

YouTube™ as a source of information on vitamin D: A content-quality analysis

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Abstract

Background. YouTube™ is considered a convenient and popular platform to seek healthcare information, which is uploaded by people of various professions.

Objectives. This study aimed to assess the content and quality of the YouTube videos containing information about vitamin D for children.

Material and methods. A YouTube search was performed using the terms ‘vitamin D for children’ and ‘vitamin D deficiency in children’. Two independent reviewers scored the videos with the use of a customized 11-point scoring scheme and the 5-point Global Quality Scale (GQS) to assess the content and quality of each video. The videos were further classified into poor, moderate and good videos. The Kruskal–Wallis and χ^2 tests as well as Spearman’s correlation coefficient were used for statistical analysis.

Results. In a total of 120 videos screened, 70 videos were included. They had a median content score of 4 and a median GQS score of 3. According to the information included in the videos and their overall quality, most of the videos were categorized as moderate ($n = 33$; 47.14% and $n = 32$; 45.71%, respectively). Good-quality videos had statistically significantly higher content scores as compared to the other groups ($p = 0.001$). A positive correlation was found between the total content score and the GQS score ($\rho = 0.434$; $p = 0.001$).

Conclusions. Most of the videos on YouTube about vitamin D were rated as moderate according to the sufficiency of information, and also their overall quality. This suggests that health organizations need to make further efforts to create good-quality medical content on popular social media platforms, such as YouTube.

Keywords: vitamin D deficiency, social media, YouTube™, vitamin D

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Introduction

Vitamin D has become a globally popular topic and its deficiency is recognized as a major worldwide public health concern.¹ Vitamin D plays an important role in the human body, maintaining the normal growth and the mineralization of the bone and other calcified tissues, including the teeth.² It has been proven to be beneficial for general human well-being.³ The main source of vitamin D is exposure to natural sunlight whereby the ultraviolet rays that strike the skin trigger the synthesis of vitamin D.⁴ Vitamin D is also naturally present in some foods and is available as a dietary supplement.⁵

The vitamin D status is classified based on the level of 25-hydroxyvitamin D (25(OH)D) in the serum. The U.S. Endocrine Society defines vitamin D deficiency as 25(OH)D <20 ng/mL (<50 nmol/L), insufficiency as 21–29 ng/mL (52.5–72.5 nmol/L) and sufficiency as >30 ng/mL (>75 nmol/L).⁴ Vitamin D deficiency is often asymptomatic; however, severe and prolonged deficiency can manifest symptoms, including muscle aches, bone pain, proximal muscle weakness, and in the long run, it can cause bone mineralization diseases, such as rickets in children and osteomalacia in adults.⁴ It has also been associated with bone fractures, falls, functional limitations, some types of cancer, diabetes, and cardiovascular disease.⁴ However, the association of these diseases with vitamin D deficiency is still unclear.

The major cause of vitamin D deficiency is the lack of sun exposure.⁴ Therefore, individuals with limited sun exposure are at risk of having vitamin D deficiency. Besides that, individuals who are dark-skinned, obese or undernourished are also at risk of having a low vitamin D level. These groups of individuals are recommended to do screening for vitamin D deficiency and vitamin D supplements may be considered for those with confirmed vitamin D deficiency.⁴

According to the American Association of Clinical Endocrinology (AACE), the recommended daily intake of vitamin D to prevent vitamin D deficiency and to maximize bone health is 400 IU for infants and 600 IU for children aged 1–18 years; as for adults, the recommended daily intake of vitamin D is 600 IU for adults between 19 and 70 years of age and 800 IU for adults older than 70 years.⁴

There has been an increasing trend in the use of social media throughout the years. YouTube™ has been ranked as the second most popular social media platform with 1.9 billion active users monthly in 2018.⁶ Moreover, in 2019, statistics showed that among the 7.7 billion population of the world,⁷ 45% (3.5 billion) are the active users of social media.⁸ A study by Orr revealed that YouTube was the world's biggest video sharing and hosting site on the Internet.⁹ Hence, it has been suggested that YouTube is a convenient and popular platform for the public to seek further healthcare knowledge as well as advice and assistance.⁹

Several studies have been conducted to ascertain the quality of information that is offered by YouTube videos in various medical healthcare disciplines, including the dental aspects.^{10–13} Erroneous and deceptive health-related information has been reported, and as such it might harm the public's health. To the best of our knowledge, there is no study on social media, regarding the evaluation of information about vitamin D deficiency in children. Therefore, the content and quality of the videos on YouTube concerning this topic was assessed in this study in order to determine if these videos provide parents and users with adequate and accurate information.

Methodology

Ethics approval was granted by the Human Ethics Committee at the MARA University of Technology (Universiti Teknologi MARA), Shah Alam, Malaysia, to conduct this study using the publicly available data on the Internet.

Video collection

The structured method used in previous studies was systematically implemented in this study to search the contents of YouTube.^{12–14} The Google Trends application was used to identify the search terms that are most frequently used on the Internet with regard to the topic discussed in this study.¹⁵ In this research, 2 search terms were used, namely 'vitamin D for children' and 'vitamin D deficiency in children'. The search was carried out on March 2, 2020, using YouTube default settings without any filters. A previous study reported that a vast majority of YouTube users went through the first 30 videos multiple times in a day.¹⁶ Hence, videos that appeared on the first 3 pages (the first 60 videos) for each search term were included in the study. Meanwhile, the layout of the site was changed. Therefore, the first 60 videos that appeared on the screen for each term were counted and explored. These 120 videos were downloaded and briefly scanned to exclude irrelevant videos, videos that were not in English and duplicates with regard to the 2 search terms before further evaluation.

Video evaluation

The demographics of the videos, such as the title, the country of origin, duration in minutes, the date of upload, the source of upload, and the total number of views, likes and dislikes, were extracted. The sources of upload were categorized as academic or professional organizations, companies, healthcare professionals, individual users, and others. Viewer interaction was evaluated in terms of the interaction index and the viewing rate, which were calculated for

each video based on the methods described in previous studies (Equations 1,2).^{13,14}

$$\text{interaction index} = \frac{\text{number of likes} - \text{number of dislikes}}{\text{total number of views}} \times 100\% \quad (1)$$

$$\text{viewing rate} = \frac{\text{number of views}}{\text{number of days since upload}} \times 100\% \quad (2)$$

These videos were further evaluated independently by 2 researchers using a customized 11-point scoring scheme that was constructed with reference to the 2019 AACE guidelines on vitamin D deficiency (Table 1).⁴ Each video was scored from 0 to 11 with regard to providing parents with information about vitamin D for their children in terms of its importance, sources, the recommended daily intake, risk factors, and the consequences of vitamin D deficiency for the child's health. Each aspect mentioned in the video correctly was given 1 point, and if the aspect was not mentioned or incorrect information was given, then the score was 0 (Table 1).¹⁴ Videos with a score of 0–3 were evaluated as having 'poor information content', a score between 4 and 7 was considered as 'moderate information content' and a score between 8 and 11 was considered as 'good information content'.

As previously reported,^{12,13} the overall video quality was evaluated based on the 5-point Global Quality Scale (GQS) (a range of 1–5, with 1 indicating poor quality and 5 indicating excellent quality) (Table 2). Scores 1 and 2 were categorized as 'poor quality', a score of 3 was categorized as 'moderate quality', while 4 and 5 were categorized as 'good quality'. These scores were tabulated for all videos on both search terms and the scores from the 2 researchers were compared. Videos with different scores were then re-evaluated by reviewing the literature

Table 2. Global Quality Scale (GQS) criteria used to score the quality of videos about vitamin D

GQS	Description
1	poor quality and flow, most information missing, not at all useful for patients
2	generally poor quality and poor flow, some information listed, but many important topics missing, of very limited use to patients
3	moderate quality, suboptimal flow, some important information adequately discussed, but other poorly discussed, somewhat useful for patients
4	good quality and generally good flow, most of the relevant information listed, but some topics not covered, useful for patients
5	excellent quality and flow, very useful for patients

and discussing the issue by the 2 researchers until consensus was achieved. A new score was then given based on the agreed consensus.¹³

Statistical analysis

The data was entered in a Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, USA). The statistical analysis was performed with the use of the IBM SPSS Statistics for Windows software, v. 25.0 (IBM Corp., Armonk, USA). Descriptive statistics referred to the characteristics of the videos, comprising the number of views, the number of likes, the number of dislikes, duration in minutes, the number of days since upload, the viewing rate, and the interaction index. Non-parametric tests were performed after testing the normality of data distribution with the Shapiro–Wilk test. Continuous variables were presented as median and interquartile range (*Me (IQR)*), while categorical variables were expressed as frequency and percentage (*n (%)*). The Kruskal–Wallis test for continuous variables and the χ^2 test for categorical variables were used to compare the video parameters between poor, moderate and good information content as well as between the GQS categories. The Spearman

Table 1. Content criteria used to score the videos containing information about vitamin D

Content criteria	Description	Score
Importance of vitamin D	– growth – mineralization of bone and the teeth	1
Sources of vitamin D	– sunlight exposure – food – food fortified with vitamin D – supplements	1 each (total of 4)
Recommended daily intake of vitamin D to prevent vitamin D deficiency and to maximize bone health	– 400 IU for infants – 600 IU for children and adults – 800 IU for adults above 70 years of age	1
Risk factors for vitamin D deficiency	– limited sun exposure – malnutrition/malabsorption – obesity – dark skin	1 each (total of 4)
Health effects of vitamin D deficiency	– rickets – bone fractures	1
Total content score		11

rank-order correlation coefficient was used to investigate the correlation between video characteristics and the total information content and GQS scores. The interclass correlation coefficient (ICC) was calculated to determine the degree of agreement between the 2 raters (model: two-way mixed; type: consistency).¹² A p -value <0.05 was considered statistically significant.

Results

The initial search using the terms 'vitamin D for children' and 'vitamin D deficiency in children' revealed a total of 120 videos, of which 70 were included, whereas 50 were excluded due to the reasons provided in Fig. 1. The analysis of these videos suggested that most of them were dedicated to all age groups. Hence, the videos were analyzed regardless of the age group.

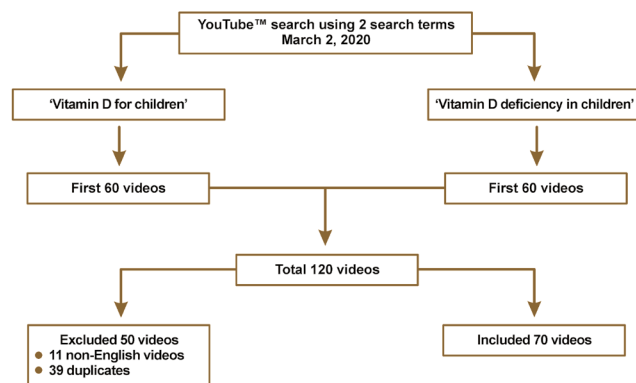


Fig. 1. Flow diagram of YouTube videos search strategy

Demographics

The descriptive statistics of the videos are presented in Table 3. The median duration of the videos was 2.75 min. The total number of views was 6,479,549 with a median

Table 3. Demographic characteristics of the included videos

Characteristics	Me (IQR)	Minimum	Maximum
Number of views	2,984 (14,256)	29	2,780,250
Number of likes	17 (89)	0	34,000
Number of dislikes	1 (7)	0	525
Duration [min]	2.75 (3.76)	0.12	50.55
Number of days since upload	1,469 (1,920)	55	4,190
Viewing rate	2.25 (21.75)	0.02	1,408.72
Interaction index	0.53 (0.69)	-0.75	6.14
Content score	4 (4)	0	11
GQS score	3(1)	1	5

Me – median; IQR – interquartile range.

viewing rate of 2.25 views/day. The median distribution of interaction with viewers was 17 likes and 1 dislike with a median viewer's interaction index of 0.53. The median content score was 4 and the median GQS score was 3. Most of the viewed videos were uploaded by academic institutions and professional organizations ($n = 27$; 38.57%), whereas other videos were uploaded by companies, healthcare professionals, individual users, and others (Fig. 2).

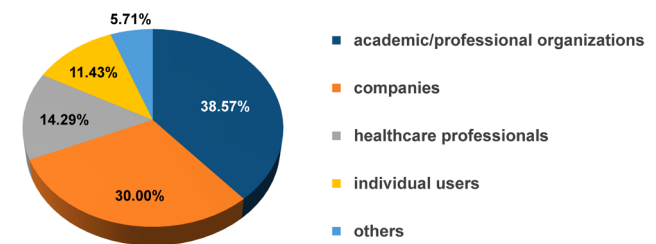


Fig. 2. Distribution of the videos according to the video source

Content of the videos

The videos contained a variety of information about vitamin D in terms of its importance, sources, the recommended daily intake, risk factors, and the health effects of vitamin D deficiency. The majority of the videos addressed the sources of vitamin D ($n = 62$; 88.57%), followed by the importance of vitamin D for the body ($n = 41$; 58.57%). Less than half of the videos discussed the health effects of vitamin D deficiency ($n = 31$; 44.29%) and risk factors for vitamin D deficiency ($n = 33$; 47.14%). Only 37.14% ($n = 26$) of the videos mentioned the recommended daily intake to prevent vitamin D deficiency and to maximize bone health (Fig. 3). As far as the evaluation of content is concerned, a total of 26 videos (37.14%) were defined as poor, 33 (47.14%) as moderate and 11 (15.71%) as good (Table 4). Good-information content videos had a significantly longer duration ($p = 0.040$) and higher GQS scores ($p = 0.001$) than the other groups. Furthermore, most of the good-information content videos were uploaded by academic

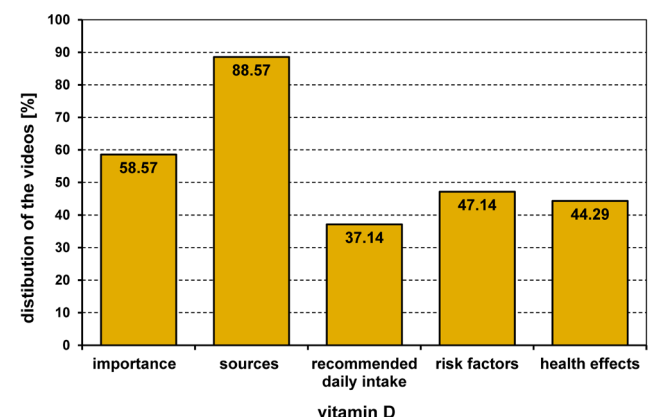


Fig. 3. Distribution of the videos according to the content criteria

Table 4. Comparison of video characteristics between good-, moderate- and poor-information content videos

Characteristics	Information content			p-value	
	poor n = 26	moderate n = 33	good n = 11		
Number of views M ±SD	2,086 (14,427)	3,832 (45,506)	2,990 (9,983)	0.740	
Number of likes M ±SD	8 (96)	17 (619)	38 (56)	0.710	
Number of dislikes M ±SD	1 (7)	2 (18)	1 (6)	0.750	
Duration [min] M ±SD	2.19 (3.34)	3.13 (2.99)	5.36 (21.29)	0.040*	
Number of days since upload M ±SD	1,469 (1,479)	1,173 (2,347)	1,798 (1,799)	0.510	
Viewing rate M ±SD	1.46 (16.64)	3.27 (44.10)	2.25 (3.74)	0.500	
Interaction index M ±SD	0.53 (0.66)	0.53 (1.21)	0.56 (0.54)	0.890	
Source of upload n (%)	academic/professional organizations	8 (29.6)	15 (55.6)	4 (14.8)	0.004*
	companies	10 (47.6)	8 (38.1)	3 (14.3)	
	healthcare professionals	4 (40.0)	5 (50.0)	1 (10.0)	
	individual users	3 (37.5)	3 (37.5)	2 (25.0)	
	others	1 (25.0)	2 (50.0)	1 (25.0)	
GQS score M ±SD	3 (1)	3 (1)	4 (1)	0.001*	

Kruskal–Wallis test for continuous variables and χ^2 test for categorical variables. M – mean; SD – standard deviation; * statistically significant.

institutions and professional organizations ($n = 4$; 14.8%), whereas most of the poor-information content videos were uploaded by companies ($n = 10$; 47.6%), with the difference being statistically significant ($p = 0.004$). However, with regard to the number of views, likes and dislikes, the number of days since upload, the viewing rate, and the interaction index, no significant differences were observed between the groups ($p > 0.05$) (Table 4).

Quality of the videos

The overall quality of the videos was assessed using GQS. With regard to quality, a total of 13 videos (18.57%) were scored poor, 32 (45.71%) were scored moderate and 25 (35.71%) were scored good (Table 5). Good-quality videos had significantly higher information content scores than the other groups ($p = 0.001$). Most of the good-quality videos ($n = 10$; 37.0%) were uploaded by academic institutions and professional organizations, whereas most of the poor-quality videos were equally uploaded by healthcare professionals ($n = 5$; 50.0%) and academic institutions and professional organizations ($n = 5$; 18.5%), with significant differences between poor- and good-quality videos ($p = 0.001$). However, with regard to the number of views, likes and dislikes, duration, the number of days since upload, the viewing rate, and the interaction index, no significant differences were observed between the groups ($p > 0.05$) (Table 5).

Correlation analysis

The correlations of the descriptive characteristics of the evaluated videos with the total information content and GQS scores were examined. No significant correlations were identified between the video characteristics and the total information content score except for the duration of the video ($\rho = 0.318$; $p = 0.007$). Likewise, no significant correlations between the video characteristics and the video quality were observed. However, a weak positive correlation was found between the total content score and the GQS score ($\rho = 0.434$; $p = 0.001$). The interclass correlation coefficient was calculated for the information content score (0.96) and the GQS score (0.76), indicating an excellent and good agreement, respectively.

Discussion

Vitamin D deficiency has been highlighted as a serious public health concern.¹ The increasing popularity of social media and the Internet has attracted a significant proportion of the population to search for health information or advice/assistance in regard to medical problems through YouTube. The validity of information on YouTube is questionable due to its non-standardized content and simple video sharing without any quality control.¹⁷ This study aimed to assess the content and quality

Table 5. Comparison of video characteristics between good-, moderate- and poor-quality videos

Characteristics	Quality			p-value	
	poor n = 13	moderate n = 32	good n = 25		
Number of views M ±SD	1,962 (51,440)	3,779 (10,143)	3,405 (24,815)	0.900	
Number of likes M ±SD	7 (237)	10 (73)	38 (89)	0.670	
Number of dislikes M ±SD	1 (110)	1 (5)	3 (14)	0.700	
Duration [min] M ±SD	2.15 (4.41)	2.46 (2.88)	3.25 (5.94)	0.250	
Number of days since upload M ±SD	1,663 (1,530)	1,482 (2,367)	1,142 (1,520)	0.350	
Viewing rate M ±SD	0.96 (146.30)	1.95 (7.07)	3.05 (38.11)	0.490	
Interaction index M ±SD	0.33 (1.14)	0.42 (0.65)	0.63 (0.77)	0.230	
Source of upload n (%)	academic/professional organizations	5 (18.5)	12 (44.4)	10 (37.0)	0.001*
	companies	3 (14.3)	9 (42.9)	9 (42.9)	
	healthcare professionals	5 (50.0)	3 (30.0)	2 (20.0)	
	individual users	0 (0.00)	6 (75.0)	2 (25.0)	
	others	0 (0.00)	2 (50.0)	2 (50.0)	
Information content score M ±SD	2 (2)	5 (3)	9 (2)	0.001*	

Kruskal–Wallis test for continuous variables and χ^2 test for categorical variables. * statistically significant.

of videos about vitamin D on YouTube. Although numerous studies have assessed the content of YouTube videos and their quality with regard to different medical aspects, this is the first study to evaluate the content and quality of the YouTube videos related to vitamin D. The findings showed that YouTube videos on vitamin D had different content and quality. There were only a few videos about vitamin D with good information content and good quality on YouTube.

Several studies have suggested the role of vitamin D for health outcomes,^{18–20} including maintaining the normal growth and the mineralization of the bone and other calcified tissues, such as the teeth.^{2,21} Vitamin D has also been proven to be beneficial for general well-being,³ to prevent rickets and to boost the immune system. The findings of the current study showed that more than half of the videos ($n = 41$; 58.57%) advocated the importance of vitamin D and its association with health benefits for the bone and the teeth, the normal growth, calcium absorption, and rickets prevention. Only a few videos provided information on the role of vitamin D in boosting the immune system.

Most of the videos ($n = 62$; 88.57%) mentioned the sources of vitamin D, including the exposure of the skin to natural sunlight and common dietary foods, such as cod liver oil, fatty fish, eggs, milk/dairy products, mushrooms, and vitamin D-fortified food. However, the contribution of the food sources in achieving the appropriate vitamin D

levels is considered low as compared to sunlight exposure. Likewise, supplements are one of the alternatives to obtain vitamin D.⁵

Behavior and the attitude toward exposure to sunlight, obesity, skin pigmentation, age, gender, dairy allergy, cloudy weather, and pollution are the main determinants of the status of vitamin D, and are considered risk factors for vitamin D deficiency.^{21,22} However, only 33 videos (47.14%) addressed the factors hindering the production of vitamin D and leading to its deficiency in the body.

A mild lack of vitamin D may not cause symptoms, but can result in tiredness, and general aches and pains. A more severe lack can cause serious problems, such as rickets in children and osteomalacia in adults.²³ Nevertheless, less than half of the videos ($n = 31$, 44.29%) highlighted the health effects of vitamin D deficiency, such as the impaired mineralization of bone.

Some people are more at risk of vitamin D deficiency; hence, they are recommended to take vitamin D supplements routinely. These groups of people include children below 5 years of age, pregnant and breastfeeding women, seniors above 65 years of age, and those who are not exposed to the sun. Vitamin D supplementation is also recommended for people with darker skin and for those with certain gut, liver or kidney diseases.²³

The U.S. Institute of Medicine recommends that dark-skinned infants who are exclusively breastfed and are at greater risk of rickets should receive 400 IU of vitamin D

supplement per day.⁴ Healthy children and adults should take 600 IU per day, whereas adults older than 70 years should take 800 IU per day to maintain skeletal health.⁴ Vitamin D supplementation in these ranges is likely to prevent bone loss, may improve bone density and reduce the incidence of fractures, and appears to reduce the incidence of falls. Most videos ($n = 44$; 62.86%) failed to address the recommended daily intake/consumption of vitamin D to maximize bone health and to prevent vitamin D deficiency.

As reported in the literature, a considerable proportion of parents rely on the Internet-based sources to retrieve the information regarding vitamin D for their children.^{5,24} Parental health awareness and practices usually have a direct effect on their child's health.⁵ Therefore, increasing knowledge about vitamin D among parents is vital to achieve and maintain adequate levels of vitamin D in children.²¹

A study by Day et al. stated that around half of the parents reported the lack of information about vitamin D for their young children and the majority obtained information by proactively seeking it via a range of medical and parenting websites/platforms, including YouTube.²⁴ Additionally, parents also declared that they improved information about vitamin D through signposting to the approved websites, such as hospital, medical and parenting websites, and also through e-mails, text messages, smartphone Apps, an online messaging service with the assistance of a health professional, and YouTube videos.²⁴ These findings suggest that the YouTube platform can be considered as a potential information source for parents. However, our findings revealed that the content of most of the videos analyzed in this study was moderate and lacked some information.

Although some demographics of the analyzed videos, i.e., the number of likes, the number of dislikes, the viewing rate, and the interaction index, showed a positive correlation with the total content score, the duration of the video was the only parameter that significantly correlated with the total content score ($\rho = 0.318$; $p = 0.007$). This is similar to previous studies, which revealed a positive correlation between the information content and duration of YouTube videos.^{25,26} Likewise, the present study demonstrated that good-information content videos had a longer duration, a greater number of likes, fewer dislikes, and a greater interaction index than videos in the moderate- and poor-information content groups. However, among the variables, only the duration of the video turned out to be statistically significantly different ($p = 0.040$). This indicates that viewers had a positive interaction with the well-organized and educational content of videos about the importance of vitamin D for well-being, and such videos were found to have an adequate (longer) duration ($Me: 5.36$ min) as compared to poor-information content videos ($Me: 2.19$ min). This finding suggests that videos on the topic of vitamin D should include informative and advanced content, and be produced at reasonable time to gain larger audience on the YouTube platform.

According to the median GQS scores obtained in this study, most of the evaluated videos were generally of moderate quality. Good-information content videos had significantly higher GQS scores than the other groups, and a weak positive correlation was observed between the quality score and the content score. Other studies evaluating YouTube videos indicated a moderate positive correlation between the video's quality and content.^{27,28} The information flow and a great number of informative elements in the videos, such as images and video captions, increased the quality and content scores. In addition, videos that contained balanced information and were uploaded/published by trustworthy sources were more beneficial for viewers/users. These aspects might elucidate the correlation between the quality score and the content score.

Strengths and limitations

There are several limitations of this study. Firstly, only English-language videos were analyzed; hence, 11 videos were excluded. It may have limited the results by ignoring the popularity of this topic in developing countries, in which English is not widely used. Secondly, the YouTube platform is very dynamic, and the results may change when new videos are uploaded or the old ones are removed. This study reveals information about videos on the topic of vitamin D at a particular time. Therefore, our results depended on the time at which the search took place. Finally, even though scientific criteria from the current guidelines were used, it was subjective to evaluate the videos with the use of a customized information content scoring scheme by 2 researchers, as there is no validated tool for assessing video content to date. Despite the limitations, this method can still be used to obtain preliminary information that can be considered reliable regardless of its relatively subjective nature, and such an approach has been used in several studies.^{14,26} Moreover, according to the obtained ICC values, the agreement between the 2 researchers was excellent and good, thus indicating that the method of evaluation of the video's quality and content was reliable. The small number of good-information content videos, as observed in the current and previous studies, points to the need for professionals to be more active on such platforms and to improve the quality of education through these media.

Conclusions

YouTube is continuously being accessed and it offers a wide diversity of health-related information. Although most of the videos on vitamin D were rated as moderate with regard to the sufficiency of information as well as quality, the results of this study disclosed that YouTube videos still could not be considered as an excellent source of information for parents on vitamin D for their children.

Health organizations need to make further efforts to create good-quality medical content on popular social media platforms, such as YouTube. Further studies evaluating the content and quality of videos in different languages and using other social media are warranted.

Ethics approval and consent to participate

Not applicable.


Data availability


The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for publication


Not applicable.


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