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Increasingly polarised or finding common ground? Exploring pro- and anti-vaccine rhetoric on two South African Facebook pages

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Abstract

We investigated pro- and anti-vaccine rhetoric on two South African Facebook pages to identify the nature, sources and justifications of the vaccine-related claims published on these pages. Our dataset consisted of 440 Facebook posts made by page administrators during 2019. Statements related to the safety and necessity of vaccines dominated the pro-vaccine page, while the anti-vaccine page focussed primarily on claims about the dangers of vaccines. Posts on both pages frequently contained content shared from within Facebook, with much of the content originating from the United States. Both pages made equal use of scientific justifications (i.e. published journal articles) to support claims, and most of these articles were published in accredited journals. The authors hope that a better understanding of the nature, sources and justifications of pro- and anti-vaccine rhetoric may lead to more constructive dialogue about vaccines, including the ongoing debate about COVID-19 vaccines.

Keywords

Health communication; Public perception of science and technology; Science communication in the developing world

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Introduction and rationale

In 2019, the World Health Organisation identified vaccine hesitancy, or the reluctance to vaccinate despite the availability of vaccines, as one of the top 10 threats to global health [World Health Organization, 2019]. This was in response to increases in vaccine-preventable disease outbreaks. For example, between January and March 2019, measles cases increased by close to 300 percent compared with the same period in 2018 [Sidhu, 2019].

Public uncertainty and hesitancy about vaccines, and indeed outright opposition to vaccines, are not new. These can be traced back to the introduction of the first vaccine for smallpox in 1796 [Colgrove, 2006]. In recent decades though, changing information ecosystems have transformed the ways people communicate and share

health information. Social media platforms, such as Facebook, contribute to the widespread sharing of misinformation, and are characterised by so-called 'filter bubbles' and 'echo chambers' which strengthen confirmation bias and polarise public debate [Brossard & Scheufele, 2013; Larson, 2018; Schmidt, Zollo, Scala, Betsch & Quattrociocchi, 2018].

The risks associated with inaccurate or misleading health information shared online are well established [Larson, 2018]. Links have been made between vaccine refusal and information shared regarding vaccine side effects on social and traditional media platforms [Ma & Stahl, 2017]. Exposure to a vaccine-critical website for as little as five to ten minutes has been found to increase the belief that vaccines are risky, and decrease intention to vaccinate [Betsch, Renkewitz, Betsch & Ulshöfer, 2010]. Moreover, exposure to anti-vaccine conspiracy theories has a direct negative impact on intention to vaccinate [Jolley & Douglas, 2014] and vaccine coverage was found to be lower in areas where people have more exposure to vaccine safety concerns and misinformation [Dunn et al., 2017].

Since late 2020, the rollout of COVID-19 vaccines has again focused attention on the issue of vaccine hesitancy and refusal. A recent meta-analysis reveals that concern about side effects is the most common reason for hesitancy in low and middle-income countries [Solís Arce et al., 2021]. A survey in South Africa in early 2021 found that 67% of respondents said they would definitely, or probably, get vaccinated, while 18% said they would definitely, or probably, not. Among the most frequent reasons for non-acceptance were concerns about effectiveness and side effects [Runciman, Roberts, Alexander, Bohler-Muller & Bekker, 2021].

Immunisation rates in South Africa are disputed [Dyosop, 2012]. Nevertheless, severe outbreaks of measles over the past ten years, and a whooping cough epidemic in 2019, indicate serious gaps in coverage. This is partly due to vaccine shortages and logistical challenges. However, surveys have also reported resistance to vaccination from parents because of anti-vaccine "rumours" [Burnett, von Gogh, Moloi & François, 2015, p. 922]. Similarly, when only 80% of a targeted 5-million children were reached during a 2017 measles vaccination campaign, former South African Health Minister Aaron Motsoaledi pointed to "a number of disturbing factors including anti-vaccine lobby groups and non-cooperative parents who refuse to sign consent forms" [Child, 2017]. An evaluation of the national rollout of the Human Papillomavirus (HPV) vaccine in South Africa also noted the influence of negative social media messaging on parental consent for the vaccine [Delany-Moretlwe et al., 2018]. Yet, knowledge regarding vaccine hesitancy in South Africa remains limited [Ngcobo, Burnett, Cooper & Wiysonge, 2019].

In 2019, 54% of the South African population used the internet "in some format", and 40% were active social media users [Kemp, 2019b]. An estimated 23 million South Africans were active Facebook users [Kemp, 2019b], with a similar level of Facebook penetration across all socio-economic levels in the country [Ornico and World Wide Worx, 2018]. Previous research investigated online anti-vaccine lobbying in South Africa, but social media was not considered [Burnett et al., 2015]. Given the increasing use and popularity of social media in the country, research considering these channels is necessary. Against this backdrop, we sought to understand vaccine rhetoric as it emerged on Facebook in the South African context.

Current study and research questions

We analysed vaccine rhetoric as it emerged on two open, public-facing Facebook pages that identified as South African from 1 January to 31 December 2019. Facebook was the third most-visited website globally in 2019 [Kemp, 2019a]. Moreover, the platform has been singled out both for containing more vaccine-related misinformation than other online sources [Elkin, Pullon & Stubbe, 2020; Gandhi, Patel & Zhan, 2020] and for inaction regarding the spread of such misinformation. Following mounting pressure on the tech giant to act because of the public health threat this represents [Boseley, 2019; Pilkington & Glenza, 2019], Facebook introduced several, increasingly stricter, measures to combat vaccine misinformation from March 2019 onward [Bickert, 2019]. These elements, and the public discussion they generated, contributed to our decision to focus on 2019 as our period of study.

In January 2019, we were able to locate only two open, public-facing Facebook pages that overtly identified as South African and specifically posted vaccine-related content. One of the pages explicitly positioned itself as pro-vaccine. The other page, although posting primarily vaccine-critical content, stated its commitment to educating about vaccines, informed consent, and preventing and treating diseases naturally. The anti-vaccine page had both a longer history and a larger following than the pro-vaccine page. As of 9 November 2019, the anti-vaccine page, established in 2012, had 6,945 followers. On the same date, the pro-vaccine page, established in 2017, had only 1,957 followers. In the case of both pages, the identities of page administrators were not evident and no specific political alignment was apparent. Both pages also had private groups associated with them though we did not join or study these groups. Although there was no explicit evidence of any funding received to run either of the pages, it is interesting to note that another page which sold natural health and wellness products, including anti-ageing agents, vitamins, immune boosters and pain relievers, some of which were marketed as treating adverse vaccine reactions, listed the anti-vaccine page we studied among its affiliated pages.

We chose to study open, public-facing Facebook pages, since this meant that anyone may 'like' or 'follow' the pages, their posts, and the discussions they generate. Therefore, the pages' public posts can be understood as an authentic public voice, in that they are unmediated by political actors or the media [Orr, Baram-Tsabari & Landsman, 2016]. To the best of our knowledge, this is the first study to focus on vaccine rhetoric on Facebook in South Africa.

The ethical clearance for this study prohibits the explicit identification of the pages in any published work. As such, the pages are referred to as 'pro-vaccine' and 'anti-vaccine' for ease of reference. In line with previous research [Faasse, Chatman & Martin, 2016; Agergaard, Smith & Nielsen, 2020; Elkin et al., 2020], we found that the pages were heterogeneous and vaccine sentiment occurred on a continuum. Not all posts were in favour of or opposed to all vaccines and we acknowledge that the dichotomous classification of the pages as 'pro' and 'anti' is over-simplistic.

We posed the following three research questions:

RQ1: What claims are made about vaccines? This relates to statements made on the Facebook posts themselves.

RQ2: Where do these claims originate from? This relates to where posts are shared from, whether elsewhere on Facebook, other social media platforms or online content outside social media, as well as geographic locations (e.g., names of cities, countries or regions) used in posts.

RQ3: How are these claims justified? This relates to how claims are substantiated, and what form(s) of evidence are provided for claims.

Literature review

Contemporary concerns about vaccines remain similar to those raised in the early 1900s, including fear of vaccine contamination, distrust of medical professionals, and resistance to compulsory vaccination [Hausman, Ghebremichael, Hayek & Mack, 2014]. As deadly infectious diseases became less prevalent in the global north throughout the 1980s, other childhood illnesses and disorders — including autism, ADHD, diabetes, asthma and autoimmune disorders — became more visible, resulting in a "new generation of vaccine critics claiming new forms of harm from vaccination" [Allen, 2007, p. 329].

Extensive work has been done to understand the nature, size and influence of the online anti-vaccine movement, with an increasing focus on exploring vaccine sentiment on social media throughout the past decade [Madden, Nan, Briones & Waks, 2012; Larson, Jarrett, Eckersberger, Smith & Paterson, 2014; Becker et al., 2016; Surian et al., 2016; Dunn et al., 2017; Karafillakis et al., 2021]. Many of the tactics and tropes employed by the online anti-vaccine movement identified in earlier research [Kata, 2010, 2012] remain prevalent more than a decade later, including a prevailing theme of questioning the safety and efficacy of vaccines, along with persistent claims that vaccines cause injury. These range from claims that vaccines cause allergic reactions, autism or sudden infant death syndrome (SIDS), to vaccines containing toxic substances, being ineffective, or not conferring immunity, as well as the claim that vaccine-preventable diseases are harmless [Davies, Chapman & Leask, 2002; Kata, 2010; Bean, 2011; Burnett et al., 2015; Smith & Graham, 2019; Hoffman et al., 2019].

While some themes endure, others are more specific to time and place. When new vaccines are introduced, new evidence emerges, or public health policy changes, new anti-vaccination arguments — or shifts in hypothesis — may emerge on anti-vaccination websites or social media [Bean, 2011; Kata, 2012; Orr et al., 2016].

A prominent example of an enduring claim concerning vaccine harm relates to the alleged link between the measles-mumps-rubella (MMR) vaccine and autism in children that surfaced in a 1998 article published in *The Lancet*, authored by former medical doctor Andrew Wakefield and colleagues. The article generated and sustained significant media attention. By 2004, scientific consensus that the MMR vaccine did not cause or contribute to autism had been reached, but the article was only retracted in 2010 [Flaherty, 2011]. By that time, it had "turned tens of thousands of parents around the world against the MMR vaccine" [Eggertson, 2010, p. E199]. The Wakefield study and surrounding publicity were subsequently linked to decreased MMR vaccination rates in the United Kingdom (U.K.), United States (U.S.), Ireland and other countries [Poland & Jacobson, 2011]. Meanwhile, Wakefield has continued to campaign against the vaccine, and his efforts have been directly linked to events such as a 2017 measles outbreak in Minnesota, U.S.

"Bad science" of the Wakefield variety has been categorised as among the most dangerous types of vaccine misinformation [Larson, 2018, p. 309].

This kind of misinformation, in combination with the unprecedented direct audience reach offered by social media channels, have transformed the health communication environment. Kata [2012] argues that actress and vaccine sceptic, Jenny McCarthy, drew the MMR/autism narrative into the mainstream via her social media platforms. The publication of her book, detailing her experience of raising an autistic child, coincided with the exponential growth of Facebook and Twitter. This enabled her to reach and interact with a sizable audience of fans and followers directly, making her the celebrity face of the anti-vaccine movement.

More recent vaccine scares have focussed on the HPV vaccine. For example, the Japanese government retracted its recommendation for the HPV vaccine in 2013 following widespread media coverage of adverse events following the injection. Vaccination rates declined from between 70% and 80% to only a few percent in some areas of the country [Okuhara, Ishikawa, Okada, Kato & Kiuchi, 2018]. Social media campaigning by a group claiming to be victims of the vaccine leveraged significant political and media influence in this context [Larson, 2017].

Regarding vaccine-related claims on Facebook specifically (RQ1), previous research highlights the prevalence of themes relating to conspiracy theories, media censorship, and high levels of mistrust of government and the scientific and medical community [Smith & Graham, 2019; Vulpe & Stoian, 2018; Hoffman et al., 2019; Xu, 2019]. Specific claims, such as ethical objections to vaccines due to the suspected use of aborted foetal tissue in manufacture, and claims of vaccine ineffectiveness, seem to be declining in prevalence. Conversely, a stronger presence of so-called 'expert testimony' and the use of appeals to civil liberties and individual rights are evident [Bean, 2011; Broniatowski et al., 2020].

Pro-vaccine messages frequently focus their efforts on providing information in a neutral manner, debunking misinformation or promoting the health benefits of vaccination [Vulpe & Stoian, 2018; Broniatowski et al., 2020]. Although pro-vaccine messages on Facebook have been increasing in recent years, anti-vaccine messages continue to receive more engagement [Vulpe & Stoian, 2018; Gandhi et al., 2020; Luisi, 2020] and individuals remain more likely to come across vaccine-critical content on Facebook [Guess, Nyhan, O'Keeffe & Reifler, 2020].

In terms of where claims originate from (RQ2), individuals expressing vaccine hesitancy have been found to engage more consistently on social media, compared with individuals in favour of vaccines who engage primarily due to specific events or outbreaks [Deiner et al., 2019]. Additionally, vaccine-critical content is often shared from Facebook pages that position themselves as "pro-vaccine choice" or "pro-science" [Hoffman et al., 2019, p. 2219]. Anti-vaccine Facebook posts are also widely shared, suggesting the reach of anti-vaccine rhetoric on Facebook is broader than those who engage on the actual pages [Smith & Graham, 2019; Gandhi et al., 2020; Luisi, 2020]. Moreover, mapping vaccine-related content from Facebook users globally reveals that although vaccine-critical individuals are relatively few in number, they are better able to engage undecided individuals. As a result, they gain greater involvement with the undecided group and appear more central in the online environment [Johnson et al., 2020].

When considering the geographic locations of vaccine rhetoric, previous research investigating online anti-vaccine lobbying in South Africa highlights the strong influence of the U.S., with 77.6% of anti-vaccine claims originating there [Burnett et al., 2015]. Similarly, a global study exploring the origin of Facebook posts between 2009–2016 reveals that the majority of posts for which geolocation was available were located in the U.S. [Deiner et al., 2019]. Recent research further corroborates the dominance of the U.S., especially in terms of vaccine-sceptical content [Martin et al., 2020]. Nevertheless, this influence may not be universal. A recent European study on vaccine-related Facebook pages found a strong focus on the local context and local news outlets [Agergaard et al., 2020].

Concerning justifications provided for vaccine-related claims (RQ3), dominant rhetorical appeals include evidence of authority and scientific rigour as well as claims that there is scientific evidence for the negative impact of vaccines [Davies et al., 2002; Wolfe, Sharp & Lipsky, 2002; Vulpe & Stoian, 2018; Hoffman et al., 2019]. A high degree of analytical thinking and "logically structured statements that mimic valid scientific information" is also evident in messages opposed to vaccines [Faasse et al., 2016, p. 5811]. Furthermore, vaccine-critical discourse explicitly uses titles such as "Dr" in contexts otherwise unconcerned with verbal etiquette, indicating a selective reliance on figures of authority [Buts, 2020]. The associated reliance on the 'rebel doctor or scientist' has also been present in online anti-vaccine content for several years [Davies et al., 2002; Bean, 2011]. Interestingly, pro-vaccine messages including personal stories receive the most heated discussion online while pure scientific knowledge receives the least attention. Emotive stories about illness have been found to be highly persuasive, and both pro- and anti-vaccine messages use personal stories and testimonials to persuade readers [Okuhara, Ishikawa, Kato, Okada & Kiuchi, 2018; Vulpe & Stoian, 2018; Xu, 2019].

Methodology

Data collection and analysis

In order to answer our three research questions, we employed a process of systematic content analysis as described by Bryman [2012, pp. 295–299]. Specifically, we utilised thematic coding guided by a codebook consisting of 11 (three descriptive and eight interpretive) variables. Each of the interpretive variables required the coders to answer a specific question. The data were captured in a dataset and the codes were transformed into variables which were used for the descriptive, bi-variate analyses (see supplementary material for the complete codebook).

Content analysis is regarded as a flexible and practical research tool to interpret textual data [Hsieh & Shannon, 2005] and has been used effectively in previous work exploring online vaccine sentiment [Wolfe et al., 2002; Smith & Graham, 2019; Hoffman et al., 2019]. Combining aspects of "conventional" and "directed" approaches to content analysis [Hsieh & Shannon, 2005, pp. 1279–1282], codes were developed inductively from an initial analysis of one month of data. Codebook development was informed by previous work on vaccine sentiment online and on social media [Kata, 2010; Bean, 2011; Kata, 2012; Nicholson & Leask, 2012] with specific reference to Hoffman et al. [2019], whose codebook in turn relied on earlier studies [Wolfe et al., 2002; Smith & Graham, 2019]. As is evident, our codebook was

based on previous research investigating vaccine sentiment rather than a specific theoretical framework.

The complete codebook was subsequently tested on 10% of the sample to ascertain whether the questions were formulated clearly and with relevance to the research questions. Inter-coder reliability was calculated after two coders independently coded the same 48 posts (24 per page, two each for every month of 2019). We obtained final inter-coder reliability agreement of 90%, which was calculated taking into account interpretive codes only, since no disagreement was evident in coding descriptive codes. The remaining posts were subsequently divided between two coders who met regularly to discuss the posts and coding process.

Two further points should be noted regarding our methodology. Firstly, we attempted to simulate everyday interaction on Facebook. As such, we judged the content of the posts on face value and did not click through on links to further investigate statements made. Practically, this means that if a certain post shared and commented on an article for instance, we read the post and the article title and short blurb visible when shared, but not the full text of the article to which the post linked. Therefore, if the content of a shared article was in fact, different from what was claimed on the Facebook post, we would not have captured such nuances, since our intent was to investigate the content on Facebook as presented to the public. Secondly, in an attempt to capture the full complexity of the posts, coders could select any number of relevant options from the codebook. Thus, a single Facebook post often contained several vaccine-related claims and justifications.

Description of sample

We manually recorded all posts generated by administrators on both pages from 1 January to 31 December 2019, yielding 460 posts across both pages. We excluded posts that were not related to vaccines. These were primarily about unrelated medical issues or were lifestyle-related, such as posts about healthy eating habits. The final dataset consisted of 440 posts (222 on the pro-vaccine page and 218 on the anti-vaccine page).

Figure 1 shows the number of posts for each page per month. Although some variation is evident, both pages were relatively active throughout 2019.

Results

The nature (types) of claims

Tables 1 and 3 list the types of vaccine-related claims made on the respective Facebook pages (RQ1). Posts were individually examined and the primary message(s) coded using thematic analysis. Table 1 describes the types of claims made on the pro-vaccine page. When considering these numbers, we reiterate that a single post often contained more than one claim.

An analysis of the claims made on the pro-vaccine page yielded nine themes, as shown in Table 1. These themes were further classified into four overarching types of claims. First, the majority of claims refer to the safety and necessity of vaccines. This includes claims that *vaccines are safe and/or necessary* ($n = 158$), *vaccines are safe*

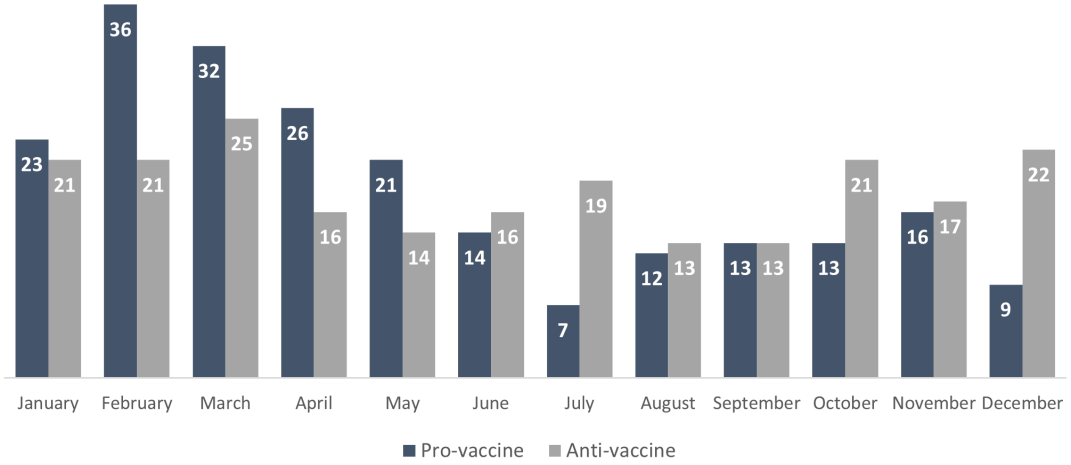

Figure 1. Number of posts per month made by administrators on the pro- and anti-vaccine Facebook pages over the course of 2019.

Table 1. Types of claims on the pro-vaccine Facebook page.

Type of claim	*Count*
Vaccines are safe and/or necessary	158
Vaccine-preventable diseases are still a serious issue and ought not to be taken lightly (this includes updates on disease outbreaks with encouragement to get vaccinated and news of recent deaths related to vaccine-preventable diseases)	118
Not getting vaccinated is dangerous	61
The efficacy of vaccines is proven by research and/or there is scientific consensus on the issue	44
Misinformation related to vaccines is dangerous	36
Vaccines promote community health (you should get vaccinated not only for your own benefit but also for the benefit of the community and those in it who can't be vaccinated)	25
Vaccines are safe and/or necessary during pregnancy	13
New vaccines should be developed and/or such development should be supported by the entire community	12
The historical threat of vaccine-preventable diseases has been largely forgotten due to vaccines (a call to collectively remember our history and the nature of these diseases)	12

and/or necessary during pregnancy ($n = 13$) and *not getting vaccinated is dangerous* ($n = 61$). A second group of claims emphasises the *serious threat* of vaccine-preventable diseases ($n = 118$) and serve as a reminder that the *historical threat of such diseases has been largely forgotten* ($n = 12$). The third group highlights scientific consensus and misinformation. We observe that approximately 20% ($n = 44$) of claims refer to the *efficacy of vaccines as proven by research* or mention *scientific consensus* regarding vaccines. A smaller number of claims ($n = 36$) raise the dangers of *misinformation* about vaccines. A fourth group of claims concerns vaccines and the community. It includes posts that emphasise the importance of being vaccinated for the *benefit of those who cannot receive vaccines* ($n = 25$) and posts which highlight that *new vaccine development should receive community support* ($n = 12$). Table 2 illustrates each of these four main themes on the pro-vaccine page, with excerpts from posts as examples.

Table 2. Main themes of claims on the pro-vaccine Facebook page with posts as examples.

Theme:	*Quote:*
Safety and necessity of vaccines	"A four-year-old girl recently came to the emergency room where I work as a resident doctor. She was writhing in pain, her body convulsed with seizures [...]. The diagnosis was clear: she had rabies — and it was too late to save her. Persistent gaps in vaccination coverage must be addressed on a war-like footing. [...] Rabies is terrifying. Don't hesitate, vaccinate your animals too."
Continued threat of vaccine-preventable diseases	"Madagascar, [...] has been hammered by its worst measles outbreak in decades. [...] more than 50,000 people have caught the disease since October 2018 and there have been more than 300 deaths – mostly children."
Scientific consensus about vaccines and dangers of misinformation	"Think of all these studies — thousands and thousands of them — as a jigsaw puzzle. The puzzle isn't one piece. It is composed of many pieces that fit together, creating a complete picture. The big picture on vaccinations is that they are safe and save lives."
Importance of community health/extending the benefits of vaccines beyond the individual	"There's always the chance that [...] if he does come in contact with these deadly, preventable diseases, he might not be strong enough to fight them off. [...]. He relies on the effect of a vaccinated population to prevent these diseases from reaching him in the first place. This is not a hypothetical. This is not statistics. This is a child, who relies on medical science to keep him alive. My child. My son. Vaccinate."

Table 3. Types of claims on the anti-vaccine Facebook page.

Type of claim	*Count*
Vaccines are potentially harmful and/or dangerous	115
Vaccines are part of a wider conspiracy and/or deception	84
Vaccines cause injury and/or other illnesses	66
Vaccines are unnecessary and/or ineffective	45
Vaccines are unnatural/contain chemicals/additives/other harmful substances	43
Vaccines cause death	39
Mandatory vaccination is a violation of individual right to choose (freedom of choice focus)	32
Too many vaccines are currently mandatory and/or the number of vaccines are continually increasing	29
Vaccines cause autism	28
Vaccine ingredients are manufactured and/or obtained through unethical means	18
Promotion of natural remedies	10

An exploration of the types of claims made on the anti-vaccine page returned 11 themes, as shown in Table 3. These fall into five broad categories. The first set of claims speaks to the dangers associated with vaccines. Such claims constitute the majority of posts and include statements that maintain *vaccines are potentially harmful and/or dangerous* ($n = 115$), *vaccines cause injury and/or other illnesses* ($n = 66$), *vaccines cause autism* ($n = 28$) and *vaccines cause death* ($n = 39$). A second category of claims views vaccines as *part of a wider conspiracy and/or deception* ($n = 84$). Approximately a fifth of claims ($n = 45$) question the *effectiveness and/or need* for vaccines. A fourth category contains claims concerning the 'unnaturalness' of vaccines and comprises claims that *vaccines are unnatural/contain*

chemicals/additives/other harmful substances ($n = 43$), that *vaccine ingredients are manufactured and/or obtained through unethical means* ($n = 18$) or claims that promote *natural remedies* ($n = 10$) instead of vaccines. A fifth set of claims criticises mandatory vaccination and includes statements about *mandatory vaccination as a violation of an individual's right to choose* ($n = 32$) and concerns that *too many vaccines are currently mandatory* ($n = 29$). Table 4 illustrates each of these five main themes on the anti-vaccine page, with excerpts from posts as examples.

The origins (sources) of claims

In this section, we explore the origin of the content on the two Facebook pages (RQ2). Facebook allows page administrators to post updates directly to their followers (posts that are original to the page), to share posts from other groups, pages or personal profiles on Facebook, as well as links from sources external to Facebook. We were interested in establishing how much of the content was original to the pages. For posts not original to the pages we studied, we wanted to explore where the posts were shared from within Facebook, as well as what sources they linked or referred to, including other forms of social media as well as sources outside social media.

Our findings indicated that the pro-vaccine page was marginally more likely to share posts that refer to social media platforms ($n = 105$) compared to the anti-vaccine page ($n = 98$). The majority of these posts (102 of the 105 and 80 of the 98 respectively) were shared from elsewhere on Facebook (this includes Facebook groups, pages and personal profiles). The anti-vaccine page was slightly more likely to post original Facebook content, not shared from elsewhere on Facebook ($n = 137$ compared to $n = 120$). However, the results of a Pearson's chi-square test yielded no statistically significant differences.

Figure 2 presents the nature of traditional sources (i.e., not social media) referenced in posts on both pages. The pro-vaccine page referenced mainly news websites (in 77 posts) followed by scholarly material (20 posts). Here we defined scholarly material as academic texts. Posts were categorised as such only if they included a link to a published journal article. Conversely, the two most referenced sources for the anti-vaccine page were other anti-vaccine websites (36 posts); and alternative medicine or health websites (28 posts). The results of a Pearson's chi-square test showed statistically significant results (chi-square = 101.343, df = 5, $p = .000$). Two-sided tests showed that at the significance level of 0.05, the proportion of news websites cited was significantly higher for the pro-vaccine page than the anti-vaccine page.[1]

Posts were also coded according to the geographical focus of the content as shown in Figure 3. It should be noted that a country or region was only categorised in cases where the content of the post itself referred to a specific geographical location (city, country or region). Geotagging was not done. Furthermore, a large number of posts (115 on the pro-vaccine page and 89 on the anti-vaccine page), did not

[1] It should be noted that figures illustrate the main findings in each category and not necessarily *all* findings. As evident in our codebook (supplementary material), each category also had an "other" option that could be used when posts did not fall into any of the existing categories. However, due to space constraints the various "others" are not discussed in this article.

Table 4. Main themes of claims on the anti-vaccine Facebook page with posts as examples.

Theme:	*Quote:*
Dangers associated with vaccines	"My little boy died and I wasn't there. The next time I got to hold him he was lifeless in my arms. And he didn't go peacefully in his sleep. He suffered. But yet we were told he died from SIDS, which is only a label when they cannot tell you why your baby died. But I know it was from the vaccines. This isn't my opinion on vaccines, it's just my story. Do your own research before you make choices for your children. Realize it's you and no one else that protects them from this world. I wish I had done so many things differently. I will no longer vaccinate my other children."
Vaccines as part of a wider conspiracy or deception	"Timeline of vaccine mind control being pushed on the population from the last couple months Step 1.) WHO says anti vaxxers are global health threat Step 2.) Golden globe awards has segment giving out flu shots to the crowd Step 3.) Measles "outbreak" in several states (a few hundred cases of a harmless rash is somehow an outbreak) Step 4.) Washington issues declaration of "emergency" over measles (nobody died) Step 5.) Legislation brought forward in over 30 states over vaccines and vaccine exemptions Step 6.) Media fabricates story of an unvaccinated teenager who goes behind parents' backs to vaccinate himself (later gets invited to speak in front of senate) Step 7.) Senate meets to discuss vaccines Step 8.) Impeccable timing of a study that claims the MMR vaccine doesn't cause autism (the exact vaccine and disease garnering so much media attention gets "exonerated" in terrible methodological study funded by the pharmaceutical industry) Step 9.) Censor any and all information that contradicts the government created narrative. Essentially ban the truth so those being programmed only see the side they want you to see. And that my friends is how mind control works."
Questioning the effectiveness and need for vaccines	Women and children are the sheep being led off the ledge. I have written about a known 4250% increase in fetal demise during the 2009/10 flu season, about evidence-based inefficacy and risks of the pertussis vaccine pushed on pregnant women, about Gardasil killing healthy girls across the globe, fear mongering about SIDS that is actually caused by a visit to the paediatrician, and of the corruption of an infant's birthday by the Hepatitis B vaccine. In rejecting the paradigm of vaccination, it is important to grasp the nature of the political beast that is pushing vaccines into the arms (legs and buttocks) of every human"
Claims concerning the 'unnaturalness' of vaccines	"How I wish I could go back to that day I declined [vaccinations] at 2 months and start my research then! How different things would be had I stood firm and learned back then what I know now. The toxic load of aluminium, formaldehyde, human and animal tissues, etc and etc, were too much for my son's neurological system and detoxification system. He lost his words & eye contact altogether, started flapping, spinning, walking on his toes, horrible GI symptoms, food limiting, had no desire for social interaction, etc. He was diagnosed with severe autism. And our world was turned upside down."
Critiques of mandatory vaccination	"Big pharma is reaching the Goldilocks zone of their business plan with the nationwide rollout of mandatory vaccination laws, for the first time in history every person in the U.S.A. will be forced to use a commercially manufactured profit-generating product or face criminal charges."

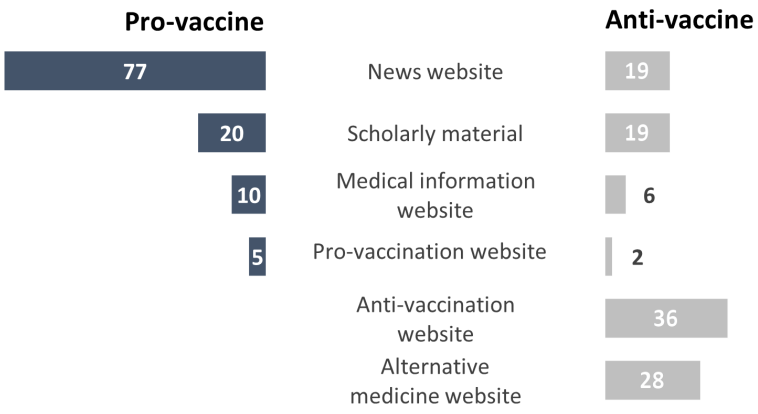

Figure 2. Number of posts referring to various sources outside social media on the pro- and anti-vaccine Facebook pages.

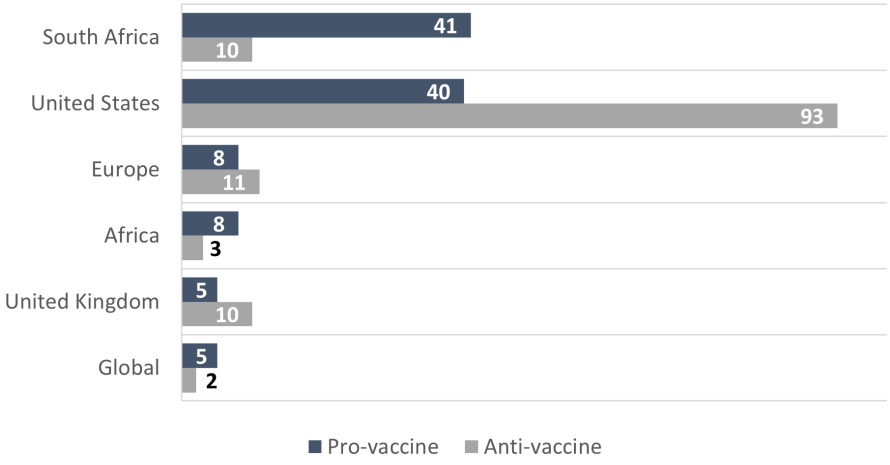

Figure 3. Number of posts containing geographical locations on the pro- and anti-vaccine Facebook pages.

include reference to any geographical location. Among the pro-vaccine page's posts that could be coded geographically, most (41 posts) had a local, South African focus while a near equal number (40) focused on the U.S. By contrast, content posted on the anti-vaccine page was largely U.S. focussed (93 posts), with a small number of posts linked to South Africa, the U.K. or Europe. 'Global' referred to posts making worldwide statements.

The justifications (substantiations) of claims

Our final research question considers how the content of the posts is justified, or what form(s) of evidence are provided to substantiate claims (RQ3). Figure 4 illustrates the prevalence of various justifications. We found that the pages demonstrated almost equal reliance on anecdotal justifications (with 62 and 57 posts respectively). The pro-vaccine page frequently posted content from news sources (63 posts) and official sources (39 posts). Official sources were defined as healthcare organisations (such as the WHO, UNICEF, FDA or CDC) as well as any government health department.

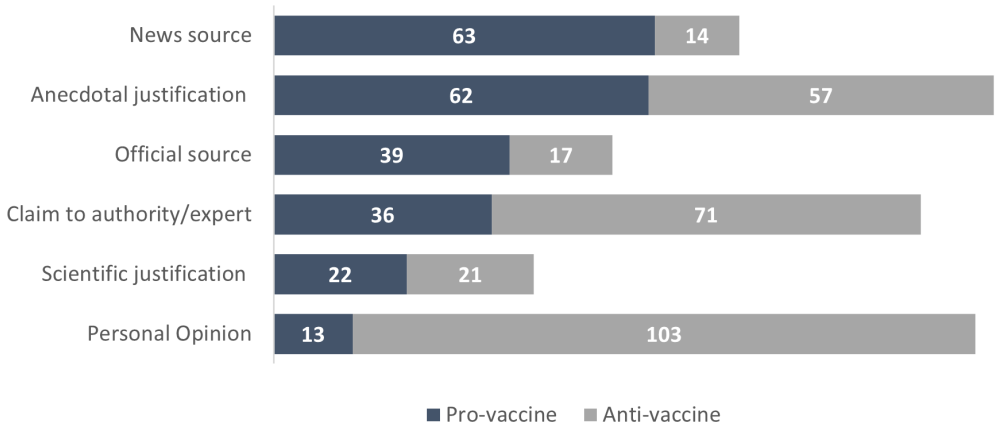

Figure 4. Number of posts using various justifications on the pro- and anti-vaccine Facebook pages.

The majority of posts (103) on the anti-vaccine page were justified by personal opinion, compared to only 13 posts using this justification on the pro-vaccine page. We considered posts to be personal opinion in cases where claims were made without providing any evidence to support arguments. Furthermore, on the anti-vaccine page, almost a third of posts (71) relied on a claim to authority or expertise, defined as the use of titles such as Dr, Professor, or the like, in posts to support arguments, compared to 36 posts on the pro-vaccine page. The results of a Pearson's chi-square test indicated statistically significant results (chi-square $= 121.800$, df $= 6$, $p = 0.000$). Two-sided tests showed that at the significance level of 0.05, the proportion of 1) personal opinion and 2) authority/expert related justifications were significantly higher for the anti-vaccine page than the pro-vaccine page.[2]

For both pages, the use of scientific justifications (here referring to a link to a published journal article) was less frequent than other types of substantiations, albeit, somewhat surprisingly, equally distributed between the pro- and anti-vaccine pages (used in 22 and 21 posts respectively). A seemingly contradictory trend has been observed in previous research whereby vaccine sceptics both criticise scientific studies and the scientific method, while simultaneously "craving scientific legitimacy" [Kata, 2012, p. 3781] and using scientific research to support their claims [Davies et al., 2002; Faasse et al., 2016; Hoffman et al., 2019]. Given the increased prevalence of reliance on scientific information and expertise in the context of online vaccine rhetoric [Faasse et al., 2016; Hoffman et al., 2019], we wanted to explore this question further.

Our analysis of the use of scientific material is framed around two questions. Firstly, is the scientific material on the Facebook posts credible? For instance, are publications from reputable journals listed in academic databases? Secondly, are the sources recent or older, i.e. dated, in terms of their publication dates?

[2]The number of "scientific justifications" given in Figure 4 differs slightly from the number of "scholarly material" given in Figure 2. This is because in a few instances a link to a published journal article appeared only in an image attached to a post, but not in the post text itself. In such cases, the post was coded as having a scientific justification, but not as linking directly to scholarly material. Thus, the numbers are slightly higher in Figure 4 than in Figure 2.

Table 5. Number and source of scholarly articles cited on the pro-vaccine Facebook page.

*Journal**	*Number of articles cited*
The Lancet	4
Annals of Internal Medicine	2
Pediatrics, official journal of the American Academy of Pediatrics	2
Science	2
Archives of Disease in Childhood	1
Clinical Infectious Diseases	1
Eurosurveillance	1
Frontiers in Immunology	1
JAMA Pediatrics	1
JAMA Psychiatry	1
PLoS ONE	1
New England Journal of Medicine	1
Vaccine	1
Total	*19*

* All the journals listed above were indexed on the Web of Science database as of August 2021.

In the section below, we investigate the credibility of scientific evidence posted on the respective Facebook pages. We examine the sources of scientific claims through an analysis of the journals cited. As such, we define a credible source as a peer-reviewed article published in a journal that is indexed in the Clarivate Analytics Web of Science or Scopus databases. The Web of Science master journal list (as of October 2021) was used to search for the respective journals listed in Tables 5 and 6 to determine whether they are indexed in the Web of Science. Similarly, the Scopus source list (as of September 2021) was used to identify Scopus-listed journals. Importantly, however, we did not compare the claims made on the Facebook pages with the contents of the scientific articles that are provided as sources to determine whether the claims are evidence-based. This could be the focus of future research. Furthermore, it should be noted that on both pages some links that were no longer functioning were discarded. Additionally, in cases where articles were posted multiple times, duplications were disregarded.

Table 5 lists the number of scholarly article links and the journals in which they were published that was posted on the pro-vaccine page, 19 unique articles from 13 different journals were identified in 22 posts. All 13 referenced journals were listed in the Web of Science database (as of October 2021).

Table 6 lists the number of scholarly article links and the journals in which they were published that was posted on the anti-vaccine page. Within Table 6, Y and N indicates yes or no respectively, to the question of whether or not a specific journal was listed in either the Web of Science or Scopus databases (as of September/October 2021). A single post often contained links to multiple articles. Ultimately, 97 unique articles from 60 different journals were identified in the 21 posts on the anti-vaccine page. As is evident, three of the referenced journals were not listed in either database. However, two of these were listed as predatory journals on both the Beall's list of potential predatory journals and publishers

(see https://beallslist.net/) and Cabell's predatory reports (see https://www2.cabells.com/predatory). Although these lists by no means constitute global agreement on predatory journals within academia, the fact that both journals appear on both lists is at least a call to caution in terms of their credibility.

Table 6. Number and source of scholarly articles cited on the anti-vaccine Facebook page.

Journal	*n*	*Indexed on WoS and/or Scopus*
Journal of Toxicology and Environmental Health	8	Y
Pediatric Neurology	5	Y
British Medical Journal	4	Y
Journal of Infectious Diseases	4	Y
North American Journal of Medical Sciences	4	Y
Medical Hypotheses	3	Y
Vaccine	3	Y
American Journal of Diseases of Children	2	Y
American Journal of Epidemiology	2	Y
American Journal of Public Health	2	Y
Autism	2	Y
Cochrane Database of Systematic Reviews	2	Y
International Journal of Environmental Research and Public Health	2	Y
Journal of Biomedical Science	2	Y
Journal of Immunotoxicology	2	Y
Journal of Tropical Pediatrics	2	Y
Neuroendocrinology Letters	2	Y
New England Journal of Medicine	2	Y
Pediatrics, official journal of the American Academy of Pediatrics	2	Y
Translational Neurodegeneration	2	Y
Alternative Therapies in Health and Medicine	1	Y
American Journal of Public Health	1	Y
American Journal of Respiratory and Critical Care Medicine	1	Y
Antiviral Research	1	Y
Archives of Pediatric and Adolescent Medicine	1	Y
BioMed Research International	1	Y
Clinical and Diagnostic Laboratory Immunology	1	Y
Clinical Infectious Diseases	1	Y
Clinical Therapeutics	1	Y
Clinical Toxicology	1	Y
Eurosurveillance	1	Y
Gut	1	Y
Human & Experimental Toxicology	1	Y
Immunologic Research	1	Y
Indian Journal of Medical Ethics	1	Y
Indian Journal of Medical Research	1	Y
International Journal of Epidemiology	1	Y
International Journal of Toxicology	1	Y

Continued on the next page.

Table 6. *Continued from the previous page.*

Journal	*n*	*Indexed on WoS and/or Scopus*
International Journal of Vaccines & Vaccination	1	N
Journal of Clinical Microbiology	1	Y
Journal of Forensic and Legal Medicine	1	Y
Journal of Inorganic Biochemistry	1	Y
Journal of Maternal-Fetal & Neonatal Medicine	1	Y
Journal of Medical Genetics	1	Y
Journal of Public Health and Epidemiology	1	N
JAMA, Journal of the American Medical Association	1	Y
Journal of the Indian Medical Association	1	Y
Journal of the Royal Society of Medicine	1	Y
Journal of Toxicology	1	Y
Journal of Trace Elements in Medicine and Biology	1	Y
Molecular Psychiatry	1	Y
Nutrition Reviews	1	Y
Oregon Law Review	1	N
Pediatric Blood & Cancer	1	Y
Pediatric Nursing	1	Y
PLoS ONE	1	Y
PNAS	1	Y
The FASEB Journal, Federation of American Societies for Experimental Biology	1	Y
The Lancet	1	Y
Toxicological Sciences	1	Y
Total	*97*	

Judging by clear retraction notices within the articles themselves rather than further investigation, two retracted articles were cited on the anti-vaccine page. One of these was the 1998 article published in *The Lancet* by Andrew Wakefield and colleagues (retracted in 2010). The other was published in *Journal of Toxicology and Environmental Health* in 2018 (retracted in 2019) and dealt with pregnancy and the HPV vaccine. This provides further evidence for both the enduring influence of the Wakefield article in substantiating anti-vaccine rhetoric as well as the more recent focus on the HPV vaccine within anti-vaccine rhetoric.

Figure 5 illustrates the publication dates of articles cited on both pages.
The majority (68%) of scholarly articles referenced on the pro-vaccine page was published between 2016 and 2019. This compares to only 5% of articles referenced on the anti-vaccine page for the same period. The bulk (68%) of scholarly articles referenced on the anti-vaccine page was older, published between 2000 and 2015. Moreover, one in five articles (22%) cited on the anti-vaccine page referenced research published before 2000, while this is true for only 5% of articles on the pro-vaccine page. Results from a Pearson's chi-square test showed statistically significant results (chi-square = 69.873, df = 6, $p = .000$), with two-sided tests, at the significance level of 0.05, showing that the anti-vaccine page was more likely to cite sources from 2000 to 2009 and 2010 to 2015 than the pro-vaccine page.

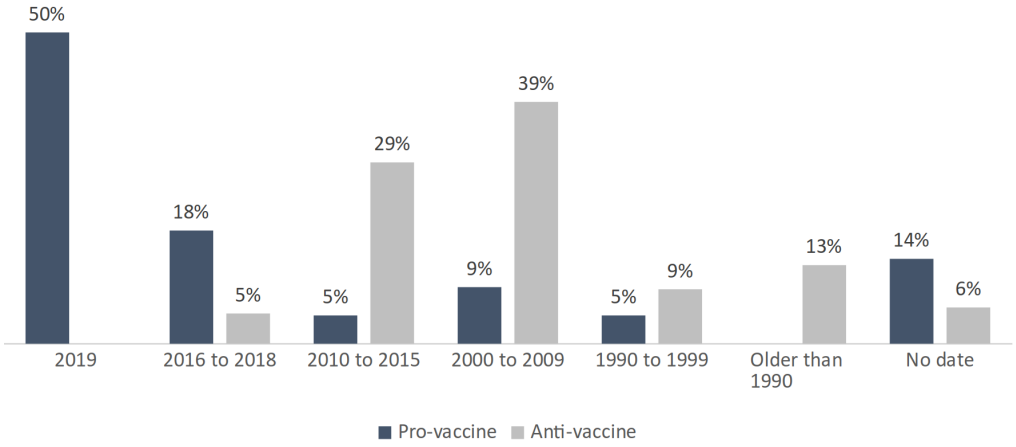

Figure 5. Publication dates of scholarly articles cited on pro- and anti-vaccine Facebook pages.

Discussion

The nature (types) of claims

Our results demonstrate that the content of these pages is diverse, and spans several topics. This is consistent with earlier studies [Kata, 2012; Vulpe & Stoian, 2018; Hoffman et al., 2019]. The majority of claims made on the pro-vaccine page referred to the safety and necessity of vaccines, while the antithesis was evident in the majority of claims made on the anti-vaccine page. In this way, there appears to be a measure of connectedness in the 'pro' and 'anti' rhetoric in the sense that their main themes mirror each other. These results confirm the existing literature [Davies et al., 2002; Kata, 2010; Bean, 2011; Burnett et al., 2015; Smith & Graham, 2019; Vulpe & Stoian, 2018; Hoffman et al., 2019]. However, we found that the emphasis of pro-vaccine messages on debunking misinformation noted elsewhere [Broniatowski et al., 2020] was not as prevalent in our sample.

Our analysis of anti-vaccine rhetoric reveals that the second largest set of claims associated vaccines with conspiracy theories or deception. This is also consistent with previous research [Wolfe et al., 2002; Smith & Graham, 2019; Hoffman et al., 2019; Xu, 2019]. Belief in conspiracy theories is widespread [Jolley & Douglas, 2014] and since they are relatively common among the general population, the prevalence of conspiracy-style thinking among those opposed to vaccines is not surprising [Smith & Graham, 2019]. Previous work characterising the anti-vaccine movement has noted conspiracy, deception, a search for truth and claims of government, media and pharmaceutical industry secrecy as common content themes [Jolley & Douglas, 2014; Hoffman et al., 2019].

Opposition to vaccines on the basis of the infringement of civil liberties or individual freedoms was not as dominant a theme in our analysis when compared with other studies [Bean, 2011; Hoffman et al., 2019; Broniatowski et al., 2020]. Furthermore, only a small number of posts ($n = 28$) referred to the ostensible link between vaccines and autism. This may be because our study investigated posts made in 2019 and, as previously noted, more recent vaccination concerns, such as the HPV vaccine, have partially overshadowed the autism debate in recent years [Okuhara, Ishikawa, Okada et al., 2018].

The origins (sources) of claims

In terms of the origin of vaccine-related claims, prior research found that vaccine hesitancy is largely situated within online communities who are particularly active on social media platforms such as Facebook [Deiner et al., 2019]. Our results reveal a slightly different picture in that the anti-vaccine page was more likely to post original content not found elsewhere on Facebook. Nevertheless, among posts linking to or shared from social media platforms, Facebook still dominated with 80 of the 98 posts shared from elsewhere on Facebook.

Among the Facebook pages with the largest followings from which the anti-vaccine page shared content were author and lawyer Robert F. Kennedy Jnr's 'Children's Health Defense Fund', and celebrity doctors and vaccine critics Dr. Sherri Tenpenny, and Dr. Christiane Northrup. All three of these sources have recently been named as members of the 'Disinformation Dozen', 12 prominent vaccine critics based in the U.S., who were identified as being responsible for up to 73% of anti-vaccine content on Facebook [Center for Countering Digital Hate, 2021]. This highlights the architecture of Facebook's content sharing mechanisms and corroborates the international integration and influence of the U.S. among anti-vaccine activists identified in earlier research [Ward, Peretti-Watel, Larson, Raude & Verger, 2015]. Moreover, it demonstrates the level of inter-connectedness between groups and individuals that Facebook facilitates [Hoffman et al., 2019].

In terms of traditional (non-social media) sources used, our findings support existing literature. The reliance of pro-vaccine messages on news sources and official sources has also been observed elsewhere [Faasse et al., 2016; Vulpe & Stoian, 2018; Buts, 2020]. Moreover, the dominance of alternative medicine or health websites in supporting anti-vaccine messages is well established. The fact that some of these also had a commercial aspect, selling natural health and wellness products, sometimes marketed as treatments for adverse vaccine reactions has also been found elsewhere [Burnett et al., 2015; Ward et al., 2015; Jamison et al., 2020].

Our analysis of the geographical focus of content on the two Facebook pages is not surprising in that it confirms the dominance and influence of the U.S. in vaccine rhetoric. However, on the pro-vaccine page, the amount of U.S. content is matched with local, South African content. Nevertheless, comparatively little content from the African continent is evident on both pages, which affirms the influence of the global north in framing online vaccine rhetoric in South Africa.

It is illustrative of the influence of the organised and powerful anti-vaccine movement in the U.S. that 32 posts in our sample are specifically concerned with opposition to mandatory vaccination, even though South Africa does not have a compulsory vaccination schedule. Indeed, most of these posts are related to a 2019 California bill, which intended to close a legislative loophole allowing parents to seek medical exemptions from doctors for mandatory vaccinations for children of school-going age. While very specifically a U.S. issue, with seemingly little relevance to South Africa, the anti-vaccine page criticised this legislation for being an overreach of government power. This is in keeping with earlier research characterising anti-vaccine sentiment on websites in South Africa, which remarked on the influence of the U.S. anti-vaccine movement on local content [Burnett et al., 2012; Burnett et al., 2015].

Although only 10 posts on the anti-vaccine page deal specifically with South African vaccine topics, scepticism regarding the South African government and industry interests is palpable in these posts. We would argue that this could at least partly be related to South Africa's contemporary 'crisis of trust' as illustrated in the 2018 Afrobarometer, which detailed low levels of trust in public institutions in the country related to current political scandals and corruption [Afrobarometer, 2018; Faull, 2019]. This concurs with research in other countries contextualising pro and anti-vaccine debates on Facebook in terms of countries' political contexts. Specifically, Orr et al. [2016] argue that the pro and anti-vaccine arguments made on several Israeli Facebook pages were linked to that country's political moment. Similarly, previous work has found a connection between vaccine confidence or hesitancy and trust or mistrust in government, healthcare systems and related scientific institutions [Jennings et al., 2021].

The justifications (substantiations) of claims

Regarding justifications, or forms of evidence provided for claims, the equal reliance of both pages on anecdotal justifications aligns with previous research [Okuhara, Ishikawa, Okada et al., 2018; Okuhara, Ishikawa, Kato et al., 2018; Vulpe & Stoian, 2018; Xu, 2019]. The tendency within anti-vaccine rhetoric to make statements without providing evidence [Orr & Baram-Tsabari, 2018], as well as the reliance on professional titles to lend authority to statements made [Davies et al., 2002; Bean, 2011; Buts, 2020] has also been identified elsewhere.

When considering the use of scientific material to support vaccine-related claims on both pages, we identified references to a total of 116 unique academic articles in 43 posts. Both pages predominantly posted scholarly articles that were published in reputable journals, as measured by their inclusion in either the Web of Science or Scopus databases (as of September/October 2021). Moreover, both pages referenced articles from *The Lancet*, *Clinical Infectious Diseases*, *Eurosurveillance*, *PLoS ONE*, and *Vaccine*. However, some noteworthy differences between the pages are also evident. For the pro-vaccine page, 22 posts referenced 19 different articles from 13 different journals. Conversely, the anti-vaccine page included links to 97 different articles from 60 different journals in 21 posts. Thus, the anti-vaccine page referenced substantially more articles in an equal number of posts, indicating the frequent inclusion of several articles in a single post. The range of journals referenced via the anti-vaccine page is also considerably larger than that of the pro-vaccine page. Finally, we could not identify any questionable scientific references on the pro-vaccine page, while the anti-vaccine page included references to two journals that have been flagged as predatory journals, as well as two retracted articles. Nonetheless, our results were not statistically significant which demonstrates that the anti-vaccine page was not statistically less likely to cite credible sources than the pro-vaccine page.

Our analysis of the publication date of scientific material indicates that the pro-vaccine page cited more recently published material than the anti-vaccine page. This is in keeping with earlier findings which noted that 75% of the content on anti-vaccine websites was from outdated and/or disproven sources [Kata, 2010].

Limitations and suggestions for future research

We explored only one pro and one anti-vaccine Facebook page to identify their claims, sources and justifications and analysed only one year (2019) worth of data. As such, the small scale of our sample limits the generalisation possibilities of our results. Nevertheless studies considering anti-vaccine rhetoric remain notably more common compared with studies examining pro-vaccine rhetoric, thus an important contribution of the current study lies in placing this seemingly polarized rhetoric alongside each other and discovering that there is in fact a shared common ground in that their main themes mirror each other.

In terms of origin, the dominance of the global north in framing vaccine rhetoric held true within our sample, despite the fact that both pages explicitly identified as South African. More vaccine-related studies from the global south is necessary to determine whether this is also evident in other developing countries.

We investigated the credibility and publication dates of scientific articles used to support vaccine-related claims and found that both pages primarily cite credible journals although significantly more articles and older research is cited on the anti-vaccine page. Importantly, it should be noted that we analysed posts only on face-value throughout the study. We did not investigate further to determine whether cited sources supported claims made on the pages. An important question for future research is how such pages engage with scientific material. Are the claims made on Facebook substantiated by the evidence and findings presented in the scientific articles, or is the science misrepresented or misunderstood? Previous research investigating the use of open access journal articles by the anti-vaccine movement reveals that scientific papers are used selectively to further arguments against vaccines, without meaningful engagement with the actual research [van Schalkwyk, 2019]. This "selective harvesting" of scientific information can create uncertainty among non-scientific publics, even when the evidence overwhelmingly points to the safety and effectiveness of vaccines [van Schalkwyk, 2019, p. 157]. The in-depth analysis required to answer these questions in the case of the Facebook pages discussed here falls outside the scope of the current study, but considering such questions is recommended for future research.

Conclusion

We analysed 440 vaccine-related Facebook posts made by administrators on two open, public-facing South African Facebook pages throughout 2019. Claims related to the safety and necessity of vaccines dominated the pro-vaccine page while the anti-vaccine page focussed on the dangers of vaccines. Posts on both pages were often shared from within Facebook and despite identifying as South African, a U.S. focus was evident in numerous posts. Both pages had an equal number of posts employing scientific justifications (linking to published journal articles), the majority of which were published in accredited journals. On the anti-vaccine page, several articles were often included in a single post. Additionally, most articles cited on the anti-vaccine page referred to research articles published before 2015, while half of the articles cited on the pro-vaccine page referred to research published in 2019.

Our study provides an important pre-COVID baseline for vaccine information on Facebook in the South African context. We hope that a better understanding of the nature, origins and justifications of pro- and anti-vaccine views, as illuminated in this study, may provide a starting point for constructive public dialogue.

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Ethical considerations

Ethical clearance for this study was obtained from the Research Ethics Committee for the Humanities at Stellenbosch University on 11 June 2019, project number: 10235. Since the pages we studied were open and public-facing, all information on them could be accessed by anyone, even without access to a Facebook account. Nevertheless, in line with our ethical clearance and the preliminary recommendations of the Academy of Sciences of South Africa, we have refrained from overt identification of the pages to prevent stigmatisation. The Academy of Sciences of South Africa has undertaken to develop a POPIA code of conduct for research, which will provide further guidelines for this type of research in future.

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