

Exploring social media influences on vaccine decision-making in parents: a netnography

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Abstract

Background: Immunization is one of the most significant health initiatives of recent times. Despite this, vaccine hesitancy is increasing and was listed as one of the top 10 threats to global health by the World Health Organization in 2019. A major factor associated with vaccine hesitancy is thought to be the viral spread of misinformation by a small but active anti-vaccination movement.

Objectives: The purpose of this study was to explore the influences of social media on vaccine decision-making in parents.

Design: This study is part of a larger body of research that explored vaccine decision-making in parents. Other methods included were an online survey and semi-structured interviews. This study investigated the influence of cyberculture on parents in an online environment.

Method: This study employed netnography, a form of qualitative inquiry with its roots in ethnography as methodology and a purpose-designed Facebook page as the means of exploring a purpose-designed online community with a particular focus on the culture, belief systems and influences present. Both manual and computer-assisted thematic analyses were used to analyse the data obtained.

Results: Three key themes were identified in this study. These included vaccine safety concerns, the emotional debate and COVID-19-specific issues. The results indicated the presence of strong anti-vaccination sentiment combined with an ‘infodemic’ of conspiracy theories, misinformation and vitriol with the potential to negatively impact parents seeking immunization information.

Conclusion: Given the popularity and accessibility of social media and the ready access to misinformation present online, it is evident that parental vaccine decision-making may be impacted adversely. Therefore, it is important that healthcare professionals are aware of this and provide adequate and timely education prior to parents seeking information on social media.

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Plain language summary

Exploring the influence of social media on vaccine decision-making in parents: a netnography

This research explored the impact of Facebook interactions on the vaccine decision-making of parents.

Keywords: decision-making, parents, pregnancy, vaccinations, vaccine, vaccine hesitancy

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Introduction

Immunization is universally accepted as one of the most significant health initiatives of recent times.¹ However, vaccine hesitancy is increasing in high-income countries and was declared one of the top 10 threats to global health by the World Health Organization (WHO).^{1,2} Vaccine hesitancy has been described as the reluctance or refusal to vaccinate despite the availability of vaccines.^{1,2} Vaccine hesitancy is present in countries like Australia where nearly half of Australian parents have experienced concerns about childhood immunization.³ Despite significant successes with vaccines and evidence to support their safety and efficacy, widespread anxiety and mistrust surround vaccine safety.⁴⁻⁸

A major factor associated with vaccine hesitancy is thought to be the rapid spread of misinformation by a small but active anti-vaccination movement.⁹⁻¹² This movement relies heavily on the internet and social media to influence the decision-making of parents.^{13,14} Recent studies have drawn a link between the internet, social media and vaccine refusal.^{10,15,16} Although a thorough discussion of these issues is outside the scope of this paper, it is acknowledged that these concepts are tightly connected to vaccine decision-making and contribute to vaccine hesitancy in general. In recent years, the internet and social media have become popular sources of health information.¹⁷ This could be attributed to the popular and interactive nature of social networking sites (SNSs). In combination with active participation and social connectedness, SNSs provide a readily available, if not always accurate, source of health information and social interaction.¹⁸

With the increasing use of social media as a health information source, it is vital that healthcare providers are aware of this as well as the ease of gathering misinformation online.¹⁹ Additionally, since the outbreak of COVID-19, an infodemic of misleading information in the digital and physical environments and a proliferation of conspiracy theories have made decision-making challenging for some parents.^{20,21} (An infodemic has been described by the WHO as too much information including false or misleading information in digital and physical environments during a disease outbreak.) Research into the link between social media and vaccine distrust and refusal has increased in recent years.^{12,13,17,22-25} This research

has demonstrated a growing role in SNS use by people seeking health information online; however, none have used netnography as a framework to approach this problem nor approached this issue from a parent's perspective.

Background

Prior to the declaration of the COVID-19 pandemic, many SNSs existed to support parents who held anti-vaccination beliefs. Members of these sites shared anti-vaccination information and encouraged new members to adopt these beliefs and practices. These sites were searchable online, and membership was open to all. However, this changed in 2020 when the declaration of a global pandemic, combined with the development of COVID-19 vaccines, resulted in an increasing incidence of vaccine hesitancy.²¹ To combat the influence of online anti-vaccination groups, Facebook acted to close down any SNSs with anti-vaccination sentiments to minimize the influence of these groups.²⁶ The rationale behind these closures was concern about the risk of harm from these SNSs, due to the proliferation of inaccurate information and subsequent loss of public confidence in the COVID-19 vaccination programmes.²⁶

An integrative review of the current literature was conducted in 2022, which revealed that the internet and social media may have a negative impact on vaccine decision-making in parents and pregnant women despite being cited in some countries, including England and Indonesia, as trusted sources of information.^{5,12,27,28} A further review of current literature was conducted in 2023 which demonstrated that a link exists between social media use and public distrust of vaccines.^{22,25,29-33}

This research is part of a larger body of research that investigated vaccine hesitancy in parents and pregnant women and utilized data collected from a purpose-designed Business Facebook page. As a result of the findings of this earlier research, it became evident that social media contributed to anxiety associated with the vaccine decision-making of parents. Hence, the research question for this study was '*What social media factors have the capacity to influence vaccine decision-making and promote vaccine hesitancy?*'

The Facebook page acted as a recruiting source for the online survey and semi-structured interviews,

both of which are reported elsewhere.^{7,34,35} Additionally, the online chat that took place on this site became the basis for this netnographic study which employed the principles identified by Kozinets.³⁶ Kozinets³⁷ first introduced the methodology of netnography in the late 1990s and described it as ‘a specific approach to conducting ethnographic research in an online environment’. Virtual communities have existed for many decades and were documented as early as 1987.³⁸ However, the internet and social media have become fundamental to the lives of many people and an online culture of influence and misinformation has evolved since becoming available to the general public.³⁹ Many valuable studies have been conducted online that analysed online content of immunization websites as well as explored online mothering sites using both an online ethnographic and content analysis approach.^{40,41} Other studies have focussed on the influence of social media on vaccine uptake.⁹ This study continues the exploration of the impact of social media-based virtual communities on vaccine decision-making for parents and is the first to utilize a netnographic approach, a methodology designed for research of online data.

Netnography is a relatively recent methodological innovation that involves the study of ‘. . . networked society in all its manifestations through a variety of tools and paying particular attention to the cultural insights and conditions that are determined by the varieties of human experience’.³⁶ It is particularly well suited for researching online communications in difficult-to-access populations.³⁷ As a form of qualitative inquiry with its roots in ethnography, netnography can adopt a humanist approach whilst relying on field notes, introspection and contemplation.³⁶ Ethics approval was obtained for this research through Flinders University Ethics Committee Project No. 2464.

Purpose

This research has utilized a purpose-designed SNS to investigate the user-generated content to gain a deeper understanding of the types of information and misinformation that exist in an online environment, with the potential to better understand the influences on parental vaccine decision-making. Through an increased understanding of the influences on parents, healthcare professional

practice may be enhanced, and immunization uptake increased. This research also can inform healthcare professional education, policy and future research.

Methodology/method

Netnography was selected as a methodology for this research. Netnography is guided by the principles of classic ethnography applied to the online field whilst using online observation of textual and graphic discourses.³⁷ It has been described as a form of ethnographic research, which uses the participant-observation approach with online interactions as fieldwork.⁴² Whilst very similar to online or virtual ethnography, Netnography takes a qualitative interpretive approach to research, it has its structure, guidelines and framework and uses online communications as the primary source of data.³⁶ In comparison with ethnography, netnography takes a less obtrusive and more naturalistic approach and includes not only the written word but also the connections, communication styles and graphics.⁴³ It has a strong focus on the meaning behind posts and tweets and includes an analysis of graphics and memes. It is a relevant, rapid and unobtrusive method of data collection that produces graphic commentary, making netnography an interesting methodology for this study.³⁷ Hence, netnography was chosen as the methodology for this research because of its innate ability to get close to the research population whilst being less intrusive. Additionally, the declaration of a global COVID-19 pandemic meant that other methodologies that required close contact with participants, such as ethnography, were inappropriate and unsafe for the time.

Design

A research-specific Business Facebook (unpaid) page, assigned the category of Medical Research Centre, was established for this research. Paid promotional posts were placed on this page and are listed in Appendix 1.⁴⁴ Our recently published paper discusses the process and methodology at length and critically reflects on our experiences of using netnography.⁴⁵ Facebook was chosen as the platform for this research based on the number of regular users and its proven efficacy for cost-effective recruitment.⁴⁶ This medium provided the platform for open discussions on vaccine choices in pregnancy and parenting.⁴⁶ The

inclusion/exclusion criteria for this study were vaccine-hesitant parents or caregivers and pregnant women aged between 18 and 50 years.

Despite the popularity of social media, conducting research in this space is subject to ethics and privacy. Consent is an important aspect in any research and participants on SNSs may be unaware that data are being collected and as such are unable to make a conscious choice to participate in a study or give informed consent.⁴⁷ The Association of Internet Researchers (an association of internet researchers committed to ensuring that internet research is conducted in an ethical and professional manner) recommends obtaining informed consent when conducting internet research where possible. For full disclosure, the primary author made regular posts seeking discussion and clarifying the purpose of the SNS. Kozinets⁴⁴ stressed the importance of active participation as opposed to covert observation, when gathering online data to ensure that participants are aware of the research nature of the SNS.⁴⁴ For anonymity, where online users are quoted, names are either not used, or pseudonyms applied to protect the privacy and online presence of the participants and to meet the requirement for ethical conduct of research.

A small number of posts were initiated on the Facebook page to create discussion in areas that had previously not been discussed, and to moderate responses when commentary became aggressive or argumentative (Appendix 1). A reminder to respect other people's beliefs was posted on several occasions. The research-specific Facebook page was opened to the public in January 2021 and achieved 13,569 'learn more' clicks. During only 1 month of data collection, the SNS received 2556 posts, and 1332 people engaged with the page between 3 and 30 August 2021. Whilst all paid posts ceased at this time, the page continued to receive views, likes and comments until it was closed in December 2021. This method of recruitment and data collection proved to be an ideal choice, particularly during a global pandemic, when face-to-face contact was not only difficult but inappropriate given the risk of infection.

Analysis

Netnography can take various forms and adopt differing analytical and interpretive methods

whilst analysis can be manual, or computer-assisted qualitative data analysis (CAQDAS) or a combination of both. Thematic analysis was chosen for this study using both manual and computer-assisted methods. Data were obtained from the SNS to gain a deep understanding of relevant contemporary issues and influences following the guidelines of Braun and Clarke.⁴⁸ Data were extracted from the SNS by taking screenshots of posts and subsequently transcribing data into a word document which was collated and uploaded to NVivo. Data scrapers exist which can aid this process.³⁶ However, a more manual approach was chosen to get close to the large amount of data collected. Data were read and reread by the primary author, collated by hand and then uploaded to NVivo to organize codes and themes.⁴⁹ By following the guidelines of Kozinets,⁴⁴ 21 initial codes were produced, which were subsequently subsumed into themes and sub-themes. Initial analyses were performed by the primary author (SS). Investigator triangulation took place between the primary author and all other authors (AD, NS and LL).

Results

Participants in this study were from predominantly within Australia with an even spread across all states. Additionally, a small number of international participants largely from America also contributed to discussions. Three major themes emerged from the data which included the following: (1) vaccine safety concerns, (2) emotional debate and (3) COVID-19 issues. The themes and sub-themes are listed in Table 1.

Vaccine safety concerns

Vaccine safety concerns were a regular and emotive feature in online interactions. This theme included three sub-themes as depicted in Table 1. Discussion threads included commentary about the 'toxic and poisonous' nature of many vaccines and emotive terms such as 'toxic vaccines' and the intentional inclusion of neurotoxins in vaccines. The importance of 'doing no harm' was also raised on several occasions ($n = 15$), as was the use of dramatic and often inaccurate memes. [A meme is an image, video or piece of text, typically humorous in nature i.e. copied and spread rapidly (viral) by the internet user.] One participant referred to immunization and vaccines, as

Table 1. Themes and sub-themes.

Major themes	Vaccine safety concerns	Emotional debate	COVID-19 issues
Minor themes	Vaccines are unsafe	Fear, anxiety, aggression and deviance	Big Pharma
	Vaccines are unnecessary	Pro-vax commentary	COVID-19 commentary
	Pregnancy concerns		Mandated vaccination

‘Crimes against humanity’. Whilst another stated, ‘Nobody should put this toxic garbage into their child, why does the body need poison?’ and ‘. . .the original vaccines had both mercury and aluminum. . .Why vitamin K at birth? Why Hep B jabs for babies in oz? hmmm. . .?’.

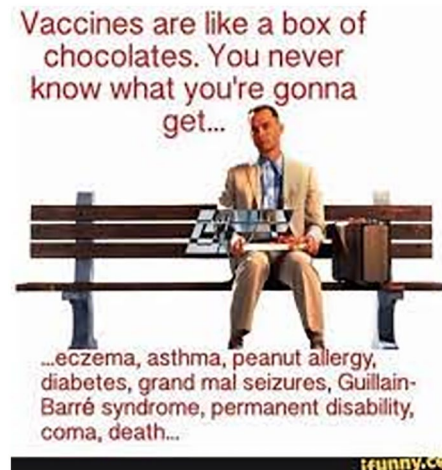
One particularly emotional post referred to the stress placed upon a parent when deciding whether to immunize a second child after a previous severe reaction. A meme was also used describing vaccines as a box of chocolates with the inference that you can never know what you are going to get (Figure 1).

I was SUPER pro vaccine, and it certainly shook my confidence when the youngest was due for the same shots. (After a previous reaction) I was told to delay by my doctor and people still told me that they would ‘rather my child was dead’ than have a reaction. People are jerks. Just don’t comment on these issues. You can’t imagine how stressful this is for some families.

Another participant expressed concerns about the long-term safety effects of immunization ‘. . . *vax ingredients are basically poisons, as one child may be immediately affected, the other may take years to have a problem surface (possibly cancers?) Very important to be aware what ingredients are in the vaccines and their side effects, both short and long term*’.

Whilst some participants were concerned about the safety of vaccines, others were of the belief that vaccines were unnecessary. One conversation thread used a conspiracy theory to discredit both Bill Gates and the importance of immunization:

The only people who lack immunity are immune deficient and their numbers are so low as to be

**Figure 1.** Box of chocolates meme.

insignificant on a global scale. This will be known as the biggest scam perpetrated on the human race since the ‘Spanish Flu’, which originated in America on a military base from a vaccine derived from horses by Bill Gates grandfather.

This participant linked both COVID-19 and the Spanish Flu to Bill Gates and his family. This thread also linked the Rothschild conglomerate, an investment banking organization, the head of the World Economic Forum and Bill Gates, the co-founder of Microsoft, a link which may or may not exist but was posted to create doubt in the credibility of immunization.

Similarly, another post with considerable misinformation stated ‘*Why would I inject my kid 70 plus times with products made by corporations that are constantly being sued for lying and killing people. . .AND aren’t liable. I had 24 shots. Mitochondrial disease, a hundred shoulder shrugs from a hundred Drs, constantly. . .*’. This post was accompanied by the meme displayed in Figure 2.



Figure 2. Seventy vaccines.

This participant claimed, inaccurately, that children would receive 70 vaccines during their first few years. Children in Australia are immunized against 17 vaccine-preventable diseases.⁵⁰ Combined with incorrect information and inaccurate memes, participants also used conspiracy theories to argue against the necessity for childhood vaccines. Whilst some participants ($n = 12$) considered that immunizing children against 17 vaccine-preventable diseases was excessive, they also argued inaccurately that some of the diseases were rare and side effects were both common and potentially fatal.⁵¹

Pregnancy was an important focus of this research. Not unexpectedly, the page received negative commentary about the perceived side effects of immunization in pregnancy which ranged from long-term health complications to miscarriage. Some participants ($n = 11$) focussed on the lack of safety testing of the COVID-19 vaccine in pregnancy whilst others were concerned about the risk of miscarriage. For example, one participant stated *'Don't get jabbed when pregnant. No data please keep them safe'*. The arguments also followed the 'my body – my choice' argument whilst others had generally anti-government sentiments:

The answer is no it's my body my choice. Just for the record I'm not an anti vaxer in the last three month's I have had the flu shot & whooping cough vaccine as I have a baby on the way.

This argument infers that immunization is mandatory in Australia, which is inaccurate.⁵² The posts demonstrate fear and anxiety associated with immunizing against COVID-19 in pregnancy. One participant stated that she had rejected the COVID-19 vaccine, whilst another cited instances of multiple miscarriages attributable to the COVID-19 vaccine with no evidence. Other posts ($n = 36$) focussed on personal rights, the boycotting of companies who mandate vaccines for their employees, the unsafe and experimental nature of the vaccines and the risk of miscarriage. In addition, pregnancy vaccine refusers were influenced by conspiracy theories, and experienced a lack of trust in the vaccines, and were often angry and fearful of potential damage to the unborn child with little concern expressed about the potential effects of acquiring disease in pregnancy. The emotive nature of these posts suggests a high degree of anxiety surrounding immunization in pregnancy and a real need for education and reassurance antenatally. This could be achieved by providing accurate and timely education in the early antenatal period, ideally before pregnant women look elsewhere, such as social media, for information on antenatal and childhood vaccines.

The emotional debate

This theme included two sub-themes: fear and aggression and the pro-vax commentary. The SNS contained an unexpected amount of emotive, aggressive and argumentative discussion threads. Whilst some of these were focussed discussions on Human Rights and the absence of an Australian injury compensation scheme ($n = 19$), most were simple pro-vaccination *versus* anti-vaccination rhetoric. However, a common thread amongst all discussions was fear, anxiety and aggression. Two sub-themes were identified in the emotional debate: (1) fear, anxiety, aggression and (2) the pro-vax community.

Fear anxiety and aggression

Posts compared the health of vaccinated and unvaccinated people. Contributors posted links to sites including 'Childrens health defence' (sic)

which featured a pilot study comparing the health of vaccinated *versus* unvaccinated children. This site was founded by Robert F. Kennedy Jr., a well-known environmental lawyer, activist and anti-vaccination advocate, whose internet site is a popular source of anti-vaccination information and conspiracy theories. Similarly, an article entitled 'Relative incidence of office visits and cumulative rates of billed diagnosis along the axis of vaccination' was cited as reliable proof that unvaccinated children were healthier than vaccinated children. This article was retracted, the author deregistered and his work was featured on Retraction Watch, a website dedicated to reporting retracted scientific papers.^{53–57}

Some participants ($n = 27$) demonstrated fear and anxiety when expressing their beliefs, whilst others used humour and aggression to make their point. One prolific contributor spent his online time on the attack, mocking the beliefs and anxieties of the anti-vaccination contributors. The posts referred to issues such as fear of 5G, aliens and contrails among other concerns of vaccine-hesitant contributors:

Don't shirk from a little scrutiny of your beliefs. I'm just engaging in some armchair psychotherapy. I find it fascinating that someone who claims to have been a health professional for 30+ years can apparently believe such nonsense. OK given your conspiratorial beliefs around vaccines, chemtrails and 5G (have I missed any?) do you think there is a link between them? Are they separate conspiracies or all part of one evil plan? Who do you think is behind this? The illuminati? Bill Gates? Agenda 20 – something? The Rothschilds are popular.

Participants used generalizations and assumptions to humiliate vaccine-hesitant participants and to garner the support of other pro-vaccine participants on this SNS. The effect of this commentary was to alienate and ostracize the vaccine-hesitant participants. One participant asked if any pro-vaccination advocates had looked at anti-vaccination information, a reasonable request, which received a lengthy reply, further mocking their beliefs:

. . .no, because (and here's the difference between normal people and anti-vaxxers) I don't think I'm a world-renowned expert on vaccines.



Figure 3. Vaccines work.

I also don't research how the pilot flies a plane, the coding that operates my electronics or how to build a space shuttle.

There was no sensitivity displayed to the feelings of others on either SNS. From observation, it became evident that social norms were ignored in the online environment with no apparent rules of etiquette or consideration of social mores. This resulted in administrator post moderation on several occasions. According to Schmidt,⁵⁸ the internet is the largest experiment in anarchy in human history.

Pro-vaccination commentary

Comments from the pro-vaccine majority were also highly emotive with some using memes to explain the effect of immunization over the last 200 years, including the elimination of smallpox and other diseases (Figure 3).

Whilst others used their experiences in the health-care industry to describe the side effects of vaccine-preventable diseases acquired in pregnancy:

I don't need experts to tell me either side of the story, as I lived through the epidemics of the pre-vaccine days and nursed children damaged by them in the 50s and 60s. By the time I retired in 2014, I had not seen a child damaged by them for many years. . .

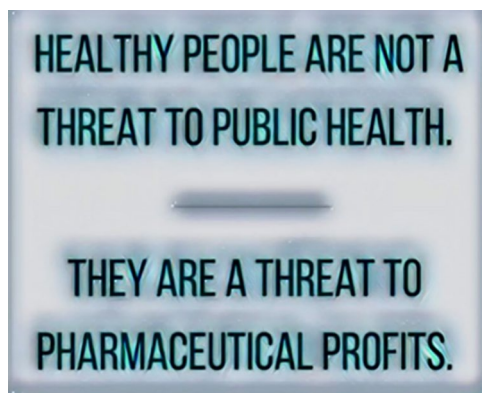


Figure 4. Pharmaceutical profits.

COVID-19 issues

This theme included three sub-themes: Big Pharma, COVID-19 commentary and mandated vaccination. Despite the Facebook page having a clear focus on pregnancy and parenting research, some participants ($n=54$) focussed their commentary on COVID-19-specific issues. This was not unexpected given the presence of the COVID-19 pandemic and the effect it has had on the lives of everyone living through it. Additionally, the COVID-19 vaccine was included in the vaccine recommendations for pregnant women in June 2021.⁵⁹ Two sub-themes were identified: Big Pharma and COVID-19, and mandated vaccines.

Big Pharma and COVID-19

The pharmaceutical industry (often referred to as Big Pharma) was criticized by some participants in this phase of the study (Figure 4). One participant stated '*Depends which science you are talking about. There is Big Pharma science and then there is the truth*'. Whilst another participant commented on the huge profit margins posted by companies such as Pfizer. In addition to the extreme distrust expressed in the pharmaceutical industry, a similar distrust was expressed in both science and scientists with a flow-on effect on healthcare professionals. Posts and memes that cast doubt on the integrity of the pharmaceutical industry were most prevalent in discussions about COVID-19 vaccines, including the speed of their development.

Conspiracy theories regarding COVID-19 were evident across social media commentary. One participant who attracted significant negative

attention claimed that COVID-19 did not exist. This participant stated, '*There is no COVID*', resulting in a string of vitriolic replies:

If you are a COVID denying, inoculation dodging carrier then your actions and tin foil hat life do affect mine! You selfish git! The constitution protects me via public health order from selfish fools like you! I have the right to know when I'm likely to be exposed to a communicable disease and who the carriers are!

Other responses claimed that the COVID-19 vaccines were an experimental computer-generated model and a plot to depopulate the world, '*Go and do your research this ONE IS NOT A VACCINE, ITS A POISON, their EVIL AGENDA is to DEPOPULATE our world with this poison*'.

Both these participants used capitalization to express their anger and frustration about the unsafe nature of COVID-19 vaccines. There was evidence of extreme emotions related to the COVID-19 vaccines, including anger, aggression, anxiety and fear. Participants referred to the pro-vaccine majority as the 'uneducated believers', the 'source of the problem' and vaccines as 'ineffective and dangerous'.

Participants expressed anger and distrust as well as the incorrect belief in a conspiracy theory that the COVID-19 vaccines which use mRNA (messenger Ribonucleic Acid) technology can reprogram DNA. The mRNA technology uses messenger RNA to produce an immune response and cannot change DNA.⁶⁰ One participant used humour to express their opinion of the risk associated with acquiring COVID-19. The meme depicted popular South Park cartoon characters Stan and Randy and suggests, inaccurately, that COVID-19 is a minor illness with a very low death rate (Figure 5).

Mandated vaccines

The primary author posted several questions including '*How do you feel about COVID-19 vaccines being a condition of employment in some workplaces?*' The responses from participants suggested that the employer-initiated mandates were a threat to human rights with financial implications due to refusing vaccination. The following response drew a link between choosing immunization or poverty, '*A violation of human rights*.



Figure 5. 'It's over Stan'.

Submit to medical treatment or live-in poverty. The vaccine is still experimental'.

The Nuremberg code was mentioned on several occasions and by several participants with a meme used to further demonstrate the point. The Nuremberg Code is a set of research ethics with a focus on the practise of human experimentation. Whilst this code has not been officially accepted as law by any country, it is a guide for practice.⁶¹ However, the argument that COVID-19 immunization is human experimentation is flawed, given that vaccines are not mandated in Australia. However, whilst some companies are legally able to require COVID-19 immunization of their frontline staff, including the Aged Care workers, others have elected to require COVID-19 immunization to protect their staff and customers.^{52,61} These posts were highly emotive and generated a large volume of comments. One participant concisely expressed the majority position on COVID-19 vaccines by stating – *'most people who are COVID vaccine hesitant are okay with other vaccines because they have gone through their required ten years of clinical trial testing, we have massive amounts of data on them, and they don't use spike proteins'*. Whilst some participants ($n=16$) were in favour of COVID-19 immunization being a workplace requirement, other participants ($n=5$) argued against the legalities of these mandates.

There was a significant animosity evident in commentary responding to questions about both COVID-19 vaccines and Australian companies such as Qantas, Alliance Airlines and SPC, who included an immunization mandate as a condition of employment.⁶² Some ($n=19$) called for boycotts of these companies whilst others claimed that this was both illegal and a breach of constitutional law. One participant stated, *'F*** the Freemasons poison'*. This comment alludes to

a conspiracy theory that the COVID-19 pandemic was invented by the Freemasons as a method of global depopulation. (The Freemasons are a fraternal organization that has existed since the 13th century with both social and philanthropic teachings.⁶³)

Discussion

This research has demonstrated the presence of both strong anti-vaccination and pro-vaccination sentiments on the SNS. Posters with anti-vaccination beliefs used predominantly inaccurate and highly emotive discourses and memes. Conspiracy theories and an 'infodemic' of misinformation posted online focussed on the unsafe nature of vaccines.^{23,24} This was often presented in a highly credible way, to instil fear and doubt in the vaccine hesitant. Similarly, misinformation was evident in discussion threads which suggested incompetence in the pharmaceutical industry in general and in the safety of pregnancy and COVID-19 vaccines in particular.^{5,35,64,65} The information and emotions posted on this page were similar to those presented in other contemporary studies.^{9-11,23,24,66,67}

Pregnancy is an emotional time and a time of high information needs. It is also a time when vaccine decision-making begins.³ Previous research drew a link between unmet information, the breakdown of therapeutic relationships and the use of social media for immunization information.^{34,35} This is despite these forms of information seeking existing simultaneously and evidence to suggest that parents will look for information online despite receiving information from a healthcare professional.⁴⁰ Trust in an information source and the desire to make the best possible decision as a parent has been shown to drive information seeking practices.⁴⁰ Through enhancing trust in the information provided by healthcare professionals in the context of effective therapeutic relationships, it may be possible to mitigate the effects of social media-acquired misinformation in vaccine decision-making.

This research has demonstrated that conspiracy theories and other misinformation proliferated on this purpose-designed SNS, which were highly credible, often emotive and inaccurate. Whilst there is currently no empirical link between social media participation and vaccine decision-making,

the data obtained in this study have demonstrated the degree of misinformation users are exposed to even on a research-created SNS.^{9,10,23,24,28,67,68} This is despite limitations placed on the social media platform, Facebook, during the COVID-19 pandemic. Participants who sought information on SNS were exposed to misinformation, cyberbullying and overt aggression which could impact the decision-making of a hesitant parent.^{23,67} These findings conflict with a recent study that found no direct association between social media use and an individual's perception of risk regarding vaccination or the intention to be immunized against COVID-19. However, these findings confirmed the results of other studies which found that after consuming immunization misinformation for as little as 5 min, an individual's perception of risk increases.^{28,69,70}

Whilst current literature suggests that the internet and social media are information sources used in parallel to healthcare provider advice and do not necessarily replace professional advice.⁷¹ Despite this, healthcare professionals must be aware of the critical time for providing accurate immunization information. This information should be provided when information seeking is at its peak, which is in early pregnancy and the first week of parenthood.^{3,35,72} Contemporary research has demonstrated that parents who gain information from healthcare professionals are substantially less likely to refuse or delay immunization.⁷³

There were significant advantages to the use of netnography as a methodology. SNSs provide the opportunity for information seeking and sharing as well as an opportunity to participate or simply observe. This methodology had the advantage of providing a platform for parents with both pro and anti-vaccination sentiments to share and seek information in an environment that was familiar and safe, thereby producing data from differing perspectives. This research has also demonstrated that it is possible to capture information from vaccine-hesitant parents in an online environment; however, whilst parents were our source populations, there could be no guarantee that all participants were parents. A further advantage of this methodology is that data can be collected from a broad geographical area. In this research, data were collected from across Australia as well as internationally; however, due to privacy constraints, we were unable to provide evidence of

the participant's location. This study has improved the awareness of the potential influence of social media on vaccine decision-making whilst using a naturalistic approach.

A limitation of this study was the timing of data collection, which took place during a global pandemic. The online environment was artificially created because of the forced closure of SNSs with anti-vaccination sentiments during the pandemic. This may have resulted in the participation of more highly vaccine-hesitant parents. Additionally, whilst inclusion/exclusion criteria were developed due to the nature of online research, there could be no guarantee that all participants were vaccine-hesitant parents, and this is a limitation of this research.

A further limitation to this research was the use of only one social media platform (Facebook) for data collection which may have limited the geographical reach of this study. The use of social media has other limitations, for example, Facebook tends to under-represent people of colour and those with lower educational attainment as well as those of low household income.⁷⁴ However, because there are more female Facebook users, it is possible that this platform may have been more suited to this population of pregnant women and parents.⁷⁵ This is despite evidence to suggest that there may be some limitations to capturing the thoughts of young parents and measuring general population constructs.⁷⁵ Additionally, it is possible that the withholding of participant location, whilst done to protect participant anonymity, may have acted as a further limitation to this study as it has inadvertently narrowed the geographical focus of this research. Despite the popularity of social media, conducting research in this space is still subject to ethical approval and privacy. Consent is an important aspect in any research and participants on SNSs may be unaware that data are being collected, hence unable to make a conscious choice to participate in a study or give informed consent.⁴⁷

There are practical, theoretical and social implications for the use of netnography as a methodology and social media as a recruiting source.⁴⁵ On a practical level, this method proved to be cost-effective and resulted in a high level of engagement by participants. There are also demonstrated business, economic and commercial implications

associated with netnography due to the popularity of social media and the ease of recruitment across a broad geographical area. Netnography is increasing in popularity by making research economically viable and is now an established inductive methodology.^{76,77} With social media use increasing globally, the ease of access to large populations for recruitment and research is apparent.⁴⁵

This study bridges the gap between theory and practice by adopting this relatively new methodology and applying it to the study of vaccine hesitancy which is viewed as a significant threat to public health.¹ The findings of this study have the potential to inform public policy through the demonstrated need for enhanced healthcare provider education and communication strategies to better communicate with vaccine-hesitant parents. Additionally, this study adds to the body of knowledge on the influence of social media on vaccine decision-making by parents. It has highlighted the need for a timely approach to communicating with vaccine-hesitant parents by educated and informed healthcare professionals who can provide accurate information, knowing that misinformation is readily accessible on social media.

Conclusion

This study provided a platform for parents with both pro- and anti-vaccination beliefs, to share their thoughts, express their concerns and respond to discussion threads. This study demonstrated that social media can provide an ‘infodemic’ of misinformation which may influence the decision-making of vaccine hesitant parents. An unexpected aspect of this research was the degree of aggression and vitriol that vaccine-hesitant parents were exposed to on the Facebook page, which had the potential to cause fear and anxiety in the undecided. The state of the SNSs during the global pandemic, whilst not a reflection of the internet under non-pandemic conditions, provided a somewhat modified example of what parents are likely to encounter when information seeking in an online environment.²⁶ This study has shown that there is a need for timely and sensitive provision of immunization information in pregnancy and early parenting to limit the need for online information searching. Additionally, educators in the tertiary space must improve immunization education to healthcare professionals, to ensure that they are adequately prepared to provide this education. By

understanding the ease of access to misinformation, its effect on decision-making and being motivated to respond in an appropriate manner, healthcare providers will be better placed to respond to the information-seeking needs of parents and pregnant women in a timely manner.

Declarations

Ethics approval and consent to participate

Ethics approval was provided by Flinders University Human Research Ethics Committee No. 2464. Written consent could not be obtained from participants due to the online nature of this research. A purpose-designed medical research social media page was established and data were obtained from participants on that page. No identifying features are included to protect the participant’s confidentiality. Participants were regularly reminded of the purpose of the research page. The need for signed informed consent was not a requirement of the Ethics committee.

Consent for publication

All participants were aware that the data were collected for research. No images or personal identification of data are included in this paper.

Author contributions

Susan E. Smith: Conceptualization; Data curation; Formal analysis; Methodology; Project administration; Software; Writing – original draft; Writing – review & editing.

Nina Sivertsen: Writing – review & editing.

Lauren Lines: Writing – review & editing.

Anita De Bellis: Supervision; Writing – review & editing.

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Competing interests

The authors declare that there is no conflict of interest.

Availability of data materials

These data will be made available on reasonable request.

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Appendix 1

Example of Facebook posts

13 December 2020, 08:43 Hello and welcome to this page. The purpose of this page is to promote my research study and to act a conduit between researchers, supporters and study participants. This is a safe space where differing opinions will be valued, and the research is the focus.

13 December 2020, 09:00 This research study now has Ethics Approval from Flinders University HREC.

14 December 2020, 09:07 Good morning, you are invited to like and follow this page. For those of you who don't know, I am doing a PhD at Flinders University and this Meta (Facebook) page will be part of that journey. I will send irregular updates on the progress of my study and will not fill your pages full of 'stuff'. I am not quite ready to promote my survey, but when I am you will be asked to kindly share it with your own Meta (Facebook) family. I really appreciate your support by simply sharing my page and eventually my survey. Thank you for your support and Merry Christmas and happy New Year.

29 January 2021, 09:44 Good morning, I want to say to anyone who has concerns about participating in this study that the researchers will not

attempt to influence your decisions on immunisation and will respect your right to decide. This is purely a research project into the decision-making process and the influences upon it. Whether you have elected to refuse vaccines or receive only specific vaccines or accept the entire schedule is your choice and will be respected. This is NOT a means of vaccine promotion.

11/02/2021, 10:03 I appreciate the amount of interest this page is attracting but would prefer if we could respect each other's views without name calling. This is exactly why I am fascinated by this divisive topic.

26 March 2021, 13:54 With Easter and school holidays in a few days this page wants to wish everyone a safe and pleasant break. I am still hoping to hear your thoughts on vaccines and would value and respect your opinions. I am still available.

17 April 2021, 08:42 I will be ceasing my data collection at the end of June and would like to thank everyone who has completed my survey and taken part in an interview. I would also like to thank everyone who has posted thoughts and comments.

25 May 2021, 08:00 I have closed my survey after 135 completed. Thank you all so much for contributing to this important research. I would now like to know what concerns or threatens you about people who choose not to vaccinate?

17 August 2021, 15:12 With SPC and Alliance Airlines, amongst other Australian companies requiring staff be immunised against COVID-19, can you share your thoughts on the topic?

1 August 2021, 08:42 Many are anxious about receiving a COVID vaccine. If this is you, has that changed your views on people who refuse other vaccines?

13 August 2021, 14:35 How do you feel about COVID-19 vaccines being a condition of employment in some workplaces?

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