Perceptions toward the use of over-the-counter dietary supplements during the coronavirus disease 2019 pandemic: A cross sectional study of the general public in Jordan

Rawand A. Khasawneh¹ | Samah F. Al-Shatnawi¹ | Hamza Alhamad² | Khalid A. Kheirallah³

1Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan
2Department of Clinical Pharmacy, Faculty of Pharmacy, Zarqa University, Zarqa, Jordan
3Department of Public Health, Faculty of Medicine, Jordan University of Science and Technology, Irbid, Jordan

Abstract

Background and Aims: Over-the-counter (OTC) dietary supplements gained popularity during the COVID-19 pandemic as a preventive measure. Lack of complete understanding among the general population of the pathophysiologic mechanisms underlying the severity and progression of infection with coronavirus disease 2019 (COVID-19) has further encouraged the use of supplements. The present study aimed to assess the perceptions of the general public toward the efficacy and safety of the use of OTC dietary supplements as immune enhancers during the COVID-19 pandemic. The factors impacting these perceptions were also explored.

Methods: This was an online survey-based, cross-sectional study conducted in Jordan over 4 months. A validated survey which comprised 28 questions covering aspects related to the respondents’ demographic characteristics, their perceptions toward the efficacy of OTC dietary supplements and their awareness regarding the safety of popular OTC supplements and healthy dietary habits was used to collect responses. Associations between patient characteristics with perception and awareness were explored.

Results: A total of 1487 responses were included in the analysis. Ascorbic acid, zinc, and vitamin D were the most popular OTC supplements, as indicated by the percentages of users (48.8%, 38.6%, and 34.6%, respectively). Perceptions toward OTC supplement use were suboptimal, with a reported mean perception score of 27.82 ± 8.56 (range 0–45). The multivariate analysis showed that participants who were of older age (>65 years) (AOR = 6.29, 95% CI = 2.2–17.9), had an income level >1500 (AOR = 1.84, 95% CI = 1.80–3.56), and used chronic medications had better perceptions than did younger participants, those with no income, and non-users of chronic medications, respectively. The mean safety awareness score was 5.36 ± 1.58 (maximum 7), with a significant direct relationship identified between perceptions and safety awareness scores (Spearman’s correlation = 0.136, p < 0.001).
Conclusion: This study highlighted the needs to organize educational campaigns that promote general public perceptions toward the safe use of OTC supplements to enhance immunity during COVID-19.

KEYWORDS
antioxidant, COVID-19, immunity boosting, OTC, vitamin c, zinc

1 INTRODUCTION

The coronavirus disease 2019 (COVID-19), which evolved in late 2019, is induced by a highly contagious novel strain of the Coronavirus family. The disease was announced by the World Health Organization (WHO) as a pandemic in March 2020, after it had affected millions of people globally and jeopardized the lives of millions of others. The hallmark in the pathophysiology of COVID-19 is the induction of cytokine storm, denoting hyperactive immune response and failure in the respiratory apparatus in prone patients. The aggregated flow of critically ill infected patients has posed great pressure on healthcare resources in different countries, especially developing ones.

Scientists have been racing against time to develop an effective yet safe vaccine to bring the current pandemic under control. Recently, multiple vaccines have been approved, and the vaccination of first-liners and vulnerable people has begun worldwide as part of meeting domestic demands of vaccination. However, given the logistic conditions that are needed to accommodate the transportation of the vaccines to different developing countries, it is expected that more time is needed to vaccinate the required proportion of the population to curb the infectious pandemic.

As a result of this, achieving herd immunity requires that safety precautions aimed at preventing COVID-19 transmission, such as physical distancing, wearing a face mask, avoiding crowds, and cleaning hands frequently, should be taken until a sufficient proportion of the population has been vaccinated. Moreover, the importance of people having healthy immune systems capable of halting the progression of the disease has been highlighted. Over-the-counter (OTC) dietary supplements claimed to enhance immune function have gained popularity during the pandemic, given their assumed efficacy, wide-spread availability, and relative safety. A wide spectrum of OTC dietary supplements and antioxidants has been brought under the spotlight throughout the pandemic. Ascorbic acid (a synthetic form of vitamin C), vitamin D, zinc, and some herbal products (Echinacea, Costus, and Hedera helix) were among the front-line OTC dietary supplements in this regard. It is important to note that the use of such supplements to activate immunity is not risk-proof, and that despite their presumed benefits in people with deficiencies, these products can induce side effects and toxicities. Recognition of the associated characteristics and perspectives of users is essential for decreasing the risks of overuse and potential toxicity. Such an understanding is also of paramount importance in guiding the choice of appropriate prophylactic treatment in vulnerable populations. The objectives of the present study were (i) to assess public perceptions toward the efficacy and safety of the use of OTC dietary supplements as immune enhancers during the COVID-19 pandemic, and (ii) to explore factors that may impact these perceptions. The main prespecified hypotheses in this study were: (i) There is positive perceptions among the public population in Jordan toward the use of OTC dietary supplements as immune enhancers during the COVID-19 pandemic, and (ii) Different demographic, health-related, and COVID-19-related factors impact perceptions among the public population in Jordan toward the use of OTC dietary supplements as immune enhancers during the COVID-19.

2 METHODS

2.1 Study design

This cross-sectional study was conducted online using a convenient sampling technique over a period of 4 months (October 2020–January 2021). The questionnaire was posted online on different social media portals to recruit participants. Eligibility criteria included: age of 18 years or older, and residence in Jordan. However, participants who did not agree (in this study less than 10 participants forgot to check the informed consent box) to participate through providing informed consent online were excluded. Based on the reported population of approximately 11,000,000 in Jordan in 2021 and by using Rao soft calculator, it was estimated that a sample size of 358 is sufficient to achieve the study objectives. However, a three times larger study sample was recruited to enhance the generalizability of study results.

The final version of the questionnaire (Supporting Information: S1) consisted of four main sections covering the following areas: (1) demographic characteristics, including age, gender, marital status, place of residence, educational level, major of practice, type of healthcare insurance, income, smoking status, and infection of oneself or a relative with COVID-19; (2) perceptions toward the use of OTC supplements, covered by 16 items scored on a four-point Likert-type scale; (3) awareness about the safety of the use of OTC dietary supplements, covered by six items; and (4) perceptions toward some healthy habits related to the COVID-19 pandemic, covered by six items scored on a three-point Likert-type scale. Negatively worded statements were reversely coded.

Based on a comprehensive review of the related literature, the study researchers developed and modified (in English) a close-ended structured questionnaire for data collection. Three bilingual

...
professors (whose native language is Arabic) translated the study tool into Arabic using the backward-forward translation method. The original and translated versions of the study tool were assessed by a panel of three academic experts in community pharmacy practice to ensure validity. The authors reviewed the academic experts’ feedback and comments and refined the questionnaire accordingly. Pilot testing on 20 subjects was conducted to evaluate the questionnaire for content and face validity. The data collected from the pilot testing were not included in the final analysis.

2.2 Ethical approval

The study protocol was approved by the Jordan University of Science and Technology (JUST) Institutional Review Board committee (reference number 8/143/2020). This study was funded by the deanship of research at JUST (Grant No. 850-2020).

2.3 Statistical analysis

Following data collection, responses were coded and entered into SPSS. Descriptive statistics were used to summarize the data using numbers and percentages for categorical variables and mean (±SD) for continuous variables. Further, the reliability of the scales was assessed and reported using Cronbach’s alpha, as applicable.

Total perceptions score was calculated by summing the individual scores of the responses to the 16 items related to perceptions toward OTC supplementation use. Total scores were assessed for normality using the Shapiro–Wilks test, and comparisons between perceptions across the demographic groups were conducted using non-parametric tests (Wilcoxon–Mann–Whitney and Kruskal–Wallis tests). The associations between the categorical variables were assessed using the Chi-square test, while Spearman’s correlation test was used to test the associations between the continuous variables. Variables with a p-value ≤ 0.2 in the univariate analysis were included in the multivariate analysis using a binary logistic regression model (with backward variable entry method) to assess the impact of different factors on total perceptions scores. Perceptions scores were categorized into high and low levels using the mean score of the total sample as a cutoff point. All statistical analyses were performed using IBM SPSS (version 25), and a 5% level of significance was set.

3 RESULTS

A total of 1478 responses were collected and included in the final analysis. The highest proportion of participants lied in the age group 18–24 years (33.4%), and more than half of the participants were female (66.5%). The majority of the participants (75.4%) did not have comorbid diseases, and only 25% were ever-smokers. Detailed demographic characteristics are presented in Table 1.

| TABLE 1 Demographic information of study participants |
|---------------------------------------------|---------------------|
| Characteristics                           | Frequency (percentage), N (%) |
| **Age group (years)**                     |                     |
| 18–24                                     | 494 (33.4)           |
| 25–34                                     | 355 (24)             |
| 35–44                                     | 282 (19.1)           |
| 45–54                                     | 191 (12.9)           |
| 55–64                                     | 117 (7.9)            |
| ≥65                                       | 39 (2.6)             |
| **Gender**                                |                     |
| Female                                    | 983 (66.5)           |
| Male                                      | 495 (33.5)           |
| **Residence**                             |                     |
| Middle                                    | 940 (63.6)           |
| North                                     | 432 (29.2)           |
| South                                     | 106 (7.1)            |
| **Marital status**                        |                     |
| Single                                    | 707 (47.8)           |
| Married                                   | 718 (48.6)           |
| Divorced/Widowed                          | 53 (3.6)             |
| **Level of education**                    |                     |
| School-level                              | 147 (9.9)            |
| College/diploma                           | 163 (11)             |
| Graduate level                            | 880 (59.5)           |
| Post-graduate level                       | 288 (19.5)           |
| **Medical field of education**            |                     |
| No                                        | 1086 (73.5)          |
| Yes                                       | 392 (26.5)           |
| **Smoking**                               |                     |
| Never-smoker                              | 1109 (75)            |
| Ever-smoker                               | 369 (25)             |
| **Self COVID-19**                         |                     |
| No                                        | 1198 (81.1)          |
| Yes                                       | 280 (18.9)           |
| **Relative with COVID-19**                |                     |
| No                                        | 164 (11.1)           |
| Yes                                       | 1314 (88.9)          |
| **Income (JD)**                           |                     |
| None/unemployed                           | 498 (33.7)           |
| <500                                      | 491 (33.2)           |
| 500–1000                                  | 310 (21.0)           |
| 1100–1500                                 | 86 (5.8)             |
| >1500                                     | 93 (6.3)             |
| P   | Item                                                                 | I don't know N (%) | No N (%)  | Maybe N (%) | Yes N (%) |
|-----|----------------------------------------------------------------------|--------------------|-----------|-------------|-----------|
| P1  | Do you think that drinking turmeric tea helps increase immunity and reduce the chance of developing COVID-19? | 341 (23.1)         | 332 (22.5) | 500 (33.8)  | 305 (20.6) |
| P2  | Do you think ginger tea helps to increase immunity and reduce the chance of developing COVID-19?           | 175 (11.8)         | 235 (15.9) | 488 (33)    | 580 (39.2) |
| P3  | Do you think that eating garlic helps to increase immunity and reduce the chance of developing COVID-19?   | 113 (7.6)          | 175 (11.8) | 374 (25.3)  | 816 (55.2) |
| P4  | Do you think that eating onions (or onion peel) help to increase the immunity and reduce the chance of developing COVID-19? | 147 (9.9)          | 217 (14.7) | 404 (27.3)  | 710 (48)   |
| P5  | Do you think that eating fish oil known as omega-3 helps to increase the immunity and reduce the chance of developing COVID-19? | 218 (14.7)         | 205 (13.9) | 476 (32.2)  | 579 (39.2) |
| P6  | Do you think that taking ginseng extract tablets help to increase the immunity and protect us from COVID-19? | 501 (33.9)         | 279 (18.9) | 471 (31.9)  | 227 (15.4) |
| P7  | Do you think that the consumption of vitamin C found in citrus or as a supplement has a role in treating or reducing the chances of developing COVID-19? | 64 (4.3)           | 94 (6.4)   | 298 (20.2)  | 1022 (69.1) |
| P8  | Do you think that the consumption of zinc has a role in treating or reducing the chances of developing COVID-19? | 143 (9.7)          | 125 (8.5)  | 367 (24.8)  | 843 (57)   |
| P9  | Do you think that the consumption of vitamin B-complex has a role in treating or reducing the chances of developing COVID-19? | 256 (17.3)         | 198 (13.4) | 563 (38.1)  | 461 (31.2) |
| P10 | Do you think that the consumption of vitamin D has a role in treating or reducing the chances of developing COVID-19? | 153 (10.4)         | 169 (11.4) | 434 (29.4)  | 722 (48.8) |
| P11 | Do you think that vinegar plays a role in treating or protecting against the COVID-19?                       | 423 (28.6)         | 436 (29.5) | 432 (29.2)  | 187 (12.7) |
| P12 | Do you think salted water plays a role in treating or protecting against the COVID-19?                        | 200 (13.5)         | 345 (23.3) | 418 (28.3)  | 515 (34.8) |
| P13 | Do you think that applying sesame oil on the body protect from COVID-19?                                     | 437 (29.6)         | 591 (40)   | 349 (23.6)  | 101 (6.8)  |
| P14 | Do you think that the consumption of sesame oil protect from COVID-19?                                       | 448 (30.3)         | 537 (36.3) | 391 (26.5)  | 102 (6.9)  |
| P15 | Do you think that consuming nutritional and herbal supplements prevents the spread of COVID-19 more than social distance? a | 191 (12.9)         | 755 (51.1) | 265 (17.9)  | 267 (18.1) |
| P16 | Do you think that consuming nutritional and herbal supplements prevents the spread of COVID-19 and prevents COVID-19 infection? | 166 (11.2)         | 469 (31.7) | 419 (31.7)  | 419 (28.3) |

*aVariable was reverse code.*
3.1 | Perceptions toward OTC dietary supplementation results

As evident in Table 2, almost one-third of the study participants responded with “maybe” with regard to turmeric and ginger tea (33.8% and 33%, respectively) being effective in preventing COVID-19 infection. In addition, almost half of the responses indicated a belief in the protective roles of garlic and onion (55.2% and 48%, respectively). Moreover, two-thirds of the participants (69.1%) signified the importance of vitamin C in preventing COVID-19 infection. Almost half of the study respondents agreed that zinc (57%) and vitamin D (48.8%) have protective properties against COVID-19 infection.

3.2 | Comparison of perceptions scores based on different demographic characteristics

Total perceptions scores were calculated and compared. Total perception score showed excellent reliability as indicated by the calculated Cronbach’s alpha (value of 0.89). The mean total perceptions score was 27.82 ± 8.56, with scores ranging between 0 and 45. Comparisons of the mean total perceptions scores based on the different demographic characteristics (Table 3) showed age to have a significant positive association with perceptions scores, whereby older respondents reported higher scores than did younger respondents (p = 0.00). Moreover, married participants had significantly higher mean scores than did their single or divorced counterparts (p = 0.00). Additionally, higher income level, the presence of comorbid diseases, and the use of chronic medications were significantly associated with having high perceptions scores (p = 0.0001, 0.002, 0.004, respectively).

3.3 | Safety of the use of OTC dietary supplements

To assess awareness about the safety of using OTC dietary supplements, the scores of the related items were summated (resulting in a maximum score of 8 and minimum score of 1), and average scores were compared. Cronbach’s alpha for this score was acceptable (value of 0.5). The mean safety awareness score was (5.76 ± 1.83), and the average of the mean scores was (1.44 ± 0.46). Moreover, there was an evident proportional relationship between perceptions and awareness scores among the participants, as indicated by the Spearman’s correlation test (p < 0.0001).

In assessing the potential correlations between the confounders, zinc use and awareness about the need for laboratory assessment of zinc level before use were found to be significantly associated, as indicated by the Chi-square test result (p = 0.001). On the other hand, vitamin C users were not aware of the potential hazard of developing renal calculi upon the use of higher doses (p = 0.47). Likewise, vitamin D users were not aware of the imminent need to check vitamin D level before supplementation (p = 0.32).

3.4 | OTC supplements purchase behaviors

Almost half of the participants (49.9%) indicated using OTC supplements as immune system fortifying agents. Specifically, three main OTC supplements with presumed efficacy were believed to be immune enhancers, namely ascorbic acid, zinc, and vitamin D. Almost half of the participants (48.8%) indicated that they had tried to supplement with ascorbic acid, and about two-thirds had tried zinc.

### Table 3 Comparison of mean perception scores among different demographic characteristics

| Characteristicsa | Mean scores ± SD | p-value |
|-------------------|------------------|---------|
| Age group (years) |                  |         |
| 18–24 (ref)       | 26.17 ± 8.79     | 0.0001  |
| 25–34             | 27.12 ± 8.58     | (0.580) |
| 35–44             | 28.17 ± 8.38     | (0.018) |
| 45–54             | 30.40 ± 7.72     | (0.001) |
| 55–64             | 30.89 ± 6.52     | (0.001) |
| ≥65               | 30.77 ± 9.88     | (0.013) |
| Marital status    |                  |         |
| Single            | 26.50 ± 8.97     | 0.0001  |
| Married           | 29.16 ± 7.87     |         |
| Divorced/Widowed  | 27.15 ± 9.10     |         |
| Level of education|                  |         |
| School-level      | 33.68 ± 6.60     | 0.0001  |
| College/ diploma  | 30.15 ± 8.09     |         |
| Graduate level    | 27.69 ± 8.26     |         |
| Post-graduate level| 27.10 ± 9.05    |         |
| Medical field of education | | 0.006 |
| No                | 28.04 ± 8.64     |         |
| Yes               | 27.22 ± 8.30     |         |
| Income (JD)       |                  |         |
| None/unemployed   | 26.37 ± 8.90     | 0.0001  |
| <500              | 28.46 ± 8.82     |         |
| 500–1000          | 28.86 ± 7.58     |         |
| 1100–1500         | 27.31 ± 8.46     |         |
| >1500             | 29.19 ± 7.40     |         |
| Insurance         |                  | 0.043   |
| None              | 26.95 ± 8.57     |         |
| Private           | 27.68 ± 8.86     |         |
| Military          | 28.22 ± 8.49     |         |
| Governmental      | 28.36 ± 8.35     |         |
| Comorbid Diseases |                  |         |
| Yes               | 29.10 ± 8.18     | 0.002   |
| No                | 27.42 ± 8.63     |         |
| Use of chronic drugs |               | 0.004   |
| Yes               | 28.91 ± 8.51     |         |
| No                | 27.46 ± 8.54     |         |

*aOnly significant factors are listed in the table.*
and vitamin D (38.6% and 34.6%, respectively). Only a quarter of all OTC users (24.8%) reported using supplements following the advice of a healthcare provider, and 43.4% of users purchased their OTC supplements from community pharmacies.

3.5 | Perceptions toward healthy habits

As presented in Table 4, one-third (38.1%) of the respondents were not sure whether or not the flu vaccine protected against COVID-19 infection. Meanwhile, responses to all other items indicated acceptable perceptions related to healthy habits proven to enhance immunity, with 86.8%, 89.2%, 97.6%, and 94.7% of the participants agreeing on the positive roles of smoking cessation, stress management, healthy diet, and sufficient sleep, respectively.

3.6 | Factors influencing perceptions scores

Multivariate logistic regression analysis adjusted for confounders showed that the respondents' perceptions toward OTC supplementation were influenced by age, gender, marital status, income, use of chronic drugs, infection of a relative with COVID-19, and safety awareness score. As shown in Table 5, respondents in the oldest age group (>65 years) were six times more likely to report higher perception scores (OR = 6.29, 95% CI = 2.20–17.90) than were participants in the youngest age group. Males were less likely than females to report high perception levels (OR = 0.69, 95% CI = 0.52–0.92), while married participants were more likely than single participants to report high perception levels (OR = 2.64, 95% CI = 1.34–5.22). Considering its impact on ability to purchase different supplementary products, income was identified as a significant factor influencing the participants’ perceptions. Participants with income >1500 JOD were more likely to indicate higher levels of perceptions (OR = 1.84, 95% CI = 0.81–1.65) as compared to participants with no income. Further, as compared to chronic drug users, nonusers were less likely to indicate high perception levels (OR = 0.68, 95% CI = 0.48–0.98). In addition, respondents with a relative infected with COVID-19 were more likely than their counterparts to have high perceptions.

| TABLE 4 Responses to healthy habits items |
|------------------------------------------|
| Factor | Yes (%) | I don't know (%) | No (%) |
| Does flu vaccine confer protection against COVID-19? | 127 (8.6) | 534 (36.1) | 817 (55.3) |
| Do you think smoking cessation is important to enhance immunity? | 1283 (86.8) | 102 (6.9) | 39 (6.3) |
| Do you think stress management is important to enhance immunity? | 1318 (89.2) | 105 (7.1) | 55 (3.7) |
| Do you think healthy diet is important to enhance immunity? | 1443 (97.6) | 25 (1.7) | 10 (0.7) |
| Do you think that sufficient sleep is important to enhance immunity? | 1400 (94.7) | 55 (3.7) | 23 (1.6) |

| TABLE 5 Multivariate analysis of factors affecting perception levels of over-the-counter supplement use |
|-----------------------------------------------|
| Characteristics | OR | 95% CI | p-value |
| Age group in years | | | |
| 18–24 (ref) | 1.00 | 1.00–1.00 | 0.001 |
| 25–34 | 1.21 | (0.83–1.76) | 0.32 |
| 35–44 | 1.28 | (0.79–2.05) | 0.31 |
| 45–54 | 2.44 | (1.41–4.2) | 0.001 |
| 55–64 | 2.83 | (1.48–5.43) | 0.002 |
| >65 | 6.29 | (2.20–17.90) | 0.001 |
| Gender | | | |
| Female (ref) | 1.00 | 1.00–1.00 | 0.001 |
| Male | 0.69 | (0.52–0.92) | 0.012 |
| Marital status | | | |
| Single (ref) | 1.00 | 1.00–1.00 | 0.001 |
| Married | 2.64 | (1.34–5.22) | 0.034 |
| Divorced/widowed | 0.47 | (0.25–1.37) | 0.22 |
| Income (per month) | | | |
| None (ref) | 1.00 | 1.00–1.00 | 0.001 |
| <500 JD | 0.87 | (0.81–1.52) | 0.52 |
| 500–1000 JD | 1.11 | (0.59–1.27) | 0.48 |
| 1100–1500 | 1.07 | (0.38–1.19) | 0.17 |
| >1500 | 1.84 | (1.80–3.56) | 0.032 |
| Relative case infected with COVID-19 | | | |
| No (ref) | 1.00 | 1.00–1.00 | 0.001 |
| Yes | 1.57 | (1.07–2.31) | 0.022 |
| Chronic drug use | | | |
| No (ref) | 1.00 | 1.00–1.00 | 0.001 |
| Yes | 0.68 | (0.48–0.98) | 0.036 |
| Safety awareness score | 1.1 | (1.01–1.15) | 0.026 |

aOnly significant factors are presented.

bRef: reference group.
toward OTC supplement use (OR = 1.57, 95% CI = 1.07–2.31). Finally, participants with higher safety awareness scores were slightly more likely than participants with lower scores to indicate high perceptions (OR = 1.1, 95% CI = 1.01–1.15).

4 | DISCUSSION

The current study assessed the Jordanian general population’s perceptions toward the use of OTC immune enhancers and awareness about the safety of the use of such supplements. The findings indicated suboptimal perceptions and awareness related to the use of OTC immune enhancers. The predictors of high perceptions score included increased age, being married, being female, using chronic medications, having a relative diagnosed with COVID-19, and high safety awareness score.

With regard to the participants’ perceptions toward OTC supplement use, a large proportion of the sample agreed on the beneficial roles of vitamin C and zinc in enhancing immunity and mitigating infection with COVID-19. This finding comes consistent with the findings of a number of previous studies.18,19

As with regard to perceptions scores, older participants had higher perceptions toward the use of OTC immune enhancers than did younger participants. Elderly people tend to be more anxious about issues pertaining to their general health, and so they are expected to take more time exploring the advantages of supplements before trying them. Another potential explanation is that older people have been found to be more susceptible to COVID-19 infection in general and its associated complications in particular. Therefore, it is expected that this subset of patients will spend more time weighing the benefits of using immune enhancers to combat the virus. This is in line with the findings reported by Chao and Lee,20 whereby older age and chronic diseases were reported to be major factors contributing to expenditure on OTC dietary supplements in general.

Married participants had higher perception scores than did single participants. This may be explained by the fact that married people are likely to feel responsible for their partners as well as their own selves, as one partner may easily transmit the virus to the other. Therefore, this subgroup is expected to value the benefits of natural and OTC immune enhancers as a defense mechanism against the spread of the virus.

Higher income level was found to be another predictor of higher perception levels. People with higher income are more capable of paying for OTC supplements that are not usually covered by health insurance plans. In consequence, they will spend more time reading and exploring the pros and cons of using such supplements before willingly paying for them. This is consistent with the results reported by Anderson and Newman,21 whereby income was found to be reported an enabling factor in health service utilization, including access to medications.

In addition, chronic medication users had better perceptions and awareness than did participants who did not take chronic medications. Patients who use chronic medications, who are likely to be of older age, tend to go a step further before deciding to add another medication (such as an OTC supplement) to their medication burden. Such knowledge-seeking behavior is expected to improve their perceptions and awareness related to OTC immune enhancers. No previous studies have investigated the correlation between the use of chronic pharmaceuticals and perceptions toward the use of OTC dietary supplements, which highlights the need for further investigation. Moreover, healthy respondents who did not report any chronic diseases had higher perception scores than did participants with chronic diseases, though the difference in scores was not of statistical significance (p > 0.05) in the multivariate analysis. This may be explained by the fact that healthier people are more likely to be more cognizant about their health and to check the scientific evidence regarding the presumed efficacy of OTC immune fortifying products.

As with regard to safety awareness, the majority of the participants believed OTC immune boosters to be generally safe. However, some participants were not aware of the need for preliminary laboratory assessment of some vitamins and minerals such as zinc and vitamin D. Also, participants who used vitamin C supplements were unaware of the potential risk of nephrotoxicity, such as renal calculi. Overall, participants with higher safety awareness scores were more likely to report higher perceptions toward the use of OTC immune boosters against infection with COVID-19.

It is important to highlight that the use of OTC immune-enhancing medications to mitigate COVID-19 infection has not been supported by well-established scientific evidence to recommend effective agents, dosage, and duration. To further clarify this, a potential immunomodulatory effect of zinc and vitamin C in reducing infection signs and symptoms and length of hospital stay has been proposed in many studies.22-27 Particularly with COVID-19 patients, the findings of a case series of four patients showed high doses of zinc to be linked with improved oxygenation and recovery of shortness of breath after 1 day of treatment.28 However, stronger evidence from a prospective study of 242 patients failed to report a considerable correlation between zinc supplementation and reduced COVID-19-associated mortality. As for vitamin C, a case series study of 17 patients showed a reduction of anti-inflammatory markers such as ferritin and d-dimers after the use of 1 g of IV vitamin C. However, this effect was not determined to be a result of vitamin C alone, as the patients were receiving other medications.29 The findings of a recent randomized clinical trial among 214 patients infected with COVID-19 showed that treatment with high-dose zinc, ascorbic acid, or both combined did not significantly decrease the duration of symptoms, as compared to standard care.30 In regard to vitamin D, several studies supported the use of vitamin D given its immunomodulatory effects.31,32 Razdan et al.33 articulated the protective effect of vitamin D against COVID-19 which goes in line with the reported beliefs of public toward the immunomodulatory effects of COVID-19 in the present study.

To the authors’ knowledge, this is the first study to report findings on the perceptions toward the use and safety of OTC immune boosters for COVID-19 among the general population in
Jordan. The large number of retrieved responses adds to the reliability and generalizability of our results. However, there are a few limitations to our study. Given the limited number of studies which have addressed the factors impacting the use of OTC immune enhancers during the COVID-19 pandemic, it was difficult to compare the current study findings with the findings of previous studies. Further, data were collected online using a self-report tool, and respondents were recruited based on the authors’ networks. Additionally, the inclusion of different kinds of factors could have affected the inter-relations between the different interlayers. Moreover, as the authors tried to collect timely COVID-19 related information, they used the overall COVID-19 pandemic timeline, thus recall bias was not well-controlled as well as selection bias which was inherent through the online participation recruitment process and data collection. Lastly, given the applied online study approach the response rate was not calculated, thus the participation flow-diagram was not used.

5 | CONCLUSIONS

COVID-19 is a global infectious pandemic threatening the lives of millions. The potential benefits of OTC immune enhancers and antioxidants can be offset through misuse by the general population. The findings of the current study may be used to establish a framework for future regulatory interventions related to the use of OTC dietary supplements and aimed at promoting patient safety. Educational programs and awareness campaigns targeting the general population, as well as healthcare providers, and addressing the issue of misuse of OTC supplementation should be implemented.

AUTHOR CONTRIBUTIONS

Rawand A. Khasawneh: Conceptualization; data curation; funding acquisition; investigation; methodology; project administration; resources; software; supervision; validation; visualization; writing—original draft; writing—review and editing. Samah F. Al-Shatnawi: Conceptualization; data curation; formal analysis; investigation; methodology; project administration; software; supervision; validation; writing—original draft; writing—review and editing. Hamza Alhamad: Conceptualization; investigation; methodology; validation; writing—original draft; writing—review and editing. Khalid A. Kheirallah: Data curation; formal analysis; software; validation; writing—review and editing.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Deanship of Research at Jordan University of Science and Technology for supporting the present study. All authors read and approved the final version of the manuscript before submission. The funders had no role in study design, data collection, data analysis, data interpretation, or writing of the report. Rawand A. Khasawneh had full access to all the data in the study and had final responsibility for the decision to submit for publication.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, RAK, upon reasonable request.

TRANSPARENCY STATEMENT

Rawand A. Khasawneh affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

ORCID

Rawand A. Khasawneh https://orcid.org/0000-0003-4583-2727

REFERENCES

1. Jean SS, Lee PI, Hsueh PR. Treatment options for COVID-19: the reality and challenges. J Microbiol Immunol Infect. 2020;53(3):436-443. doi:10.1016/j.jmii.2020.03.034.
2. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. Acta Biomed. 2020;91(1):157-160.
3. Shadmi E, Chen Y, Dourado I, et al. Health equity and COVID-19: global perspectives. Int J Equity Health. 2020;19(104):1-16.
4. Centers for Disease Prevention and Control (CDC). Different COVID-19 Vaccines; 2021. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines.html
5. World Health Organization (WHO). Coronavirus Disease (COVID-19) Advice for the Public; 2021. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public
6. Mitranyunja M, Pavithra V, Neelam R, Janhavi P, Halami PM, Ravindra PV. Immune-Boosting, antioxidant and anti-inflammatory food supplements targeting pathogenesis of COVID-19. Front Immunol. 2020;11:1-12.
7. Shakoor H, Feehan J, Al Dhaheri AS, et al. Immune-boosting role of vitamins D, C, E, zinc, selenium and omega-3 fatty acids: could they help against COVID-19? Maturitas. 2021;143:1-9. doi:10.1016/j.maturitas.2020.08.003
8. Aucoin M, Cooley K, Saunders PR, et al. The effect of Echinacea spp. on the prevention or treatment of COVID-19 and other respiratory tract infections in humans: a rapid review. Adv Integr Med. 2020;7(4):203-217.
9. Wessels I, Rolles B, Rink L. The potential impact of zinc supplementation on COVID-19 pathogenesis. Front Immunol. 2020;11:1-11.
10. Barnes LA, Leach M, Anhayer D, et al. The effects of Hedera helix on viral respiratory infections in humans: a rapid review. Adv Integr Med. 2020;7(4):222-226. doi:10.1016/j.aimed.2020.07.012
11. Abobaker A, Alzwi A, Alraied AHA. Overview of the possible role of vitamin C in management of COVID-19. Pharmacol Rep. 2020;72(6):1517-1528. doi:10.1016/s0344-0202-00176-1
12. Lamarche J, Nair R, Peguero A, Courville C. Vitamin C-induced oxalate nephropathy. Int J Nephrol. 2011:2011:1-4.
13. Department of Statistics (DOS). Estimated Population in Jordan. DOS; 2021.
14. Raosoft Sample Size Calculator; 2021. http://www.raosoft.com/samplesize.html
15. 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 Clin Res Rev. 2020;14:367-382.
16. Cîrstea SD, Moldovan-Teselios C, Iancu AI. Analysis of factors that influence OTC purchasing behavior. IFMBE Proc. 2017;59:59303-59308.

17. Kalfoss M. Translation and adaption of questionnaires: a nursing challenge. SAGE Open Nurs. 2019;5(0319):1-13.

18. Wintergerst ES, Maggini S, Hornig DH. Immune-enhancing role of vitamin C and zinc and effect on clinical conditions. Ann Nutr Metab. 2006;50(2):85-94.

19. Michienzi SM, Badowski ME. Can vitamins and/or supplements provide hope against coronavirus? Drugs Context. 2020;9:1-29. doi:10.7573/dic.2020-5-7

20. Cho JH, Lee TJ. The factors contributing to expenditures on over-the-counter drugs in South Korea. Value Heal Reg Issues. 2013;2(1):147-151. doi:10.1016/j.vhri.2013.01.010.

21. Andersen R, Newman JF. Societal and individual determinants of medical care utilization in the United States. Milbank Q. 2005;83(4):1-28. doi:10.1111/j.1468-0009.2005.00428.x

22. Souza ACR, Vasconcelos AR, Prado PS, Pereira CPM. Zinc, vitamin D and vitamin C: perspectives for COVID-19 with a focus on physical tissue barrier integrity. Front Nutr. 2020;7:295.

23. Brewer J, Gomez Marti JL, Brufsky A. Potential interventions for SARS-CoV-2 infections: zinc showing promise. J Med Virol. 2021;93(3):1201-1203.

24. Hoang BX, Han B. A possible application of hinokitiol as a natural zinc ionophore and anti-infective agent for the prevention and treatment of COVID-19 and viral infections. Med Hypotheses. 2020;145:110333.

25. Gombart AF, Pierre A, Maggini S. A review of micronutrients and the immune system–working in harmony to reduce the risk of infection. Nutrients. 2020;12(1):236. doi:10.3390/nu12010236

26. Maggini S, Wenzlaff S, Hornig D. Essential role of vitamin C and zinc in child immunity and health. J Int Med Res. 2010;38(2):386-414.

27. Hemili H, Chalker E. Vitamin C can shorten the length of stay in the ICU: a meta-analysis. Nutrients. 2019;11(4):1-30.

28. Finzi E. Treatment of SARS-CoV-2 with high dose oral zinc salts: a report on four patients. Int J Infect Dis. 2020;99:307-309.

29. Hiedra R, Lo KB, Elbashabsheh M, et al. The use of IV vitamin C for patients with COVID-19: a case series. Expert Rev Anti Infect Ther. 2020;18(12):1259-1261.

30. Thomas S, Patel D, Bittel B, et al. Effect of high-dose zinc and ascorbic acid supplementation vs usual care on symptom length and reduction among ambulatory patients with SARS-CoV-2 infection. JAMA Netw Open. 2021;4(2):e210369.

31. Charoenngam N, Shirvani A, Holick MF. Vitamin D and its potential benefit for the COVID-19 pandemic. Endocr Pract. 2021;27(5):484-493. doi:10.1016/j.eprac.2021.03.006

32. Ghelani D, Alesi S, Moua A. Vitamin D and COVID-19: an overview of recent evidence. Int J Mol Sci. 2021;22(19):10559. doi:10.3390/ijms221910559

33. Razdan K, Singh K, Singh D. Vitamin D levels and COVID-19 susceptibility: is there any correlation? Med Drug Discov. 2020;7:100051. doi:10.1016/j.medidd.2020.100051

SUPPORTING INFORMATION
Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Khasawneh RA, Al-Shatnawi SF, Alhamad H, Kheirallah KA. Perceptions toward the use of over-the-counter dietary supplements during the coronavirus disease 2019 pandemic: a cross sectional study of the general public in Jordan. Health Sci Rep. 2022;5:e716. doi:10.1002/hsr2.716