change in the lifestyle specifically those of physical activity and eating habits [14].

Currently, caring with maintaining a balance in the lifestyle is crucial to safe the mental and physical health. In this concern, the Italian Ministry of Health publicized a specified page on coronavirus that focused on the lifestyles during COVID-19 to afford citizens with simple and useful behavior procedures [15].

It has been noticed that consumption of some vitamins may help in preventing or reducing the symptoms of viral infection. Those vitamins

include vitamin C, D and zinc. Up-regulating intracellular Zn concentration with zinc-ionophores like PT can efficiently impair the replication of a variety of RNA viruses. Vitamin C is an important cofactor involved in the formation of blood vessels, cartilage, muscle and collagen in bone and is vital for the healing process, it helps to protect cells from damage by chemical free radicals [6], [7], [8], [16]. Similarly, vitamin D has an essential role in regulating the immune system, and it also showed a role in regulating viral infection. The studies provide evidence that vitamin D deficiency may raise the risk of getting influenza and respiratory tract infection [10,16].

When talking about all the participants either those who were infected with corona or those who did not infected among our sample, daily taking vitamin C, zinc and multivitamin supplements was increased after emerging corona virus pandemic. In addition, the weekly use of vitamin D, it was also increased. This could be due to that the general public believes that the use of vitamins, especially vitamins C, D and zinc, reduces the chance of acquiring COVID-19. This finding is similar to the findings of a study by (Adams et al., 2020)[16] where this study found that the sales of dietary supplements such as vitamin C, vitamin D, zinc, and elderberry have significantly increased after corona virus pandemic. In addition, Hamulka et al., [17] found that the international concern about the nutrients affecting the immunity, bioactive compounds, and food supplements like “vitamins C and D, zinc, selenium, garlic, ginger, turmeric, honey, *echinacea*, *elderberry*, *Nigella sativa*, *Glycyrrhiza glabra*” reached their peaks during the first or second wave of COVID-19.

Among participants diagnosed with COVID-19 and participants who were in contact with COVID-19 cases in our study, daily use vitamin C, zinc supplements and weekly use of vitamin D were more after spread the pandemic. On other hand, there was no significant difference between using multivitamin supplements before and after the pandemic. This could be due to the role of these vitamins in improving immunity. These findings are partly consistent with that of Mayasari et al.[18], that revealed an increased interest with vitamin C, garlic, zinc, onion, ginger, but not vitamins D. In a previous study conducted in the USA, it was reported that starting a medication during corona virus pandemic included mostly vitamins or other supplements like zinc, vitamin C and other supplements [19].

Among the observations in this study was that large percent of the participants were females and this was observed in so many survey-based studies. It might be attributed to the interest of the females to express their opinions and willing for participation. This is in agreement with same observation reported in previous studies [20]

It was also observed that intake of three out of four vitamins included in this study was significantly higher among the participants with education less than high school. This might be due to their fear of COVID-19 infection or having less information about the pandemic. Regarding vitamin D intake in specific, it was significantly higher among females. This might be due to the females usually perceiving themselves in a need for vitamin D supplement.

5. CONCLUSIONS

This study showed the effect of COVID-19 pandemic on consumption of multivitamins by Saudi population. The interest of taking a multivitamin, such as vitamins C and D, zinc increased, among the studied sample, during and after the pandemic compared to that before it. There is no scientific evidence based on previous studies confirmed the role of dietary supplementation and multivitamins in preventing COVID-19 infection, therefore, effective education on the rational use of vitamins during COVID-19 pandemic should be emphasized at local and/or national levels. Based on the results presented in this cross-sectional study, there is a clear association between vitamin and dietary supplements consumption and getting infected with the virus. Although no clear causal relationship is established, the fact that people who are consuming these supplements are less likely to be infected with the virus is worth exploring and examining thoroughly. With growing evidence, effective education and community awareness can be raised based on sound scientific evidence, and this study should be a stepping stone for more advanced, randomized trials that will provide such evidence that can be used to persuade people to live healthier.

In this study, we examined the association between vitamin consumption and the probability of getting infected with SARS-CoV 2. Such an association will serve as a platform for further studies and investigations that can pinpoint the

direct effect of supplementary vitamins on immunity and disease progression.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

This cross-sectional study was revised and approved by the Biomedical Research Ethics Committee, Faculty of Medicine, King Abdulaziz University with (Reference No 483-20).

DATA AVAILABILITY

The raw data will be provided by the author upon rational request.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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