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Health-, medication- and dietary supplement-related behaviors and beliefs relatively unchanged during the COVID-19 pandemic lockdown

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ABSTRACT

Background: The lockdown imposed to counter the coronavirus disease 2019 (COVID-19) pandemic has evoked an unprecedented phenomenon that could affect health behaviors and beliefs.

Objective: To examine how medication-, dietary supplement- and health-related behaviors, beliefs and other psychological constructs changed in Polish online health service users during the COVID-19 pandemic lockdown.

Methods: A one-time online survey accessed through a health service website was completed before and during the pandemic lockdown by separate samples of respondents. The survey examined beliefs about medicines and dietary supplements, consumption of dietary supplements, trust and contact with their advertisements, sources of dietary supplement knowledge as well as perceived health, diet, physical activity and smoking, among other things.

Results: The study included 1560 participants. Most examined outcomes remained unchanged over COVID-19 pandemic lockdown. Beliefs that the dietary supplement quality is well controlled became significantly more pronounced during the lockdown (adjusted ratio of estimates 1.16, 95%CI 1.06–1.27, p = 0.001). Fewer people reported having contact with dietary supplement advertisements (adjusted odds ratio 0.59, 95%CI 0.43–0.83, p = 0.002).

Conclusions: The results may help understand some health-related issues associated with COVID-19 pandemic lockdown and may be used to shape aspects of health-related policy.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has evoked an unprecedented global crisis. Soon after the first cases were identified in Poland, in early March 2020, far-reaching restrictions were introduced. Educational institutions from nurseries to universities were closed overnight, followed by the closure of cultural institutions, multiple retail outlets and service facilities. Social and religious gatherings were strictly limited and non-essential travel was forbidden (Fig. 1). Health care services were deprioritized in favor of COVID-19 cases. Trapped at home, overwhelmed by mass media reports, afraid they will get COVID-19, uncertain about their financial and health situation, people were more likely to switch to a sedentary lifestyle with poor dietary behaviors, and experience greater anxiety and depressive symptoms. Ironically, such situation could exacerbate non-COVID-19 diseases.

During such a widespread health crisis, it would be natural for people to turn to self-medication. Indeed, public interest has grown regarding the influence of medications and self-medication for COVID-19, as well as for other conditions, and despite there being little evidence indicating that dietary supplementation may counter the effects of COVID-19, the purchase of dietary supplements (DS) has also increased. Although few studies have examined the behaviors and beliefs related to medications, dietary supplementation and overall health during the COVID-19 pandemic, they could have a significant effect on public health during lockdown periods.

Abbreviations: B-H, Benjamini and Hochberg; CI, confidence intervals; COVID-19, coronavirus disease 2019; DS, dietary supplements; GLM, general linear model.

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The aim of this study was to evaluate the changes in selected behaviors, beliefs and some other psychological constructs related to medication, DS and health among users of an online health service during the COVID-19 pandemic lockdown in Poland.

Materials and methods

Procedure

A one-time online survey was made available through multiple sources, including the main website of a popular Polish online health service and online pharmacy (DOZ.pl) between November 26, 2019 and March 11, 2020. The survey tested knowledge regarding dietary supplements and their use among the general public according to a pre-registered protocol (i.e. the primary study). For the purposes of the present study, only data obtained through the main DOZ.pl website for the period February 1, 2020 and March 11, 2020, i.e. the pre-pandemic period, was extracted.

Following this, the same one-time online survey was then made available a second time between March 15 and May 25, 2020 (i.e. the secondary study: pandemic period), but only through the DOZ.pl main website. The two sets of results from the pre-pandemic and pandemic surveys were then compared. The study timeline in relation to the COVID-19 pandemic lockdown in Poland is presented in Fig. 1. The study was approved by the Bioethics Committee of the Medical University of Lodz, Poland (KE/1382/19 with amendments).

Research instrument

Apart from the introduction, the online survey used in the study (Survio; Brno, Czech Republic) comprised 4 parts. The first was related to knowledge and beliefs about DS. It consisted of the recently-developed 17-item Questionnaire on Knowledge about DS. Reversed total score of the answers to its 4 attitudinal items related to control over quality, composition, efficacy and safety of DS as well as reversed total score of the answers to its 7 attitudinal items related to DS efficacy in disease prevention were used to assess respective beliefs (see Supplementary Material).

Of the remaining parts, the second was related to DS advertising. It consisted of a single-item measure of having contact with DS advertisements within the past week, as well as a recently-developed Questionnaire on Trust in Advertising DS. The third part comprised the General part of Beliefs about Medicines Questionnaire in its Polish version. The fourth part included a set of partially validated single-item measures of other medical and DS issues such as perceived health, diet and physical activity, cigarette smoking and e-cigarette use, use of any DS within past 30 days, personal experience of DS effects, sources of knowledge about DS. This part also referred to sociodemographic data including age, sex, educational level, having medical education, number of inhabitants in a place of residence and monthly net household earnings per a family member. A detailed description and operationalization of the applied measures as well as the survey wording and layout are presented in the report of the primary study and its protocol.

![Fig. 1. Timeline of the study in relation to COVID-19 pandemic lockdown in Poland. The part above the time axis illustrates the study procedure (description in text). Box plots within the rectangles representing the study periods depict the data for median and 1st and 3rd quartile of participant number. The major stages of the COVID-19 lockdown in Poland are given beneath the timeline.](image-url)
Data analysis

The following cases from both time periods were included to the analysis; respondents who accessed the survey through DOZ.pl main website, those with a survey completion time of at least 2:30 min and with no more than 50% of missing values. In addition, all participants had to be 18 years of age or above, with no formal medical education. As there were 1126 cases who met these criteria in the pre-pandemic period, the minimum required size of the pandemic period subsample was estimated to be 180 to reach Cohen’s d of 0.2 (small effect size) at the statistical power of 0.8. Cases with missing data were imputed using a multiple imputation by chained equation procedure under a missing at random assumption about the unobserved data.

Data collected in the pre-pandemic period was compared to that from the second survey i.e. the pandemic period. Ordinal outcome variables with at least 3 levels were assessed with the use of general linear model (GLM) analyses. Additionally, variation within these variables was tested between the groups of interest using Levene’s test. Dichotomous outcome variables were compared with the use of logistic regression. The analyses were carried out both as raw and with adjustment to sociodemographic data, which were considered potential confounders. False discovery rate was controlled at the level of 0.05 with the Benjamini-Hochberg (B-H) correction for testing multiple hypotheses. A p-value lower than B-H corrected significance level, or 0.05 in case of exploratory analyses, was considered statistically significant. The analysis was performed using Statistica Software version 13.3 (StatSoft; Tulsa, OK, USA) and R Software version 4.0.0 with package “mice” version 3.8.0 (R Foundation for Statistical Computing; Vienna, Austria).

Results

Characteristics of study participants

In total, the study included data from 1560 people: 1126 who participated in the study in the pre-pandemic period (median response on February 17, 1st-3rd quartile February 12 – February 26), and 434 in the pandemic period (median response on April 27, 1st-3rd quartile April 08 – May 11) (Fig. 1). The pandemic dataset was characterized by a higher level of missing data (0.94%) than the pre-pandemic period sample (odds ratio 1.62, 95%CI 1.37–1.92).

For the total sample, the median age of the study participants was 35 years (range 18–90 years) and nearly 85% were female. While the participants in the pandemic period were found younger and less educated than those in the pre-pandemic one, none of the other socio-demographic parameters differed significantly between the groups (Table 1).

A comparison of behaviors, beliefs and other psychological constructs between the pre-pandemic and pandemic periods

No significant differences were observed between the two periods regarding the majority of the tested parameters. However, the pandemic period was characterized by significantly more pronounced beliefs that DS are well controlled in terms of quality, composition, efficacy and safety; in addition, the respondents were less likely to report having contact with DS advertisements than in the pre-pandemic period. Both significant results survived adjustment for potential sociodemographic confounders (Table 2).

The extent of physical activity appeared less variable in the pandemic lockdown than before, but this difference in variation was of borderline statistical significance. Mean value did not appear to differ between study periods (Table 2). Exploratory GLM modeling of physical activity was therefore performed, with the study period, any sociodemographic variables and their two-way interaction as predictors. Only the inclusion of place of residence returned a significant result for the interaction, which survived adjustment for potential confounders (F (1,1552) = 5.39, p = 0.020, full model R² = 0.018). The residents of villages and towns below 5000 inhabitants, who tended to be less active before the pandemic, increased their physical activity during the lockdown (adjusted ratio of estimates 1.13, 95%CI 1.03–1.25). On the other hand, residents of the largest cities appeared insignificantly less active in the lockdown as compared to the pre-pandemic time period (adjusted ratio of estimates 0.96, 95%CI 0.89–1.04).

Discussion

The behaviors, beliefs and other psychological constructs related to medication and dietary supplements, as well as some health issues, may have a direct influence on health outcomes. As the COVID-19 pandemic lockdown, which occurred in spring 2020, substantially affected functioning of billions of people worldwide, any deterioration in such behaviors and beliefs in this time could have dramatic consequences.

Our findings indicate that most of the studied parameters changed insignificantly over the pandemic lockdown period. Beliefs that

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Table 1

| Characteristics | Total sample (N = 1560) | Pre-pandemic (n = 1126) | Pandemic (n = 434) | Test statistics and p-value for the comparison<sup>a</sup> |
|-----------------|------------------------|------------------------|-------------------|-----------------------------------------------------|
| Difference between the study periods | Mean (standard deviation) with median (1st-3rd quartile) or number (frequency) |

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<sup>a</sup> Benjamini-Hochberg corrected significance level is 0.020.
Table 2
Comparison of medication-, dietary supplement- and health-related behaviors, beliefs and other psychological constructs between the pre-pandemic and pandemic periods.

| Variable | Comparison between the periods | Test for difference in estimates<sup>a</sup> | Test for difference in variance<sup>a</sup> |
|----------|-------------------------------|---------------------------------|---------------------------------|
|          | Pre-pandemic | Pandemic | Raw analysis | Adjusted analysis<sup>b</sup> | Raw analysis | Adjusted analysis<sup>b</sup> |
|          | Estimate<sup>c</sup> (95%CI) | Effect size<sup>d</sup> | Test statistics and p-value<sup>e</sup> | Effect size<sup>d</sup> | Test statistics and p-value<sup>e</sup> | |
| Medication-related | | | | | | |
| Beliefs about medicines – overuse<sup>e</sup> | 13.2 (13.0–13.4) | 13.2 (12.9–13.5) | 1.00 | F(1,1558)=0.91, p=0.34 | 1.00 | F(1,1558)=0.01, p=0.99 | |
| Beliefs about medicines – harm<sup>f</sup> | 9.7 (9.5–9.9) | 9.6 (9.3–9.9) | 0.99 | F(1,1558)=0.57, p=0.57 | 0.99 | F(1,1558)=0.79, p=0.37 | |
| Dietary supplement-related | | | | | | |
| Beliefs about DS – control<sup>e</sup> | 1.8 (1.7–1.9) | 2.1 (1.9–2.3) | 1.18 | F(1,1558)=12.61, p=0.0004<sup>d</sup> | 1.16 | F(1,1558)=10.65, p=0.0001<sup>d</sup> | |
| Beliefs about DS – efficacy<sup>e</sup> | 4.5 (4.4–4.6) | 4.5 (4.4–4.6) | 0.99 | F(1,1558)=0.07, p=0.80 | 1.00 | F(1,1558)=0.01, p=0.95 | |
| Use of DS within past 30 days | 80% (78%–82%) | 78% (74%–82%) | 0.87 | χ²(1)=0.14, p=0.91 | 0.91 | χ²(1)=0.47, p=NA | |
| Positive experience of DS effects | 57% (54%–60%) | 54% (50%–59%) | 0.91 | χ²(1)=0.70, p=0.40 | 0.94 | χ²(1)=0.32, p=NA | |
| Negative experience of DS effects | 3% (2%–4%) | 4% (3%–7%) | 1.53 | χ²(1)=1.98, p=0.21 | 1.46 | χ²(1)=1.56, p=NA | |
| Being interested in DS<sup>e</sup> | 3.1 (3.0–3.1) | 3.1 (3.0–3.2) | 0.99 | F(1,1558)=0.13, p=0.99 | 0.99 | F(1,1558)=0.12, p=0.54 | |
| Getting knowledge about DS from medical doctors | 0.8 (0.8–0.9) | 0.8 (0.7–0.9) | 0.97 | F(1,1558)=0.30, p=0.97 | 0.97 | F(1,1558)=0.24, p=0.03 | |
| Getting knowledge about DS from pharmacists<sup>e</sup> | 1.0 (0.9–1.0) | 1.1 (1.0–1.1) | 1.06 | F(1,1558)=1.63, p=1.05 | 1.06 | F(1,1558)=1.24, p=1.78 | |
| Getting knowledge about DS from dieticians<sup>e</sup> | 0.5 (0.5–0.6) | 0.5 (0.5–0.6) | 1.09 | F(1,1558)=0.91, p=1.07 | 1.07 | F(1,1558)=0.54, p=0.034 | |
| Getting knowledge about DS from friends<sup>e</sup> | 0.8 (0.7–0.8) | 0.7 (0.6–0.8) | 0.90 | F(1,1558)=3.17, p=0.89 | 0.90 | F(1,1558)=3.64, p=0.95 | |
| Getting knowledge about DS from media<sup>e</sup> | 1.5 (1.4–1.6) | 1.4 (1.3–1.5) | 0.94 | F(1,1558)=2.39, p=0.95 | 0.94 | F(1,1558)=1.58, p=0.11 | |
| Having contact with DS ads within past week | 91% (89%–92%) | 85% (81%–88%) | 0.60 | χ²(1)=9.42, p=0.0021<sup>e</sup> | 0.59 | χ²(1)=9.34, p=0.0022<sup>e</sup> | |
| Trust in advertising DS<sup>o</sup> | 18.9 (17.8–20.0) | 19.3 (18.8–19.8) | 1.02 | F(1,1558)=1.73, p=1.02 | 0.99 | F(1,1558)=1.50, p=2.00 | |
| Health-related | | | | | | |
| Perceived health<sup>e</sup> | 2.6 (2.5–2.6) | 2.6 (2.5–2.6) | 1.00 | F(1,1558)=0.06, p=0.99 | 0.99 | F(1,1558)=0.28, p=0.01 | |
| Diet<sup>e</sup> | 3.5 (3.4–3.5) | 3.4 (3.3–3.5) | 0.98 | F(1,1558)=1.53, p=1.00 | 0.99 | F(1,1558)=0.02, p=0.99 | |
| Physical activity<sup>e</sup> | 2.8 (2.7–2.8) | 2.8 (2.7–2.9) | 1.01 | F(1,1558)=0.08, p=1.01 | 0.97 | F(1,1558)=0.49, p=0.0036<sup>e</sup> | |
| Current cigarettesmoking<sup>e</sup> | 9% (8%–12%) | 12% (9%–15%) | 1.29 | χ²(1)=1.99, p=1.27 | 1.27 | χ²(1)=1.64, p=NA | |
| Current e-cigarette use<sup>e</sup> | 2% (1%–3%) | 1% (0%–3%) | 0.54 | χ²(1)=1.60, p=0.54 | 0.21 | χ²(1)=1.52, p=NA | |

CI – confidence intervals.
DS – dietary supplements.
NA – not applicable.
The result presented in bold are statistically significant at the Benjamini-Hochberg corrected significance level of 0.0050 for raw and adjusted analyses of difference in estimates, and of 0.0036 for analyses of difference in variance.

<sup>a</sup> General Linear Model analyses (for ordinal outcome variables with at least 3 levels) or logistic regression analyses (for dichotomous outcome variables).

<sup>b</sup> Adjusted for age, sex, educational level, number of inhabitants in a place of residence and monthly net household earnings per family member – all included to the analyses in a linear way.

<sup>c</sup> Performed with the use of Levene’s test.

<sup>d</sup> Arithmetic mean (for ordinal outcome variables with at least 3 levels) or frequency (for dichotomous outcome variables).

<sup>e</sup> Ratio of pandemic to pre-pandemic outcome variable estimate (for ordinal outcome variables with at least 3 levels) or odds ratio (for dichotomous outcome variables).

<sup>f</sup> Fisher-Snedecor test statistics (in case of General Linear Model analyses) or Wald chi-square test statistics (in case of logistic regression).

<sup>g</sup> Estimate range 4–20.

<sup>h</sup> Estimate range 0–4. Cronbach’s alpha of the scale = 0.83.

<sup>i</sup> The result remains significant with non-parametric asymptotic Mann Whithney U test: Z = –3.43, p = 0.0006.

<sup>j</sup> Estimate range 0–7. Cronbach’s alpha of the scale = 0.60.

<sup>k</sup> Estimate range 1–5.

<sup>l</sup> Estimate range 0–3.

<sup>m</sup> Estimate range 8–40.

<sup>n</sup> Estimate range 1–4.

<sup>o</sup> Variance of physical activity estimate in the pre-pandemic period was 1.16, whereas in the pandemic period 0.96.
medicines are harmful or overused did not change; indeed, such beliefs have previously been found to remain temporarily stable irrespective of changes in health status.\textsuperscript{21} Similarly, Bush and Iannotti\textsuperscript{22} found some other health behaviors and beliefs largely unchanged over time.

Interestingly, our findings suggest that consumption of DS did not significantly change over the pandemic period, which is inconsistent with market analysis reports suggesting a rise in DS purchase and use in this time.\textsuperscript{11,23} This discrepancy may be an artefact of the studied population: the participants were users of an online health service and pharmacy, among whom as much as four fifths reported to use DS before the pandemic. These people may be regarded as “chronic DS users”, irrespective of the situation, even the COVID-19 pandemic.

During the pandemic, the respondents expressed more pronounced beliefs that DS are well controlled in terms of quality, composition, efficacy and safety. Although the lockdown was characterized by far-reaching governmental control over the economy and society, this control did not extend to ensuring DS quality. Unfortunately, such misconceptions could occur as the pandemic state restrictions were generally well accepted in Poland.\textsuperscript{24} However, it appears that stronger beliefs about DS quality control could not be attributed to public overall confidence in supplements,\textsuperscript{24} as beliefs about DS efficacy in disease prevention were found to not change over the pandemic lockdown period.

In addition, the respondents reported having less contact with DS advertisements during the lockdown period than before; this would be in line with the reduction in DS advertising expenditure at this time.\textsuperscript{26} Moreover, public attention turned to sanitary protective equipment rather than DS.\textsuperscript{26}

During the lockdown, less variation in physical activity was observed than before, which contradicts the report by Lesser and Nienhuis.\textsuperscript{27} According to the present findings, rural residents seemed to be more physically active during the lockdown. This is, however, likely a false positive result, representing the effect of seasonal shift from late winter to spring, in which rural residents are more engaged in physical activity associated with agricultural work.

This study has some limitations. First of all, the participants were recruited from a specific population of online health service users;\textsuperscript{14} therefore, any generalization of the results to wider populations should be attempted with caution. Secondly, due to changes in social mood, the reported findings may not be replicated during other lockdowns related to the second COVID-19 wave or any other economic collapse. Thirdly, the applied research design is not capable of investigating the effect of pandemic lockdown. For example, the research outcomes could have been influenced by the change from late winter to spring, as discussed above with regard to physical activity. Moreover, although the analyses were controlled in terms of sociodemographic confounders, it is still possible that the participants during the pandemic differed from those from the pre-pandemic period in some other regard not covered in the present study, and hence any conclusions regarding the casual relationship can only be tentative. Fourthly, as the incidence of COVID-19 in Poland was relatively low during the first wave of the pandemic, it may not have resulted in dramatic changes in beliefs and behavior. Finally, self-reported declarative measures were used in the study, and hence there may have been some systematic error in the estimates, as indicated by the social desirability bias theory.\textsuperscript{28}

Conclusions

Among Polish online health service users, the majority of examined medication-, dietary supplement- and health-related behaviors, beliefs and other psychological constructs remained unchanged in COVID-19 pandemic lockdown compared to the pre-pandemic time period. The pandemic period was characterized by more intense beliefs that the quality, composition, efficacy and safety of DS are well controlled, as well as less contact with advertisements for DS. The degree of variability in the research outcomes appeared insignificant over the pandemic lockdown with a possibly false positive effect regarding physical activity. Although the research report is preliminary and bears some methodological limitations, it may help understand some health-related issues in the time of pandemic lockdown and become the basis for shaping some aspects of health-related policy.

Author contributions

Conceptualization: MSK. Data curation: MSK. Formal analysis: MSK. Funding acquisition: MSK, EK. Investigation: MSK, MD, EP, RPK. Methodology: MSK. Project administration: MSK, EK. Resources: MSK. Software N/A, Supervision: MSK, EK. Validation: MSK. Visualization: MSK, MD. Writing - original draft: MSK, MD, EP, RPK. Writing - review & editing: MSK, MD, EP, RPK, EK.

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Declaration of competing interest

EP, a co-author of the study, has been employed in OSOM STUDIO, an e-marketing agency. The role of DOZ.pl Sp. z o.o. in the study was to prepare promotional materials to help recruit participants and to enter the survey content into an external online survey system. OSOM STUDIO and DOZ.pl Sp. z o.o. had no role in study design, data collection, analysis and interpretation, decision to publish, or preparation, review and approval of the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sapharm.2020.11.015.

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