

Vitamin D in the news: A call for clear public health messaging during Covid-19

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Abstract

Background: The public are increasingly reliant on the internet and media to access healthcare related information during the Covid-19 pandemic. Vitamin D is essential for musculoskeletal and immune health, with daily supplementation advised by public health bodies. Several studies assessing a possible link between vitamin D and Covid-19 severity have arrived at conflicting results and news articles have been rapidly disseminating such research to the public. There has been little focus on studying the quality of information available. **Aim:** To identify if online search interest in vitamin D increased with pandemic burden and analyse the accuracy of public health messaging relating to vitamin D in online news articles. **Methods:** Online search interest data for vitamin D was correlated with pandemic burden, defined as the number of Covid-19 deaths. Online news articles discussing vitamin D and Covid-19 were analysed using qualitative coding. **Results:** Online search interest for vitamin D increased as pandemic burden increased ($p < 0.0001$, Spearman's rank). Of the 72 articles identified, most (50%) offered a mixed opinion on the benefit of vitamin D in Covid-19. From articles making a recommendation for vitamin D supplementation, 23% of articles gave mixed messaging or advised against supplementation. 16% of articles recommended a dose which exceeded the safe limit of 4000 IU/day, risking toxicity. **Conclusion:** A significant number of articles provided mixed messaging or incorrectly advised supratherapeutic doses. This study highlights an opportunity for public health bodies to utilise the increased interest in vitamin D during the pandemic to raise awareness with accurate information.

Introduction

Interest in a putative link between vitamin D deficiency and severity of Coronavirus disease 2019 (Covid-19) has led to several studies being published showing conflicting results (Murdaca et al., 2020). In the United Kingdom (UK), a demand for clarity amongst the medical community was met by the publication of a rapid review by the National Institute for Health and Care Excellence (NICE) in December 2020 which concluded that there is currently insufficient evidence to recommend vitamin D supplementation for the prevention or treatment of Covid-19 (NICE, 2020a). Since this guidance, further reviews of high-quality studies have confirmed this lack of evidence (Bassatne et al., 2021). Although these publications and guidelines are targeted towards healthcare professionals, during the Covid-19 pandemic the public have been increasingly exposed to scientific literature which has been rapidly cited by major news outlets prior to peer review (Nadella and Navathe, 2020). Without a clear strategy for public health messaging, conflicting reports disseminated through these outlets may lead to confusion amongst the public, eventually leading to reduced engagement with health promoting behaviours and public health recommendations (Carpenter et al.,

2015). Reduced face to face contact with healthcare professionals during the pandemic has encouraged many people to rely on the internet and media to make healthcare related decisions (Tsao et al., 2021).

This is particularly important within the context of vitamin D where the public may be discouraged from taking supplements after exposure to news articles reporting unclear or unelucidated benefits in Covid-19. Regardless of any putative benefit related to Covid-19, adequate vitamin D levels are essential for musculoskeletal health and immune function (Nair and Maseeh, 2012). Prior to the pandemic, the prevalence of vitamin D deficiency in the UK was as high as 40%, a figure which may have increased during 'lockdown' restrictions because of reduced sunlight exposure (SACN, 2016). Adults in the UK are advised to take 400 IU/ day of vitamin D supplementation during winter months when

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sunlight is reduced and those at increased risk of deficiency are encouraged to supplement throughout the year (NICE, 2020a). Whilst doses up to 4000 IU/ day are considered safe (SACN, 2016; EFSA NDA Panel, 2016), there have been reports of ‘mega-doses’ of vitamin D being recommended, which could result in toxicity when taken unsupervised (Lanham-New et al., 2020).

During times of heightened pandemic burden, healthcare behaviours of the public may be altered. Aspects of the Health Belief Model (HBM) such as perceived risk may be increased due to increased fear from Covid-19 (Schneider et al., 2021). This could in turn lead to an increased interest in possible protective measures against the disease such as vitamin D supplementation. When combined with recommendations of ‘mega-doses’, misleading information that suggests a clear benefit of vitamin D in Covid-19 may result in over-consumption of vitamin D due to the public’s fear of the disease. The aims of this study were twofold. Firstly, to identify if public interest in vitamin D measured through online searches increased as the burden of the pandemic increased in the UK. And secondly, to characterise the reporting of vitamin D research in the midst of Covid-19 and analyse the accuracy of public health messaging within online news articles.

Methods

Public interest in vitamin D

Public interest in vitamin D during the pandemic was measured through internet search demand from the popular search engine Google. Data was extracted from Google Trends (<https://trends.google.com/trends>) for searches performed from the UK using the term “vitamin D” between 5th January 2020 and 10th January 2021 (the height of the second wave of the pandemic). Each data point represents relative search volume (RSV), where the number of searches performed in a given week is normalised against the highest number of searches over the time period studied to generate a number between 0 and 100.

The burden of the Covid-19 pandemic in the UK was measured through the number of deaths recorded within 28 days of a positive Covid-19 test. Raw data was extracted as a comma-separated values file from the UK government website for data and insights on Covid-19 (<https://coronavirus.data.gov.uk>) and total deaths for each week were calculated. RSV was also compared to the dates of national ‘lockdown’ restrictions in the UK (Institute for Government, 2021).

To identify a correlation between RSV and Covid-19 deaths, Spearman’s rank analysis was performed using GraphPad Prism for MacOS where $p < 0.05$ was deemed statistically significant.

News article analysis

Online news articles were identified through a search performed on Google News using a cleared browser on 9th

January 2021 with no time filters using the searches [vitamin D AND Covid] and [vitamin D AND coronavirus]. To identify articles focusing on vitamin D as the main topic, only articles which included these phrases in their titles were included. To focus on content designed for the general public, PubMed cited articles and articles issued directly by government agencies were excluded. Websites requiring a paid subscription or membership as a healthcare professional for viewing were also excluded.

The articles were downloaded and imported into NVivo for MacOS (QRS International), where qualitative analysis was performed. Two investigators independently performed line-by-line coding and classified each article using the criteria shown in Table 1. Articles containing videos were transcribed and also analysed using the same methodology. To assess whether articles were based directly off scientific information, articles were analysed to identify any direct citations to PubMed cited articles, articles on pre-print servers or documents from national guidelines. If articles suggested a daily vitamin D dose including a short ‘loading’ course, the maximum dose suggested and the evidence cited to support this dose were recorded. Doses mentioned in the setting of future clinical trials were excluded. All doses stated in articles were converted to equivalent IU/ day. Articles containing hyperlinks to official sources for further information regarding vitamin D defined as government websites, learned medical societies or medical charities were recorded. When there was a disagreement between the classifications made by the initial two investigators, the article was randomly assigned to one of the remaining investigators to serve as a tiebreak. Initial agreement in article classification between the two initial investigators was high, with only 6% of articles sent to a third investigator.

Results

Public interest in vitamin D

During the winter months prior to the first recorded Covid-19 death in the UK, RSV for vitamin D remained below 50 (Figure 1). As deaths increased during the first wave of the pandemic, an increase in RSV followed. In the summer months when the pandemic burden was low, RSV fell to its lowest point. As deaths increased again during the second wave, RSV also increased again and appears to be on an upward trend entering 2021. Upon applying Spearman’s rank analysis, there was a positive correlation between RSV and Covid-19 related deaths ($\rho = 0.62$, $p < 0.0001$). RSV also appeared to increase during national ‘lockdown’ restrictions.

News article analysis

The initial search returned 120 unique results of which 72 articles were included for final analysis (Figure 2). Most articles (50%) gave a mixed opinion on the benefit of vitamin D in Covid-19, followed by 35% of articles

Table 1. Criteria used to classify online news articles.

| Description and examples | |
|---|---|
| Benefit of vitamin D in Covid-19 | |
| Beneficial | Vitamin D supplementation reduces the risk of catching Covid-19 or the risk of severe disease. Low vitamin D levels are associated with higher rates of Covid-19 or severe disease. |
| Mixed | Articles containing both 'beneficial' and 'no benefit' statements. |
| No benefit | There is no benefit to vitamin D supplementation in Covid-19. Vitamin D deficiency is not associated with higher rates of infection or severe disease. Criticism of research studying vitamin D and Covid-19. |
| Recommendation for vitamin D supplementation | |
| Recommended | Statements recommending vitamin D supplementation for any reason. (Supplementation through food or sunlight is not included). Personal accounts of people taking vitamin D supplementation for any reason. |
| Mixed | Contains statements both recommending and not recommending vitamin D supplementation. |
| Not recommended | Advises against or advises caution taking vitamin D supplementation. Emphasises the harms of vitamin D supplementation without recommending supplementation. |
| Not stated | No recommendation made. |

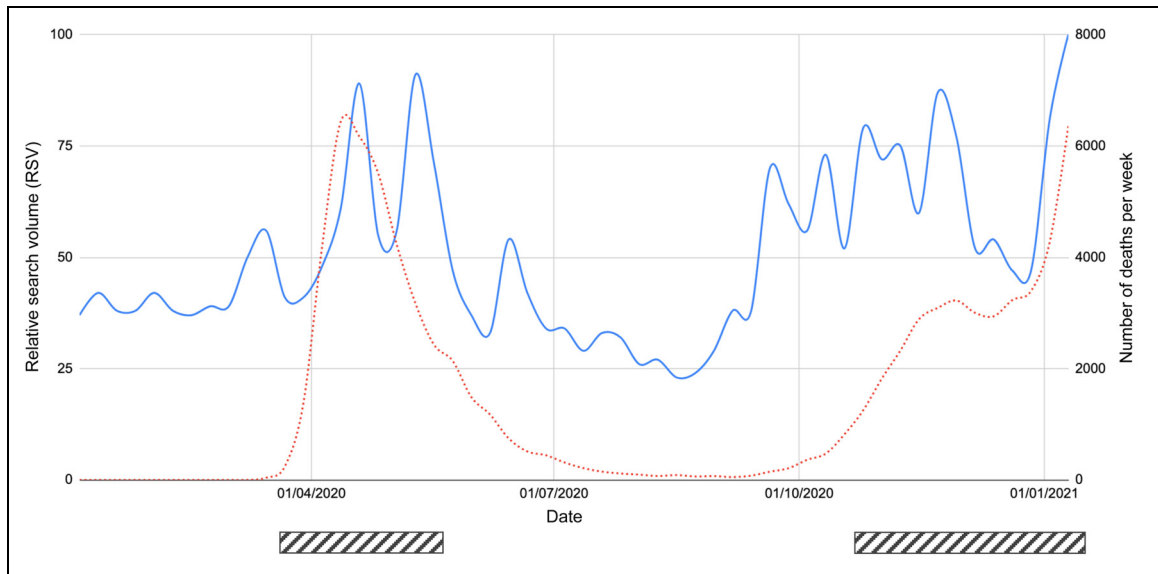


Figure 1. Interest in vitamin D correlates with pandemic burden. Relative search volume (RSV) for the term 'vitamin D' (solid blue line) correlates with both the number of deaths in the UK within 28 days of a positive Covid-19 test (dotted red line) and dates of national 'lockdown' restrictions (rectangular boxes).

being supportive of a benefit of vitamin D and 15% of articles stating no benefit of vitamin D (Table 2). Around 86% of articles made a recommendation surrounding vitamin D supplementation. Of these, the majority of articles (77%) recommended taking vitamin D supplementation with 23% of articles giving mixed messages or advising against taking supplementation. The majority of news articles (61%) were based directly off scientific information of which, 22% were based on information published on pre-print servers. Only 11 out of 72 news articles contained hyperlinks to further information for the public from

official sources such as government websites or medical charities.

There were 44 articles which stated a recommended vitamin D dose of which the majority (55%) suggested the vitamin D dose recommended by NICE of 400 IU/day (Table 3). The majority of articles also did not exceed the maximum safe dose described by public health bodies of 4000 IU/day. However, there were seven articles which exceeded this recommendation and six of these described doses of 10,000 IU/day and above. Three of these articles did not specify a duration for such a high

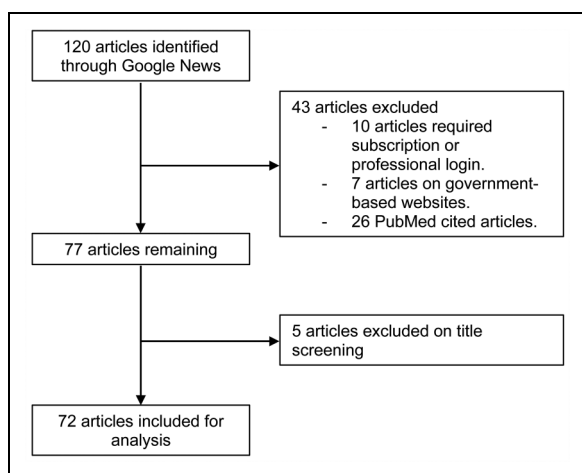


Figure 2. CONSORT flow diagram representing the selection of news articles included for analysis.

dose. The evidence cited for super-therapeutic dosing included expert opinion (six counts), PubMed cited articles (two counts) and anecdote (two counts).

Discussion

The Covid-19 pandemic has changed the way many aspects of healthcare are delivered with reduced face-to-face contact between patients and healthcare providers and increasing numbers of virtual consultations (Webster, 2020). This has likely resulted in the public having reduced exposure to materials traditionally used in public health messaging such as leaflets and posters displayed at a healthcare setting or information given by healthcare professionals during consultations. Many people may instead be relying on other sources of information such as the internet. This study has confirmed that during times of heightened pandemic burden, online search interest in vitamin D increased. Whilst it is not possible to determine the intention of these internet searches, this association may be explained by the HBM (Janz and Becker, 1984). With the public now having readily accessible information on Covid-19 and vitamin D supplementation through online materials, the accessing individual can independently assess their susceptibility to Covid-19 and likelihood of vitamin D deficiency. This would be combined with the individual learning about the benefits of supplementation, their self-efficacy in performing such a behaviour change and finally their exposure to any cues to action, such as experience of others affected from Covid-19. In the previous 2009 H1N1 influenza pandemic, certain behavioural responses such as fear and health protective behaviours correlated with pandemic burden which could increase the public's perceived risk of the disease (Wong and Sam, 2010). A previous study demonstrated Covid-19 pandemic burden to also be a predictor of perceived risk, although this was less important than other psychological factors (Schneider et al., 2021). Further study is required to

Table 2. Interpretations of the benefit of vitamin D in Covid-19 and recommendations for supplementations in online news articles.

| | Number of articles |
|---|--------------------|
| Benefit of vitamin D in Covid-19 | |
| Beneficial | 25 |
| Mixed | 36 |
| No benefit | 11 |
| Recommendation for vitamin D supplementation | |
| Recommended | 48 |
| Mixed | 11 |
| Not recommended | 3 |
| Not stated | 10 |

confirm this putative association. Media outlets and social media could also accentuate changes to these constructs of the HBM during the Covid-19 pandemic for example through altering behaviours and the public's perceived threat from Covid-19 (Raamkumar et al., 2020). Therefore, our findings of an increased search interest related to vitamin D supplementation during heightened pandemic burden may reflect the public's attempts to minimise the threat of Covid-19 due to increases in perceived risk from the disease coupled with understanding the potential perceived benefits of vitamin D supplementation. Alternatively, this association may represent people seeking further information about a possible link between vitamin D and Covid-19 or due to public awareness of reduced sunlight exposure leading to vitamin D deficiency during national 'lockdown' restrictions. Further study surveying public opinion regarding vitamin D during the Covid-19 pandemic may be helpful in better understanding the reasons for increased search interest.

At the time of writing this article, there is currently no national public health campaign in the UK for vitamin D supplementation. Regardless of a possible benefit in Covid-19, adults in the UK are advised to take 400 IU/day of vitamin D supplementation during winter months and those at higher risk of deficiency are advised to take supplements throughout the year (NICE, 2020a). However, the panel producing the rapid vitamin D guideline for Covid-19 expressed concern over the lack of public awareness of these national guidelines (NICE, 2020a). Additionally, previous qualitative studies have revealed a low level of satisfaction on the quality of information currently available to the public (Day et al., 2019). This allows for other forms of media to fulfil the role of providing health-related information to the public. Online news articles are a major influential source of information obtainable through internet searches and previous studies have highlighted instances of inaccurate information present in these articles during the Covid-19 pandemic (Islam et al., 2020). There is therefore a need to assess their role in public health messaging as they can improperly influence

Table 3. Grouped frequency table for vitamin D doses (d) described in online news articles. All doses were converted to equivalent IU/day.

| Vitamin D dose (d) | Number of articles |
|-------------------------------|--------------------|
| 0 IU < d ≤ 400 IU/day | 24 |
| 400 IU < d ≤ 4000 IU/day | 13 |
| 4000 IU < d ≤ 10,000 IU/day | 6 |
| 10,000 IU < d ≤ 30,000 IU/day | 1 |

public opinion and distract from evidence-based measures against the disease.

Whilst the benefits of vitamin D supplementation on musculoskeletal health are clear, its benefits in Covid-19 remain disputed with multiple studies performed showing conflicting results (Murdaca et al., 2020). There is, therefore, insufficient evidence currently to recommend the use of vitamin D supplementation to prevent or reduce the severity of Covid-19. The majority of articles report a mixed benefit of vitamin D in Covid-19, likely reflective of the conflicting results seen in scientific articles. Given the number of articles making a recommendation for vitamin D supplementation, it is clear that online news articles are providing a role in public health messaging when national campaigns do not exist. Additionally, as most articles were based directly off scientific information, it is evident that news articles are rapidly disseminating scientific research to the public as initially suspected. Many articles directly disseminated research from pre-print servers which had not undergone the peer review process. The general public may not be aware of the limitations of such sources unless explicitly stated in articles, meaning information from poor quality studies could improperly influence public opinion (Nadella and Navathe, 2020).

Although the majority of articles recommended vitamin D supplementation, one in five articles gave mixed or conflicting messaging or advised against supplementation which can be detrimental to public health messaging. Conflicting health information can be defined as two or more healthcare-related propositions that are inconsistent with one another (Carpenter et al., 2015). There have also been previous instances of conflicting information during the pandemic for example the use of face coverings in reducing the risk of transmission of the virus (Breslow, 2021). Such conflicting information could arise due to research showing conflicting results, differences in the way research is interpreted and disagreements in recommendations from various professional bodies or stakeholders (Nagler et al., 2020). In the context of vitamin D and Covid-19, it is likely that the abundance of conflicting research on this topic is a major reason for the extent of conflicting information present in online news articles (Murdaca et al., 2020).

Conflicting health information has been shown to cause confusion and induce negative emotional reactions to the reader including distress and frustration (Chang, 2015;

Nagler et al., 2018). Similar cognitive changes have been demonstrated in the field of nutrition whereby conflicting messages regarding nutrition led to ‘backlash’- described as negative feelings towards dietary recommendations (Lee et al., 2017). This suggests that there is a strong possibility that conflicting messaging regarding vitamin D as a nutritional supplement could therefore exert a similar effect. Additionally, when people encounter conflicting information, they may employ strategies for clarification such as seeking advice from a healthcare professional which is now less readily available due to reduced face-to-face clinical contact (Elstad et al., 2012). An alternative strategy to mitigate confusion in the absence of contact with healthcare professionals can be the use of hyperlinks (clickable links to other websites) to enable the reader to gain clarity and easily access verified information (Stroobant, 2018). However, only 15% of articles analysed contained such hyperlinks to official sources of information and this possibly reduced the intelligibility and credibility of these articles. Ultimately, these negative cognitive responses can translate into detrimental behavioural changes such as reduced engagement with health promoting behaviours and reduced trust in public health recommendations (Carpenter et al., 2015). Importantly in Covid-19, this may also result in reduced engagement with other behaviours essential in mitigating the spread of the virus including handwashing and social distancing. Given that the public are readily accessing online information about vitamin D in the UK where deficiency rates are high, and many may be incorrectly discouraged from taking vitamin D, the need for accurate and consistent public health messaging amongst news articles is highlighted.

Whilst there is no international consensus on the recommended daily vitamin D dose, public health bodies from the UK, America and Europe are in agreement that daily vitamin D doses should not exceed 4000 IU/ day (SACN, 2016; EFSA NDA Panel, 2016; Office of Dietary Supplements, 2021). We found multiple articles which recommended doses in excess of 4000 IU/ day and in one article, an extraordinary dose of 30,000 IU/ day was recommended. Although most articles recommended vitamin D supplementation, when written in the context of excessive doses, the risk of overconsumption may be increased due to the public’s fear of the disease altering the ‘perceived risk’ aspect of the HBM. Although high doses may be utilised by clinicians to correct severe deficiency, without medical supervision including prior assessment of serum calcium levels, such doses can lead to vitamin D toxicity. Other authors have also expressed concerns about overpromotion of very high doses of vitamin D during the pandemic especially when there is a lack of supporting evidence (Lanham-New et al., 2020). In fact, the level of evidence used to support high dose vitamin D supplementation in these articles was largely ‘expert opinion’ or anecdotal and lacking in scientific-based rationale. Prescription duration of high dose supplementation should generally not exceed 8 weeks (NICE, 2020b); however, in three of the

articles advocating doses in excess of 4000IU/ day, no duration was specified and the reader could easily assume these doses should be taken indefinitely. In parallel, reports of vitamin D toxicity related to high dose over-the-counter supplements are growing (Taylor and Davies, 2018).

Conclusion

It is undisputed that vitamin D has multiple health benefits, and its deficiency is readily correctable with cost-effective and safe intervention. Public interest in vitamin D measured through online search interest increased during times of heightened pandemic burden. News articles accessible through internet searches provided varying interpretations of research around the subject and provided a role in public health messaging when national campaigns did not exist. Whilst the majority of articles supported vitamin D supplementation in line with national guidelines, one in five articles provided mixed messaging or discouraged supplementation and a significant number of articles advocated supratherapeutic dosing regimens. The increased public interest in vitamin D during the pandemic may have represented a missed opportunity for public health bodies to raise awareness about vitamin D supplementation with clear messaging. Misleading information present in news articles may divert public attention away from evidence-based measures to protect against the disease. Going forward, we propose that media agencies collaborate with public health agencies to disseminate accurate information from official and validated sources.

Limitations

We acknowledge that not all members of the public are able to access the internet therefore findings described in this study may only be applicable to those who have internet access. Older adults and the institutionalised, who are inherently at risk of vitamin D deficiency, are also less likely to be familiar with the internet and to be guided by media outlets. This study does not include news disseminated on radio, television or print only media. Internet search results can vary based on location therefore findings may not be applicable to all regions of the world.

Availability of data and materials

Data used to calculate online search interest and pandemic burden are publicly available at <https://trends.google.com/trends> and <https://coronavirus.data.gov.uk> respectively.

Competing interests

All authors understand the policy of declaration of interests. RSH, PS, CW, AKJM and CGM all declare that they have no competing interests.

Contributorship

All five authors contributed to the manuscript. RSH and PS collected and analysed the data. RSH, PS, CW and AKJM wrote the manuscript and all authors were involved in its final approval. AKJM and CGM are acting as guarantors of the submitted work.

Statement of ethics committee approval

As only publicly available data was used in this study, ethical approval was not required.


Declaration of conflicting interests

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Supplemental material

Supplemental material for this article is available online.

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