Vaccine 37 (2019) 6486–6493

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Exploring parents' reasons for incomplete childhood immunisation in Indonesia

Agung Taufiqur Rokhman Syiroj [a,c,*], Jerico Franciscus Pardosi [b,c,d], Anita E. Heywood [c]

[a] National Population and Family Planning Board, East Java Province, Indonesia
[b] School of Public Health and Social Work, Faculty of Health, Queensland University of Technology, Brisbane, Australia
[c] School of Public Health and Community Medicine, Faculty of Medicine, University of New South Wales, Sydney, Australia
[d] National Institute of Health Research and Development, Ministry of Health, Jakarta, Indonesia

ARTICLE INFO

Article history:
Received 8 February 2019
Received in revised form 27 August 2019
Accepted 29 August 2019
Available online 12 September 2019

Keywords:
Vaccine hesitancy
Immunisation
Parental decision-making
Vaccination
Indonesia

ABSTRACT

Introduction: Immunisation is one of the most successful interventions for controlling infectious diseases but relies on continuous high coverage. Parental vaccine refusal and logistical barriers to access are threats to the success of immunisation programs, with resultant population immunity gaps leading to outbreaks of vaccine-preventable diseases. In Indonesia, coverage of childhood vaccines is suboptimal, with poor coverage of diphtheria-tetanus-pertussis vaccine leading to a large diphtheria outbreak in 2017.

Methods: To explore the underlying parents' reasons for incomplete childhood immunisation in Indonesia, semi-structured interviews were conducted in Tangerang Selatan, Banten Province, Indonesia. Sixteen purposively selected primary carers of partially and unimmunised children were interviewed. Transcripts were coded and analysed using inductive thematic analysis.

Results: Parental reasons were categorised into three interrelated themes of belief barriers, safety concerns, and issues of trust and misinformation. Stark differences were evident in reasons provided by carers of unimmunised children compared to partially immunised children. For parents of unimmunised children, Islamic beliefs, belief in the strength of natural immunity, and the use of alternative medicines strongly influenced behaviours. Safety concerns, issues of trust including distrust in the government, misinformation, and trust in information obtained through social networks were also prominent. In contrast, concerns about mild side-effects and logistical barriers outweighed beliefs among carers of partially immunised children.

Conclusions: Our findings highlight the complexities in decision making for parents who decide not to vaccinate their children. In the Indonesian context, public health education and engagement of religious leaders to bridge the gap between religious beliefs and vaccine acceptance are needed to address vaccine refusal. Future research on the influence of social networks on vaccine hesitancy in the Indonesian context is also warranted. For parents of partially vaccinated children, interventions should focus on barriers of access to community health staff to encourage timely schedule completion.

1. Introduction

Immunisation is recognised globally as one of the most successful and cost-effective interventions for the control of infectious diseases [1]. Each year, immunisation programs are estimated to prevent 2–3 million deaths in children under-five globally [1]. However, an estimated 19.5 million infants missed out on routine immunisation in 2017. Of infants who did not receive the third dose of Diphtheria-Tetanus-Pertussis (DTP3) vaccine in 2016, 60% lived in ten low-and middle-income countries (LMICs), including Indonesia [1]. While the Global Vaccine Action Plan (GVAP) recommends countries achieve and sustain 90% national DTP3 coverage by 2015, DTP3 coverage in Indonesia was 79% in 2016 with 1.7 million children remaining unvaccinated or partially vaccinated [2,3]. Sustained low childhood immunisation coverage increases the risk of outbreaks of vaccine preventable diseases in the population due to the resulting gaps in population immunity [4,5]. Recent outbreaks of measles in Europe and the USA and yellow fever in Angola and Brazil have been attributed to declining vaccination coverage associated with parental vaccine hesitancy [6–8].

* Corresponding author at: Kesemen 024/006, Desa Cangkringsari, Kec. Sukodono, Kab. Sidoarjo, Jawa Timur, Indonesia.
E-mail address: Agungtaufiqur@gmail.com (A.T.R. Syiroj).

https://doi.org/10.1016/j.vaccine.2019.08.081
0264-410X/

Maintaining high immunisation coverage is critical for maintaining herd immunity in the population and disease control gains are threatened if parents decide not to immunise their children.

Recent diphtheria outbreaks in Indonesia have resulted in substantial public health impact and raised questions regarding current and historical immunisation coverage and population immunity [3]. The Indonesian Ministry of Health's evaluation of the 2013 diphtheria outbreak suggested that the resurgence of diphtheria, which was previously eliminated by 1990, was an outcome of a decline in immunisation coverage and subsequent reduction in herd immunity [9–11]. The subsequent 2017 outbreak resulted in 954 confirmed cases and 44 deaths [3,12].

Globally, parental decisions not to vaccinate their children are influenced by several factors [10,13]. For vaccine refusing parents in high-income, Western countries, strong beliefs in the value of naturally acquired immunity (immunity acquired by exposure to the causative organism) [4,14] or beliefs that immunisation interrupts the natural development of the immune system [4] influence vaccine decision-making. These beliefs are supplemented by beliefs in the ability to develop a robust immune system through maintaining a healthy lifestyle such as through diet, natural therapies, and physical activity [4,15,16]. Social and religious factors also need to be considered when seeking to understand parental resistance to immunising their children [17,18]. Other factors include concern about vaccine side effects [17,19,20], vaccine safety [20,21], and distrust of either healthcare workers or the medical profession [4,15,16]. For some parents from non-Western countries, immunisation programs have also been perceived as a Western conspiracy for population control, including resulting in infertility [22,23].

Much of the global research on vaccine hesitancy has been conducted in Western countries with few studies focusing on the underlying parental vaccine decision-making in LMICs including Indonesia. Previously published studies in Indonesia focus on measurement of immunisation coverage [24], knowledge, perceptions and attitudes towards vaccination among healthcare workers [25–27], and factors associated with incomplete childhood immunisation [25,26] are limited to quantitative methodologies. To our knowledge, no qualitative studies explore vaccine hesitancy from the parents' perspective in Indonesia. This study, therefore, aimed to explore the underlying factors of why Indonesian parents choose not to immunise or partially immunise their children with the objective of informing the development of tailored strategies to improve immunisation coverage in Indonesia.

2. Methods

2.1. Study design

Semi-structured interviews were considered most appropriate for exploring parents' reasons for incomplete childhood immunisation and facilitating a participant-driven discussion. An interview guide was developed, using Harjaningrum, Kartasasmita [25] study in West Java, Indonesia as a guide for inclusion of key issues including participants' perception, knowledge, and attitudes towards immunisation; reasons for and decision-making related to not immunising (or fully immunising) their children; and consideration of risks and barriers relevant to the Indonesian context.

This study was conducted in two *Puskesmas* (community health centres) in Kota Tangerang Selatan, a city in Banten Province, Indonesia. Kota Tangerang Selatan has the highest number of reported cases of selected vaccine-preventable diseases (measles, polio, and hepatitis) in Banten Province [28,29]. *Puskesmas* Bhakti Jaya and Ciputat Timur were selected based on the research team's initial discussions with the local health officer of Tangerang Selatan City Health Office, who identified these *Puskesmas* as having the highest number of children registered who had not receive all vaccines on the National Immunisation Program (NIP) schedule between 2013 and 2018 compared to other *Puskesmas* in Banten.

2.2. Sampling and data collection

We used purposive sampling, with the assistance of district health staff using *Puskesmas* immunisation records to identify which districts the unimmunised or partially immunised children live, in accordance with the NIP. We then approached staff at the *Posyandu* (Integrated Health Post), a monthly or fortnightly village-level clinic for children and pregnant women, to identify individuals who met the inclusion criteria using *Posyandu* records. Eligible participants were primary carers aged 18 years or older of at least one child aged less than five years registered in the *Puskesmas* of Bhakti Jaya or Ciputat Timur who was not fully vaccinated according to their *Posyandu* record.

An invitation letter that consisted of a cover letter introducing the research topic, detailed information about the study and a response form were sent to the caregivers who met the inclusion criteria. A follow-up phone call was then made to invite their participation in the interview. Prior to the interview, participants were screened to confirm the eligibility through review of the following documents: identity card (to confirm carer's age), family card (child's age), and KIA (maternal and child health book from *Posyandu*) to confirm child's immunisation status.

Interviews were conducted from April to May 2018. The participants chose the interview locations, mostly conducted at their home. All interviews used the local language, Bahasa Indonesia, and were conducted by the first author (AS) who is Indonesian, trained in qualitative research methods and had prior knowledge of immunisation. Written consent was obtained prior to commencing the interview. On average, each interview lasted between 30 and 60 min.

2.3. Data analysis

Transcripts of recorded interviews and field notes taken by the interviewer were analysed. The transcripts were coded using inductive thematic analysis; that is, data were coded without any attempt to align them with *a priori* framework. The analysis process described by Braun and Clarke [30] was followed. The interviews were transcribed verbatim into Bahasa Indonesia and translated into English and reviewed by author JP to check translation accuracy. Pseudonyms were assigned to protect participants' identities. Interview transcripts were analysed independently by two research team members (AS and JP). First, each researcher read the transcript, generated initial codes and developed these into categories until no new categories could be identified. The transcripts were read word for word and the researcher made notes to label codes which were then classified into themes. Common categories were determined by consensus. Discrepancies in categories were discussed by research team with an adjudicator (AH) until consensus was reached [31]. Selected participant quotes illustrating the identified themes are presented in Appendix A.

2.4. Ethical considerations

Ethical approvals were obtained from the University of New South Wales (UNSW) Human Research Ethics Committee (HC180142) and the Health Research Ethics Committee, National Institute of Health Research and Development (HREC-NIHRD), Ministry of Health of Indonesia (LB.02.01/2/KE.130/2018).

3. Results

We sent 25 invitations and received 20 responses. Of those, two were ineligible, and two withdrew their participation. In total, 16 primary carers were interviewed: 11 mothers, two fathers, two grandmothers, and one interview with both parents. The participants included nine parents of unimmunised children and seven carers of partially immunised children. In the case of both parents, we interviewed them separately so that each informant could not intervene in the other's interview. Participants' characteristics are summarised in Table 1.

3.1. Beliefs as barriers to childhood immunisation

Key themes around beliefs impacting on immunisation decision-making included Islamic beliefs, belief in the benefits of naturally acquired immunity, and belief in the effectiveness of alternative medicines.

Most parents of unimmunised children had refused immunisation because of their Islamic beliefs. They were particularly concerned about their perceptions of vaccines as *haram* (something that is forbidden by Islamic law) and *mudharat* (anything harmful to human well-being). In relation to *haram*, they believed that vaccines contain pork products, and as Muslims are forbidden to eat pork by Islamic law, they refused all vaccines. Although they personally considered vaccines to be *haram*, this belief was reported to be reinforced by their religious leaders such as *ustadz* (an Islamic preacher) of particular Islamic organisations. Most participants also cited *mudharat* as a reason for vaccine refusal, believing vaccines were capable of destroying their children's "healthy cells" due to the presence of a harmful substance (pork) in addition to being *haram*.

Some participants attributed vaccine refusal on their beliefs in the benefits and sufficiency of natural immunity. Parents commonly considered every child to be born with innate immunity which protects them from diseases, thereby "artificial" vaccine-derived immunity was considered not necessary. Many used the example that their grandmothers were healthy without having been vaccinated to emphasise the lack of value placed on vaccination.

Most parents of unimmunised children perceived "unnatural" vaccine-derived immunity to be a denial of God's will. Paradoxically, they described other preventive actions such as providing healthy food and alternative remedies such as honey, dates and black cumin, as well as relying on exclusive breastfeeding to protect their infants from disease and the use of prescribed medication in the treatment of infections such as dengue fever, which they did not believe to be a denial of God's will.

The use of alternative medicines was connected with religious values. Several parents preferred these to modern pharmaceuticals because they wished to practise *sunnah* (the way of the prophet Muhammad). Imitating *sunnah* is believed to be a way of obtaining blessings from God. Parents of unimmunised children considered that they did not need to immunise their children because vaccines did not exist in the time of Muhammad, who consumed herbal medicines to remain healthy and protected from disease.

3.2. Concern about vaccine safety

All parents of unimmunised children believed that immunisation caused severe side effects, which included physical disabilities and autism. This perception was generated from information they obtained from a variety of sources, including books, social media, online articles, and their social networks such as their family, relatives, *ustadz*, and friends. This belief was also influenced by their belief that vaccines destroyed healthy cells and were *mudharat*. Parents were deeply convinced of these views if they or people they knew had experienced vaccine reactions following immunisation.

In contrast, most parents of partially immunised children described mild vaccine side effects namely fever, cold, and cough. They considered the perceived benefits of immunisation to outweigh these side effects. Nonetheless, despite their willingness to vaccinate, they were hesitant, and their children therefore remained partially immunised. These parents still vaccinated their children, albeit incompletely, either because their husband had suggested it or because they were more concerned about the potential consequences of not being immunised.

Table 1
Participant characteristics by immunisation status of their child (N = 16).

Characteristic	Partially immunised		Unimmunised		Total	
	n	%	n	%	n	%
Participant(s)						
Mother	4	57	7	78	11	69
Father	1	14	1	11	2	13
Grandmother	2	29	–	–	2	13
Both parents	–	–	1	11	1	6
Age (years)						
20–29	2	25	2	22	4	24
30–39	4	50	6	67	10	59
≥40	2	25	1	11	3	18
Highest education						
Elementary school	4	57	–	–	4	24
Junior or senior high school	2	29	4	40	6	35
University degree	1	14	6	60	7	41
Monthly income						
<Rp3,500,000	5	71	1	11	6	38
Rp3,500,000–Rp7,000,000	2	29	5	56	7	44
>Rp7,000,000	–	–	3	33	3	19
Number of children < 5 years old						
1	4	57	1	11	5	31
2	1	14	3	33	4	25
3	2	29	5	56	7	44

*Rp 3,500,000 = approximately US$260 (US$1 = Rp13.462).

3.3. Issues of trust and immunisation misinformation

In terms of the general political leaning of the selected participants, carers of partially immunised children supported the government's immunisation program, while carers of unimmunised children claimed distrust with the government. Several conspiracy theories were described such as immunisation as a government strategy to control population growth by causing infertility, and a conspiracy between the government of Indonesia and particular Western countries with extreme conspiracy theories including the aim of distributing vaccines that contain pork was intended to reduce the global Muslim population.

Parents refusing immunisation also did not trust the *halal* certification issued by MUI (*Majelis Ulama Indonesia*), the state-affiliated Islamic council representing both the state and Indonesian Muslim groups and considered the most legitimate source of guidance on religious rulings (*fatwa*). Although these participants explained their failure to immunise on the basis of Islamic faith, they did not trust MUI because, they argued, it is not a purely Islamic council since it is under the government's authority, with their distrust in the government considerably influencing this belief.

Most participants of unimmunised children obtained information on immunisation from their social networks including their family, religious leaders, and close friends particularly friends in the *pengajian* (a community forum for Islamic discussion) who were against immunisation. The information from their social networks were considered more trustworthy than the information given by local healthcare providers. They believed that healthcare providers hid the truth about the vaccine's ingredients and its side effects. Participants did not want to discuss immunisation with people, such as healthcare providers, they considered to have different opinions to their own.

Knowledge of immunisation was limited among most participants. While those who refused vaccination for their children held a variety of misconceptions about immunisation, parents of partially immunised children generally had limited knowledge on immunisation including beliefs that immunisation prevents any disease including non-infectious diseases. The parents of unimmunised children actively sought additional information by asking their social networks and searching on the internet. They were less likely to seek information from healthcare providers outside their social networks. As they received information, they tended to discuss it with people in their social networks, regardless of whether they had any expertisein immunisation. In contrast, the carers of partially immunised children, who were from mostly low-middle income families, relied heavily on the limited information provided by *Posyandu* staff.

Fig. 1 presents the complex emergent themes related to beliefs including the interrelated themes of beliefs barriers, safety concern, and issues of trust and misinformation. Themes related to logistics barriers described by parents of partially immunised children are described below.

3.4. Logistical barriers

Most carers of partially immunised children cited not having time to bring their children to immunisation services due to inflexibility of their work arrangements. Additionally, children missed scheduled immunisations due to illness on the scheduled day or carers' self-described indifference. When the child had recovered from sickness, the parents forgot or were reluctant to complete the missed immunisation due to long queues at the *Posyandu*.

4. Discussion

Our findings present multi-faceted reasons for not immunising children which can be broadly categorised into interrelated themes

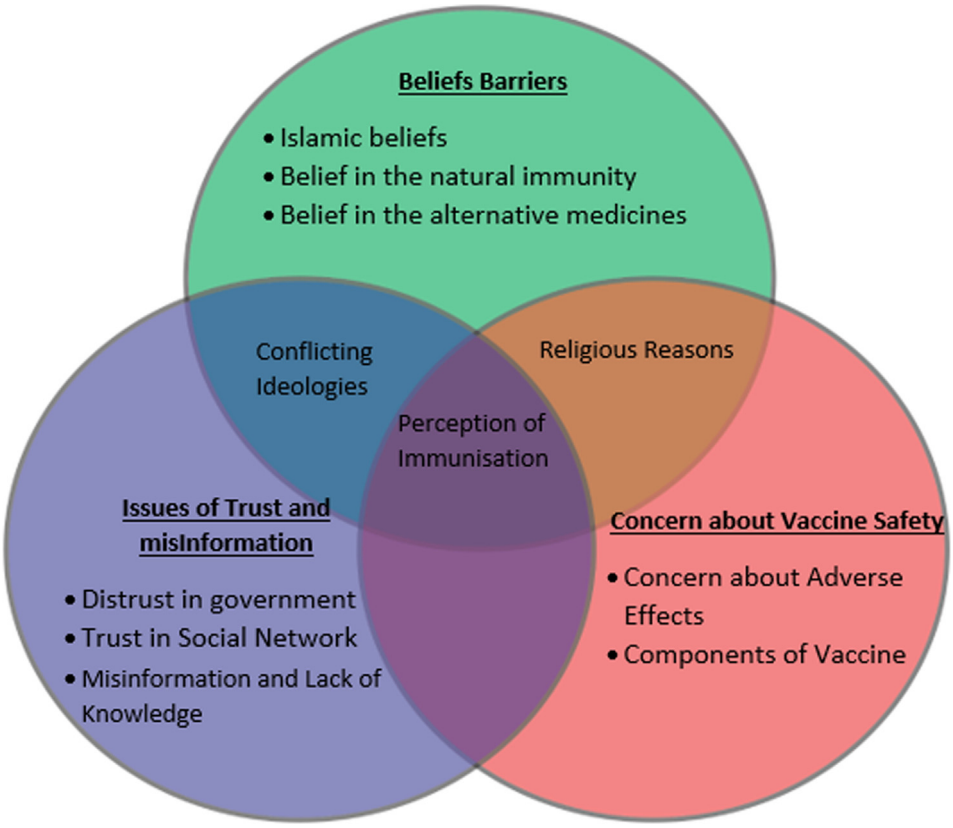

Fig. 1. The key interrelated themes emerging from the in-depth interviews.

of beliefs, safety concerns, and issues of trust and misinformation. These themes demonstrate the complexities of parental vaccine refusal and the connection between vaccine hesitancy and deeply held religious beliefs and ideologies in the Indonesian context. Table 2 summarises the different barriers to immunisation between parents with unimmunised children identified in our study and those with partially immunised children and provides recommendations to reducing these barriers.

Strong beliefs underlying vaccine refusal include religious beliefs, beliefs in natural immunity and alternative medicines, with Islamic values as an underlying theme. Participants' beliefs that vaccines are *haram* and *mudharat* and their interpretation of the Quran are a profoundly personal interpretation influenced by *ustadz*. "Muslim beliefs" cannot be summarised into one belief, but a range of views from individuals and particular Islamic organisations [16,32,33]. Religious beliefs were also evident as a reason for refusing not only vaccination but also other medicinal products derived from animals [34]. Some Muslims, Jews, Hindus, and Sikhs do not accept the use of animal-derived products except in an emergency setting, such as disease outbreaks and disaster events, when no other options are available. In these events, Muslims agree that a *halal* status is warranted [34].

In 2001, Islamic scholars and the World Health Organisation (WHO) agreed that conversion of animal-derived substances into gelatine is permitted for Muslims [35]. Despite this agreement, Muslims around the world remain sceptical of this *halal* declaration [23], and may consider vaccines that use animal-derived products in the manufacturing process as *haram*, irrespective of whether any trace amounts remain in the final product. In Indonesia, the MUI has encouraged Muslims to immunise their children through *Fatwa No. 4/2016* and *No.33/2018* (religious ruling) [36,37]. A study of vaccine provider perceptions in Yogyakarta, Indonesia considered MUI's halal label as a main consideration to parental acceptance of rotavirus vaccine [27], while vaccine-accepting parents may accept halal labels, our findings of vaccine refusing parents found that halal label did not impact on vaccine acceptance with priority given to local religious leaders' advice over the MUI postulations. Vaccine hesitancy is context-specific with religious leaders playing an important role in parental decision-making. As parents may rely on their *ustadz*'s discourse, our findings suggest an urgent need for public health authorities to educate local *ustadz* and their organisations on the importance of maintaining high immunisation coverage for routine vaccines on the national immunisation program and work with them to identify communication strategies that provide a balance between religious beliefs and vaccine acceptance in the community. We found that parents' corresponding ideologies between their religious beliefs and distrust in the government resulted in a distrust of the MUI, with their guidance disregarded. Therefore, engagement of local religious leaders is pivotal to build and maintain awareness of the value of immunisation programs in the community and their congruence with Islamic beliefs. The link between deeply held conspiracy theories related to Indonesian and Western governments was influential, a finding consistent with previous studies [4,21,25]. Lack of trust in government and authorities is a complex issue, not solely related to immunisation programs and requires a whole of government approach.

Parents' belief of the significance of natural immunity was an important barrier to immunisation including the perception of vaccines as unnecessary for maintaining human health. This overlooks the millions of lives saved through vaccination [1] and indicates a lack of knowledge or disregard for the impact of vaccines. This finding is pertinent to previous studies conducted in high-income countries, such as the US and Australia, in which harm to the immune system is also cited by vaccine hesitant and vaccine refusing parents [4,38–40]. In direct contrast to beliefs of sufficient innate immunity to prevent vaccine-preventable diseases, alternative medicines, organic food and herbal remedies are considered to strengthen their children's immunity thereby indicating that natural immunity is perceived to be insufficient to protect child's health. This paradox is commonly reported in other studies of parents' vaccine refusal [4,15,23] with a strong belief in alternative medicines negatively associated with vaccine acceptance [41–43]. All parents of unimmunised children in this study prioritised alternative medicines. Improving vaccination providers' capacity to communicate with hesitant parents is crucial to improving update of vaccines and providing parents with evidence-based information to support positive vaccine decision-making.

Safety concerns constituted a critical theme for declining vaccines for both vaccine refusing parents and those who had partially vaccinated their children. Safety concerns were particularly prominent among parents whose children or people they knew had experienced adverse post-vaccination events. Vaccine safety fears are a key reason globally for vaccine hesitancy and refusal [17,19,20]. Our study found that safety concerns are interrelated with religious beliefs that anything causing harm *(mudharat)* is *haram* among parents of unimmunised children, increasing the complexity of communicating the benefits versus harms of vaccination to parents. Conversely, carers of partially immunised children recognised that mild side effects commonly follow immunisation and viewed these as a normal process with trust in the local health staff influencing their acceptance. Studies show that these parents still relied on recommendations and information from healthcare workers despite experiencing anxiety related to the side-effects their children have [44]. This reliance, however, may not extend to their decision-making for subsequent vaccines on the schedule. Effective reminder systems (phone, mail, text messaging) should be employed by *Posyandu* staff to improve

Table 2
Barriers and recommendations for immunisation for parents of unimmunised and partially immunised children.

Parents of Partially Immunised Children	Parents of Unimmunised Children
Barrier: Lack of time to bring their children to immunisation services due to inflexibility of parents' work arrangements **Recommendation**: Increase clinic availability, including sessions outside of work hours. Provide catch-up opportunities in schools	**Barrier:** Perceptions of vaccines as haram and mudharat, with religious leaders playing an important role in parental decision-making **Recommendation:** Public health authorities to engage with local Ustadz and their organisations, to co-develop communication strategies that provide a balance between religious beliefs and vaccine acceptance in the community
Barrier: Delays due to illness on the scheduled immunisation day **Recommendation:** Active follow-up of incompletely immunised children by Posyandu staff and use of effective parental reminder systems. Provision of travel and/or food vouchers to vulnerable households to reduce the costs associated with attending immunisation appointments	**Barrier:** Belief in the benefits of natural immunity and the perception that vaccines are unnecessary for maintaining human health **Recommendation:** Improve immunisation providers' capacity to communicate with hesitant parents, to support positive vaccine decision-making
Barrier: Limited accurate immunisation information available to parents **Recommendation**: National or regional health promotion campaigns to improve understanding of the importance of vaccines in the Indonesian context, including engaging with Posyandu staff	**Barrier:** Limited accurate immunisation information available to parents **Recommendation:** National or regional health promotion campaigns to improve understanding of the importance of vaccines in the Indonesian context, including engaging with local religious leaders

schedule completion, with offering travel and/or food vouchers to vulnerable households to reduce the costs associated with obtaining vaccination also important in this setting [44].

Illness on the scheduled immunisation day was cited by parents of partially immunised children, a commonly cited as a barrier to completing childhood immunisation [45,46]. To improve access and increase coverage, follow-up of incompletely immunised children through active engagement from *Posyandu* staff is needed. The WHO also recommends such evidence-based intervention to address access issues [47]. In our study, carers of partially immunised children cited inflexible working hours as a barrier to attending scheduled immunisation sessions at their *Posyandu*. Expansion to out-of-hours clinic times, mobile clinics, parental recall and reminders and school-based delivery are effective methods for reducing barriers to access and improving childhood immunisation coverage [47].

It was evident that receipt of accurate information about immunisation was limited for all parents. Parents of partially immunised children had limited knowledge but were nonetheless aware of the importance of vaccination, consistent with similar studies in Bandung, Indonesia [25] and in Perth, Australia [48]. Future interventions should focus on increasing current national and regional health promotion campaigns to improve understanding of the importance of vaccines in the Indonesian context.

As with any qualitative study, our study limitations include the possibility that the views of our participants may differ from those of the general population. The views of hesitant parents who go on to vaccinate their children completely are not represented here. A complementary study of parents who chose to fully vaccinate their children would be of interest to explore the potentially contrasting religious and other reasons and how they justify their vaccination in a religious sense, including the identification of religious and other enablers to immunisation. While this study only included Islamic parents, which constitute 88% of the population of Indonesia [49], future research exploring views of parents of other religions and the engagement of religious leaders in the delivering discourse on immunisation within Indonesian context would complement our study. Although the findings may not be generalisable outside the Indonesian Islamic context, our study adds to the growing body of evidence of different perspectives and reasons for non-and under-immunisation among parents in Indonesia and can inform future intervention strategies particularly for Muslim communities.

5. Conclusion

Our findings highlight the complexity of parental decisions to not vaccinate their children. Interventions to encourage completion of the vaccination schedule for parents of partially vaccinated children should focus on barriers of access to community health staff. For parents of unimmunised children, engagement of religious leaders using active communication and collaborative efforts from the key stakeholders such as healthcare providers is urgently needed to bridge the gap between religious beliefs and vaccine acceptance. Future research of the influence of Indonesian parents' social networks of vaccine hesitancy and reducing barriers to access vaccination service are also warranted.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: We have no conflicts of interest to disclose related to this manuscript. Anita Heywood has received grant funding for investigator-driven research unrelated to this study from GlaxoSmithKline. Other authors have no conflicts to declare.

Acknowledgements

We thank the health officers of *Puskesmas Bhakti Jaya and Ciputat Timur and their Posyandu* staff for their support throughout data collection. We are also grateful for all informants involved in this study for sharing their stories and perceptions on immunisation.

Contributions

AS designed the study, prepared the materials, coordinated and monitored the research process, transcribed the interview transcripts, analysed the data, interpreted the results, drafted, and edited the paper. JP and AH analysed the data, interpreted the results and revised the manuscript. All authors read and approved the final manuscript. **All authors meet the ICMJE criteria for authorship.**

Financial support

This work was supported by Lembaga Pengelola Dana Pendidikan (LPDP), Indonesia Endowment Fund for Education (FR232018130388, 2018).

Appendix A. Summary of parents' reasons for not fully immunising their children

Themes	Sub-themes	Quotes
Islamic beliefs	Haram status of the vaccines	*I did not agree with the vaccine's ingredient, pork. Although they say it is medicine, the presence of pork is enough reason for me to refuse it. (Mother, 30 years old, unimmunised child).*
		I know that immunisation is beneficial and important. However, current condition makes vaccination is not good at all. It's due to ingredient of the vaccine which contains pork which is haram". (Mother, 25 years old, unimmunised child)
	Mudharat	*The haram food or medicine (vaccine) must bring negative side effects (mudharat). (Mother, 31 years old, unimmunised child).*
		The mudharat (in the vaccine) is huge. In Islam, something whose harmful

(*continued on next page*)

(*continued*)

Themes	Sub-themes	Quotes
		effects are bigger than its benefits are haram" *(Father, 31 years old, unimmunised child).*
Belief in natural immunity	Newborn babies already have innate immunity	*Immunisation is useless because newborn babies already have natural immunity. They (babies) do not need additional immunity liquid. It i's innate immunity that every baby has*". *(Mother, 30 years old, unimmunised child)*
	Disease is from God	*He [husband] said, "Just believe in Allah! You do not need immunisation. Diseases are from Allah (Mother, 24 years old, unimmunised child).*
Belief in alternative medicines		*I protect my children by giving them healthy food, honey, black cumin, and dates. These are my preventive measures. If they get an illness, it's from Allah (God) (Mother, 31 years old, unimmunised child).*
Concern about vaccine safety	Adverse effects	*Around 20 children were fatigued after getting DTP vaccination [at school]. It was the impact of vaccination. My husband's friends always remind him not to immunise due to their own experiences of negative impacts (Mother, 24 years old, unimmunised child).* *He suffered from fever, typhoid, etc [sic]. after getting that immunisation, he had a fever for several days. I was anxious and frightened. Then, I decided not to immunise (Mother, 41 years old, unimmunised child).*
	Poor experiences of previous immunisation	*It makes me traumatized. I am afraid that (the side effects) will happen to my children if I immunise them . . .. [but] I realise that immunisation is beneficial. I immunised my children, yet incompletely (Mother, 38 years old, partly immunised child).*
Issues of trust and information on immunisation	Distrust in the government	*Ya wallahu a'lam (Only God knows). We doubt what the government says. We always have big questions about the government's campaigns and recommendations (MU1) (father, 36 years old, unimmunised child).* *"I don't agree. I don't accept. MUI is under government. Everything under government is not merely for goodness sake. There is always a conflict of interest*" *(Father, 31 years old, unimmunised child).*
	Conspiracy	*[Basic immunisation] is Jew's [western countries'] program. They want to reduce population growth among Muslims, so the Muslim population will decrease (Father, 36 years old, unimmunised child).*
	Trust in social networks	*I learned from the ustadz that immunisation is haram. I do trust them. When he said no to immunisation, we (social networks in pengajian) followed. If one day he says that immunisation is good due to recent findings, I will follow (Father, 31 years old, unimmunised child)* *Ya, I trust people whom I know more. People who are close to us and expert in medicine are more reliable for me because they did not say with their mouths only. They also gave us dalil (proofs), verses of Quran and evidence in the hadith (Prophet's sayings) (Father, 31 years old, unimmunised child).*
Misinformation and lack of knowledge		*To me, childhood immunisation is so dangerous. Just imagine that new healthy born baby is then given virus or bacteria. Generally speaking, it is like the body is stimulated to be vulnerable to get the diseases (Mother, 30 years old, unimmunised child).* *I just think from my child's reaction. Look, my child was healthy before getting shot. However, he got fever after immunisation. I can conclude from that if immunisation is a toxin. Look, how the body responds the vaccine. It is negative (Father, 31 years old, unimmunised child).*
Logistics barriers	Lack of time	*I immunised my child three times. Then, I could not bring him again because I had to work. It made me forget (that my child has not been immunised yet). And I never go to posyandu because I work. I know that immunisation is important. However, I cannot leave my work as well (Mother, 38 years old, Partially immunised child)*
	Children's illness or parents' indifference	*I know that immunisation is critical for child, however, in the Posyandu time, he was sick. Posyandu staff often reminded me to go to Posyandu, but Adit was sick. What for? If I go, the midwife will not immunise as well. then, I just forgot it (Grandmother, 56 years old, Partially immunised child).*
	Long waiting times	*I am also lazy to go to posyandu because it must be long queue there. When neighbours invited me to go to Posyandu, I said' "Yes, just go! I'll go later". But, I didn't go". (Mother, 30 years old, Partially immunised child).*

References

[1] WHO. Immunization Coverage; 2018. Available from: http://www.who.int/mediacentre/factsheets/fs378/en/. Accessed in 4 February 2018.
[2] WHO and UNICEF. WHO-UNICEF estimates of DTP3 coverage. World Health Organization and UNICEF; 2017. Available from http://apps.who.int/immunization_monitoring/globalsummary/timeseries/tswucoveragedtp3.html. Accessed in 5 June 2018.
[3] Ministry of Health. Pemerintah Optimis KLB Difteri Bisa Teratasi: The Government of Indonesia is optimist to eliminate the diphtheria outbreak. Ministry of Health; 2018. Available from: http://www.depkes.go.id/article/view/18011500004/pemerintah-optimis-klb-difteri-bisa-teratasi.html. Accessed in 15 February 2018.
[4] Gross K, Hartmann K, Zemp E, Merten S. 'I know it has worked for millions of years': the role of the 'natural' in parental reasoning against child immunization in a qualitative study in Switzerland. BMC Public Health 2015;15(1):373.
[5] Siddiqui M, Salmon DA, Omer SB. Epidemiology of vaccine hesitancy in the United States. Human Vacc Immunotherap 2013;9(12):2643–8.
[6] ecdc. Measles outbreaks still ongoing in 2018 and fatalities reported from four countries. European Centre for Disease Prevention and Control; 2018. Available from: https://ecdc.europa.eu/en/news-events/measles-outbreaks-still-ongoing-2018-and-fatalities-reported-four-countries. Accessed in 3 March 2018.
[7] CDC. Measles cases and outbreaks; 2018. Available from: https://www.cdc.gov/measles/cases-outbreaks.html. Accessed in 25 February 2018.
[8] Gangarosa EJ, Galazka AM, Wolfe CR, Phillips LM, Miller E, Chen RT, et al. Impact of anti-vaccine movements on pertussis control: the untold story. Lancet 1998;351(9099):356–61.
[9] Ministry of Health. Ini Makna KLB Difteri; this is the meaning of diphtheria outbreak. 2017. Available from: http://www.depkes.go.id/article/view/17121200001/ini-makna-klb-difteri.html. Accessed in 18 February 2018.
[10] Rainey JJ, Watkins M, Ryman TK, Sandhu P, Bo A, Banerjee K. Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: findings from a systematic review of the published literature, 1999–2009. Vaccine 2011;29(46):8215–21.
[11] Husada D, Puspitasari D, Kartina L, Setiono P, Moedjito I, Kartika B. Six-year surveillance of diphtheria outbreak in Indonesia. Open Forum Infect Dis 2017;4(Suppl 1):S244-S.
[12] Ministry of Health. Imunisasi Efektif Cegah Difteri; Immunisation is effective to prevent diphtheria. 2017. Available from: http://www.depkes.go.id/article/view/17120500001/-imunisasi-efektif-cegah-difteri.html. Accessed in 18 February 2018.
[13] Falagas ME, Zarkadoulia E. Factors associated with suboptimal compliance to vaccinations in children in developed countries: a systematic review. Curr Med Res Opin 2008;24(6):1719–41.
[14] Byström E, Lindstrand A, Likhite N, Butler R, Emmelin M. Parental attitudes and decision-making regarding MMR vaccination in an anthroposophic community in Sweden – a qualitative study. Vaccine 2014;32(50):6752–7.
[15] Harmsen IA, Mollema L, Ruiter RA, Paulussen TG, de Melker HE, Kok G. Why parents refuse childhood vaccination: a qualitative study using online focus groups. BMC Public Health 2013;13(1):1183.
[16] Ministry of Health. Riset Kesehatan Dasar (RISKESDAS) 2013; Basic Health Survey. Jakarta: Ministry of Health; 2013. Available from http://www.depkes.go.id/resources/download/general/Hasil%20Riskesdas%202013.pdf. Accessed in 16 February 2018.
[17] Paterson P, Chantler T, Larson HJ. Reasons for non-vaccination: parental vaccine hesitancy and the childhood influenza vaccination school pilot programme in England. Vaccine 2017;36(36):5397–401.
[18] Leach M, Fairhead J. Understandings of immunization: some west African perspectives. Bull World Health Organ 2008;86(6):418.
[19] Kennedy A, Basket M, Sheedy K. Vaccine attitudes, concerns, and information sources reported by parents of young children: results from the 2009 HealthStyles survey. Pediatrics 2011;127(Supplement 1):S92–9.
[20] Giambi C, Fabiani M, D'Ancona F, Ferrara L, Fiacchini D, Gallo T, et al. Parental vaccine hesitancy in Italy – results from a national survey. Vaccine 2018;36(6):779–87.
[21] Healy CM, Pickering LK. How to communicate with vaccine-hesitant parents. Pediatrics 2011;127(Supplement 1):S127–33.
[22] Smith MJMDM, Marshall GSMD. Navigating parental vaccine hesitancy. Pediatr Ann 2010;39(8):476–82.
[23] Larson HJ, Jarrett C, Eckersberger E, Smith DM, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. Vaccine 2014;32(19):2150–9.
[24] Kosen Soewarta. Measuring the effective coverage of the immunisation programme in Indonesia: using community-based surveys. Lancet 2013;381:S75. https://linkinghub.elsevier.com/retrieve/pii/S014067361361329X. https://doi.org/10.1016/S0140-6736(13)61329-X.
[25] Harjaningrum AT, Kartasasmita C, Orne-Gliemann J, Jutand MA, Goujon N, Koeck JL. A qualitative study on knowledge, perceptions, and attitudes of mothers and health care providers toward pneumococcal conjugate vaccine in Bandung, West Java, Indonesia. Vaccine 2013;31(11):1516–22.
[26] Wulandari D, Dwidiyanti M. Pengetahuan and Persepsi Ibu yang Menolak Pemberian Imunisasi Dasar Balita; Knowledge and Perception from Mothers who Refuse Basic Childhood Immunisation. Indonesian J Med Sci 2017;4(1):44–55.
[27] Seale H, Sitaresmi MN, Atthobari J, Heywood AE, Kaur R, MacIntyre RC, et al. Knowledge and attitudes towards rotavirus diarrhea and the vaccine amongst healthcare providers in Yogyakarta Indonesia. BMC Health Serv Res 2015;15:528.
[28] Banten Provincial Health Office. Profil Kesehatan Provinsi Banten Tahun 2012; Health Profile of Banten Province 2012. Banten: Banten Provincial Health Office; 2013. Available from http://www.depkes.go.id/resources/download/profil/PROFIL_KES_PROVINSI_2012/16_Profil_Kes.Prov.Banten_2012.pdf. Accessed in 24 February 2018.
[29] Banten Provincial Health Office. Profil Kesehatan Provinsi Banten Tahun 2011; Health Profile of Banten Province 2011. Banten: Banten Provincial Health Office; 2012. Available from http://www.depkes.go.id/resources/download/profil/PROFIL_KES_PROV_2011/P.Prov.Banten_2011.pdf. Accessed in 24 February 2018.
[30] Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol 2006;3(2):77–101.
[31] Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care 2007;19(6):349–57.
[32] WHO. Weekly epidemiological report 2011;46(86):509–20. Available from http://www.who.int/wer/2011/wer8646.pdf. Accessed in 2 March 2018.
[33] National Institute of Health Research and Development. The 2010 Basic Health Research. Jakarta: National Institute of Health Research and Development, Ministry of Health; 2010.
[34] Eriksson A, Burcharth J, Rosenberg J. Animal derived products may conflict with religious patients' beliefs. BMC Med Ethics 2013;14:48.
[35] WHO. The Judicially Prohibited and Impure Substances in Foodstuff and Drugs. World Health Organisation Regional office for the Eastern Mediterranean 2001. Available from http://www.immunize.org/concerns/porcine.pdf. Accessed in 25 February 2018.
[36] MUI. Fatwa Penyelenggaraan Imunisasi. Jakarta: Majelis Ulama Indonesia; 2016. Available from http://www.searo.who.int/indonesia/topics/immunization/fatwa_no.4_tentang_imunisasi.pdf?ua=1. Accessed in 4 March 2018.
[37] MUI. Penggunaan Vaksin MR (Measles Rubella dari SII untuk Imunisasi vol. 33. Jakarta: MUI; 2018.
[38] Cassell JA, Leach M, Poltorak MS, Mercer CH, Iversen A, Fairhead JR. Is the cultural context of MMR rejection a key to an effective public health discourse? Publ Health 2006;120(9):783–94.
[39] Dube E, Vivion M, Sauvageau C, Gagneur A, Gagnon R, Guay M. "Nature Does Things Well, Why Should We Interfere?": vaccine hesitancy among mothers. Qual Health Res 2016;26(3):411–25.
[40] Reich JA. Of natural bodies and antibodies: parents' vaccine refusal and the dichotomies of natural and artificial. Soc Sci Med 2016;157:103–10.
[41] Busse JW, Walji R, Wilson K. Parents' experiences discussing pediatric vaccination with healthcare providers: a survey of Canadian naturopathic patients. PLoS ONE 2011;6(8):e22737.
[42] Downey L, Tyree PT, Huebner CE, Lafferty WE. Pediatric vaccination and vaccine-preventable disease acquisition: associations with care by complementary and alternative medicine providers. Matern Child Health J 2010;14(6):922–30.
[43] Jones L, Sciamanna C, Lehman E. Are those who use specific complementary and alternative medicine therapies less likely to be immunized? Prev Med 2010;50(3):148–54.
[44] Leask J, Kinnersley P, Jackson C, Cheater F, Bedford H, Rowles G. Communicating with parents about vaccination: a framework for health professionals. BMC Pediatr 2012;12(1):154.
[45] New SJ, Senior ML. "I don't believe in needles": qualitative aspects of a study into the uptake of infant immunisation in two English health authorities. Soc Sci Med 1991;33(4):509–18.
[46] Turner N. Concerns of health providers and parents affect immunisation coverage. New Zealand Med J (Online) 2004;117(1189).
[47] WHO. Strategies for addressing vaccine hesitancy-a systematic review. WHO SAGE; 2014. Available from http://www.who.int/immunization/sage/meetings/2014/october/3_SAGE_WG_Strategies_addressing_vaccine_hesitancy_2014.pdf. Accessed in 13 February 2018.
[48] Enkel SL, Attwell K, Snelling TL, Christian HE. 'Hesitant compliers': qualitative analysis of concerned fully-vaccinating parents. Vaccine 2017;36(44):6459–63.
[49] Center PR. Muslim Population of Indonesia; 2010. Available from: http://www.pewforum.org/2010/11/04/muslim-population-of-indonesia/. Accessed in 24 March 2018.