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# Assessment of knowledge, attitude, and practice toward childhood vaccination in Riyadh and Dammam, Saudi Arabia

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## ABSTRACT

*Background:* Hesitancy toward vaccination is a major problem around the globe with significant public health ramifications. It has increased worldwide. *Aim of the work:* The aim of this study is to explore the level of knowledge about and attitude and practice toward childhood vaccines among parents in Riyadh and Dammam. *Methods:* This study was a cross-sectional questionnaire-based study that was conducted in Riyadh and Dammam from December 2019-January 2020 among 899 parents who have children in the vaccination age group 0-17 years old. *Results:* The mean knowledge score among the studied population was 7.76 out of 18, indicates poor knowledge. The mean hesitancy score was 3.41 out of 14. Only 13.3% of the total population obtained a hesitancy score above 50%. The overall vaccine hesitancy rate was 14.5%. The highest knowledge and attitude scores recorded among the residents of Riyadh, whereas the lowest hesitancy score recorded among residents in Dammam. The important reported barrier for childhood vaccines was that parents didn't think vaccines were needed for their children. *Conclusion:* The current study reported poor knowledge but a good attitude toward vaccination and a low level of both vaccine hesitancy and refusal among the studied population.

**Keywords:** Vaccine Hesitancy, Knowledge, Attitude, Riyadh, Dammam

## 1. INTRODUCTION

Great advances have been made in the past two decades in developing and introducing new vaccines and expanding the reach of immunization programs. As a result of this action, more people than ever before have been vaccinated and have become able to access and use vaccines. In addition, the

annual mortality frequency among children under five years dropped by 2 million from 2000 to 2010. GVAP (Global Vaccine Action Plan) is a set of plans and initiatives to stop millions of deaths by the year 2020 by providing more equitable access to existing vaccines for people in all places (Global Vaccine Action Plan, 2013). Despite this advancement, the World Health Organization (WHO) still considers people's refusal or reluctance to become vaccinated as one of the top ten threats today (Luyten et al., 2019).

National standards for pediatric vaccination regulation have been established and include descriptions of valid contraindications and precautions to vaccination. For instance, severely immunocompromised persons should not receive live vaccines. Moreover, having an acute illness (moderate or severe) with or without a fever necessitate precautions to administrate any vaccine (ACIP Contraindications Guidelines for Immunization CDC, 2021). The most commonly observed side effects for vaccination are generally mild and go fade quickly, such as pain, swelling or redness in the site of the shot, mild fever, chills, being tired, headache, and muscle and joint aches. Although it is extremely rare to cause serious side effects to most people, the DTaP (diphtheria, tetanus, and a cellular pertussis) vaccine could very rarely cause long-term seizures, coma, lowered consciousness, or permanent brain damage (Immunization and Respiratory Diseases (NCIRD) Home CDC, 2021). Despite these side effects, the benefits of vaccines exceed the risks, and vaccination provides a great impact on individual and societal health by reducing the incidence and prevalence of infectious diseases. Further, this will lower the economic burden of the governments (Vaccines National Strategic Plan, 2017).

Although vaccinations are among modern medicine's greatest success stories, there have been recent trends of parents in Western countries refusing to vaccinate their children due to numerous reasons and perceived fears (Hussain et al., 2018). Vaccine hesitancy (VH) is defined by WHO as 'a delay in (the) acceptance of vaccination or rejection of vaccination despite the availability of vaccination services (Al-Saeed et al., 2018). The definition evens involve acceptance of vaccination with doubts about its safety and efficacy. These behaviors and attitudes vary according to personal profile of vaccines. Wakefield et al., (1998) published a study suggesting a connection between the measles, mumps, and rubella (MMR) vaccine and behavioral regression and persuasive development disorder in children (Sabra et al., 1998). Even though the study had a small sample size (n=12), was an uncontrolled study, and had a forecast conclusion, the paper spread internationally, and the MMR vaccination rates dropped because of parents' fear of autism (Sathyanarayana Rao & Andrade, 2011).

Epidemiological studies were conducted immediately after this and published that disproved the assuming link between the MMR vaccination and autism. It has been proved that Wakefield failed to disclose financial benefit in this allegation (Taylor et al., 1999; Dales, 2001). In February 2010, another paper was published (Eggertson, 2010) that acknowledged several elements in the 1998 Wakefield paper were incorrect, and he was held guilty for ethical violations and scientific fraud. But the damage was already done, parents around the world stopped vaccinations for their children, and there were measles outbreaks in the UK in 2008 and 2009. This fraud was one of the hugest frauds in the history of health (Sathyanarayana Rao & Andrade, 2011).

Factors such as complacency lack of convenience, or lack of confidence in vaccines may all contribute to the delay in vaccination or refusal of one, some, or almost all vaccines (Dubé et al., 2018). There are four main sociocultural changes that have contributed to vaccine hesitancy: a) a low level of trust in the large corporations that manufacture vaccines; b) growing public interest in natural and alternative types of medicine; c) the medical role has changed, with parents no longer wanting to be told what to do for their children but rather wanting a shared decision-making process; and d) pediatricians are increasingly under stress to see higher number of patients in less time and find themselves meeting parents that find misinformation on the internet (Al-Saeed et al., 2018). Moreover, previous works have revealed additional important factors related to the decision to accept child hood vaccinations such as risk perception, thoughts about the effectiveness and safety of vaccines, anticipated regret about vaccine-preventable diseases (VPDs) and side effects, trust in the National Immunization Program (NIP), and low barriers, like as vaccinations being free (Romijnders et al., 2019).

A previous study showed that the VH rate was 15% in Riyadh and 31.3% in Makkah, and the most important reason was the lack of vaccines in a primary care center (Al-Saeed et al., 2018; Albarakati et al., 2019), On the other hand, international studies showed that the VH rate was 16.5% in Brazil, 21% in India, and 30.3% in Romania (Brown et al., 2018; Miko et al., 2019; Gopichandran et al., 2018). This study aims to explore the level of knowledge, attitude, and practice toward childhood vaccination and to determine the major barriers for accepting vaccination among parents in Riyadh and Dammam.

## 2. MATERIALS AND METHODS

This is a cross-sectional questionnaire-based study that has been conducted in shopping malls, parks, and different local markets in Riyadh and Dammam during December 2019 to January 2020. The study included parents who have children from 0 to 17 years old. Parents who do not have children between 0 to 17 years old were excluded. The data collection tool is a structured

questionnaire consisting of three main aspects: knowledge of parents about vaccines, attitude and beliefs of parents toward vaccination, and parents practice toward vaccination. The questionnaire has been adapted from the vaccine hesitancy survey developed by the WHO SAGE (Strategic Advisory Group of Experts) working group on vaccine hesitancy (Strategic Advisory Group of Experts on Immunization (SAGE) WHO, 2014) with some modifications, and it has been initially validated through a pilot study of 20 participants.

Previous literature showed that around 26-31% of the population of Saudi Arabia are vaccine hesitant (Al-Saeed et al., 2018; Albarakati et al., 2019; Alshammari et al., 2018). The minimum sample size of the current study calculated using the STATA 14 program and considered a power of 80% (beta=20%) and a level of confidence of 95% (alpha=0.05), with a confidence interval of 10%, which was found to be 605. However, it has been raised to 899 people, 500 in Riyadh and 399 in Dammam, to generate a valid comparison between these two major cities in Saudi Arabia. The participants in the study were chosen using convenience sampling. The institutional Review Board was obtained from Princess Nourah bin Abdulrahman University, Riyadh, KSA. The IRB registration number is HAP-01-R-059, and the IRB log number: 19-0231.

## 3. RESULTS

The current study included 899 guardians who have children in the vaccination age group. Most of them (61.3%) were living in Riyadh, whereas 34.3% were from Dammam, and only 4.4% were from other cities. Although the study was conducted in Saudi Arabia, 24.5% of the participants were non-Saudi. Most participants (68.3%) were mothers, whose age ranged from 20-60 years with a mean of 35.62 ± 8.7 years. Most of the mothers (55.4%) were in the age group of 20-35 years. Fathers represented 27.8% of the studied population, and the majority of them (39.3%) were in the age group of 36-45 years. The fathers' age ranged from 20-80 years with a mean of 40.87±9.57 years. Additionally, 89.9% of the parents were married at the time they undertook the study.

Regarding education level, the results were almost identical for both mothers and fathers, showing about 61% of them have a bachelor's degree or higher. Approximately half of the fathers were working in the government sector, 36.9% were in the private sector, and only 3.6% were health care professionals. Moreover, most of the mothers (57.3%) were housewives. The mean income of the participants was 14,718.21±13,922 Saudi riyals. Nearly half of the participants declared a high monthly income of more than 10,000SAR, whereas only 20% of them reported a low monthly income less than 5,001. In addition, 65% of parents have 1-3 children, whereas half of them had one child of preschool age at the time of the study.

Table 1 shows the knowledge of the studied population about vaccines. It shows that only 38.4% of the studied population understands that the purpose of vaccination is to prevent disease. In addition, 78.2% of the total population recognizes that the timing of the first dose of vaccines is at birth. Furthermore, most of the studied population (82.9%) recognized that poliomyelitis is a disease that can be prevented by a compulsory vaccine. In addition, a great deal of participants knew that measles and hepatitis B are compulsory vaccines with 61.6% and 51.8% respectively. Regarding the side effects of vaccines, most of the population (82.6%) did not think that autism is a possible side effect of vaccination, and they realized that fever and pain around the shot are possible side effects of vaccination (65.2% and 50.6% responded, respectively). Moreover, Table 1 illustrates that 46.7% of the total population believe that the frequency of a serious side effect from vaccination is rare, whereas 37.6% of the population believe that it is very rare. Additionally, whereas 48.4% of the studied population considered fever as a contraindication of vaccination, 45.7% of them considered the history of a serious allergic reaction to a vaccine or its component as a contraindication for vaccination.

**Table 1** Knowledge of the Studied Population about Vaccines

| Item | Response No. (%) |
|---|---|
| 1) What are the effects of vaccination? | |
| To promotes your child's growth | 59 (6.6%) |
| To prevent disease | 345 (38.4%) |
| To treat disease | 80 (8.9%) |
| To improve your child's immunity | 207 (23.0%) |
| All the above | 388 (43.2%) |
| None of the above | 27 (3.0%) |
| 2) What is the timing of the first dose of vaccines? | |
| At birth | 703(78.2%) |
| At 1 months | 92(10.2%) |

| | |
|---|---|
| At 2 months | 51 (5.7%) |
| At 3 months | 25(2.8%) |
| None of the above | 26 (2.9%) |
| 3) Which of the following diseases can be prevented by compulsory vaccination? | |
| Poliomyelitis | 745 (82.9%) |
| Measles | 554 (61.6%) |
| Mumps | 192 (21.4%) |
| Rubella | 389 (43.3%) |
| Pertussis | 234 (26.0%) |
| Tetanus | 173 (19.2%) |
| Hepatitis B | 466 (51.8%) |
| Hepatitis A | 376 (41.8%) |
| Tuberculosis | 373 (41.5%) |
| Diphtheria | 153 (17.0%) |
| Influenza | 182 (20.2%) |
| Cholera | 162 (18.0%) |
| Rotavirus | 183 (20.4%) |
| Meningitis | 254 (28.3%) |
| Human papillomavirus | 109 (12.1%) |
| None of the above | 50 (5.6%) |
| 4) Which of the following is considered as a possible side effect of vaccines? | |
| Autism | 156 (17.4%) |
| Fever | 586(65.2%) |
| Paralysis | 167(18.6%) |
| Pain around the shot | 455(50.6%) |
| Weaken the immune system | 60(6.7%) |
| Diarrhea | 152(16.9%) |
| None of the above | 39(4.3%) |
| 5) What is the frequency of serious side effects from a vaccine? | |
| Very common | 55(6.1%) |
| Common | 86(9.6%) |
| Rare | 419(46.7%) |
| Very Rare | 338(37.6%) |
| 6) Which of the following is considered as contraindication for vaccination? | |
| A history of a serious allergic reaction to a vaccine or its components | 411(45.7%) |
| Unexplained encephalopathy after a previous pertussis-containing vaccine | 115(11.7%) |
| Fever | 439(48.8%) |
| Diarrhea | 107(11.9%) |
| Immunodeficiency | 154(17.1%) |
| None of the above | 114(12.7%) |

Table 2 demonstrates that the knowledge score among the studied population ranged from 0 to 18 with a mean of 7.76 ± 4.10 SD. Only 4 participants obtained the maximum value, whereas 2 obtained a 0 score. A cutoff value of ≥ 60% (score ≥11) was considered as defining people who have good knowledge, and those who obtained less were considered to have poor knowledge. Accordingly,

only 24.2% of the total studied population had a good knowledge score. Riyadh residents reported the highest percentage with good knowledge (29.2%) compared with 17.4% of Dammam residents and only 5% of residents in other cities. Table 2 shows that the knowledge score was highest among Riyadh citizens, mothers age 20-35 years old, those with a high income, also those mothers and fathers with bachelor's or postgraduate education, and those who have one preschool child with statistically significant difference. It was also higher among non-Saudis, married persons, fathers aged 20-35 years old, and parents who have 1-3 children but with no statistically significant difference.

**Table 2** Knowledge score of the studied population

| Variable | Category | Knowledge score (Mean ± SD) | P value |
|---|---|---|---|
| City | Riyadh<br>Dammam<br>Others | 8.29 ± 4.24<br>7.16 ± 3.76<br>5.15 ± 3.04 | **≤0.01*** |
| Nationality | Saudi<br>Non-Saudis | 7.63 ± 0.10<br>8.16 ± 4.08 | **0.09** |
| Guardian | Mother<br>Father<br>Other | 8.00 ± 4.06<br>7.42 ± 4.22<br>5.94 ± 3.40 | **0.001*** |
| Statues | Marred<br>Divorced | 7.83 ± 4.11<br>7.15 ± 3.99 | **0.13** |
| Father's age | 20-35 years<br>36-45 years<br>≥46 | 7.92 ± 4.19<br>7.80 ± 4.28<br>7.52 ± 3.72 | **0.50** |
| Mother's age | 20-35 years<br>36-45 years<br>≥46 | 8.11 ± 4.22<br>7.45 ± 4.15<br>7.00 ± 3.13 | **0.01** |
| Income per month | ≤5000<br>5001-10000<br>≥10001 | 6.97 ± 3.86<br>7.47 ± 3.34<br>8.37 ± 3.92 | **≤0.01*** |
| Mother's education | Below university<br>Bachelor's and postgraduate | 6.79 ± 4.23<br>8.38 ± 3.90 | **≤0.01*** |
| Father's education | Below university<br>Bachelor's and postgraduate | 6.91± 4.32<br>8.30 ± 3.87 | **≤0.01*** |
| Number of children | 1-3<br>≥4 | 7.91 ± 4.11<br>7.49 ±4.08 | **0.14** |
| Number of preschool children | 0<br>1<br>≥2 | 7.02 ± 0.80<br>8.16 ± 4.90<br>7.77 ±4.40 | **0.002*** |

*P value ≤ 0.05 is considered significant

Regarding the source of information of the studied population about childhood vaccines, MOH messages came in 1st place (43.8%) with the highest percentage (50.0%) recorded by citizens of other cities, followed by 47.4% by citizens of Dammam, and 41.6% by citizens of Riyadh. Family and friends came in 2nd place for the total population as well as residents of Riyadh and Dammam. Health professionals came in third place. On studying the attitude of the participants, the majority of the studied populations have a positive attitude toward childhood vaccinations, and 77.5%of them agreed that vaccines are important for their children health. Regarding the effectiveness of vaccines, the great majority of the studied population (75.1%) thinks that childhood vaccines are effective for their children's health. In addition, 71.2% of parents think that having their children vaccinated is important for the health of others in their community. Moreover, 74.9%of parents think that getting vaccines is a good way to protect their children from diseases. By contrast, regarding the safety and delivery of vaccines, less than half of parents (36%) were concerned about serious adverse effects of vaccines. In addition, 36.5% of parents think that newer vaccines carry more risks than older vaccines. Furthermore, 35% of parents believe that their children don't need vaccines for diseases that are not highly prevalent anymore.

Regarding the satisfaction of parents about the delivery of the vaccines, 72.8% of parents think that childhood vaccines given by the government program in their community are beneficial. In addition, 72.2% of parents think that the information they receive about vaccines from the vaccine program is accurate and trustworthy. Finally, most (75.1%) parents generally do what doctors or health care providers recommend about vaccines for their children. The average attitude score among the studied population, calculated from the response of the participant to the above questions regarding the safety, efficacy, and delivery of vaccines, is shown in Table 3. It ranged from 1 to 4 with mean 2.80 ±0.66, where 1 indicates negative attitudes toward vaccines and 4 indicates positive attitudes. The attitude score is higher among residents of Riyadh and parents with one preschool child with a statistically significant difference. In addition, it is higher among Saudis, mothers in the 20-35 age group, fathers in the 36-45 age group, parents who have a bachelor's or postgraduate degree, those with income ≥10,001 (SR), and parents who have 1-3 children but with no statistically significant difference.

**Table 3** Attitude score among studied population

| Variable | Category | Attitudes score (mean ± SD) | P value |
|---|---|---|---|
| City | Riyadh<br>Dammam<br>Other | 3.00±0.43<br>2.44±0.84<br>2.76±0.54 | **≤0.01*** |
| Nationality | Saudi<br>Non-Saudi | 2.80±0.67<br>2.78±0.62 | **0.120** |
| Guardian | Mother<br>Father<br>Other | 2.82±0.66<br>2.77±0.65<br>2.66±0.67 | **0.31** |
| Marital status | Married<br>Divorced | 2.80±0.67<br>2.73±0.60 | **0.23** |
| Father's age | 20-35 years<br>36-45 years<br>≥46 | 2.80±0.60<br>2.81±0.68<br>2.78±0.71 | **0.83** |
| Mother's age | 20-35 years<br>36-45 years<br>≥46 | 2.82±0.63<br>2.79±0.69<br>2.68±0.73 | **0.15** |
| Income per month | ≤5000<br>5001-10000<br>≥10001 | 2.76±0.65<br>2.76±0.70<br>2.85±0.62 | **0.14** |

| | | | |
|---|---|---|---|
| Father's education | Below university<br>Bachelor's or postgraduate | 2.70±0.67<br>2.86±0.65 | **0.33** |
| Mother's education | Below university<br>Bachelor's or postgraduate | 2.74±0.663<br>2.84±0.664 | **0.491** |
| Number of children | 1-3<br>≥4 | 2.81±0.65<br>2.77±0.67 | **0.313** |
| Number of preschool children | 0<br>1<br>≥2 | 2.65±0.72<br>2.88±0.62<br>2.78±0.65 | **≤0.01*** |

*P value ≤ 0.05 is considered significant

Table 4 shows the assessment of hesitancy toward childhood vaccination among the studied population. It shows that the majority (90.2%) believed that vaccines can protect their children from serious disease. However, when asked "Do you think that most parents like you have their children vaccinated with all the recommended vaccines," only 68% said yes.

**Table 4** Assessment of vaccine hesitancy among the studied population

| Item | Response | No. (%) |
|---|---|---|
| 1) Do you believe that vaccines can protect children from serious diseases? | Yes | 811 (90.2%) |
| | No | 88 (9.8%) |
| 2) Do you think that most parents like you have their children vaccinated with all the recommended vaccines? | Yes | 611 (68.0%) |
| | No | 288 (32.0%) |
| 3) Has distance to the clinic prevented you from getting your child immunized? | Yes | 90(10%) |
| | No | 809(90%) |
| 4) Has the waiting in the clinic prevented you from getting your child immunized? | Yes | 122(13.6%) |
| | No | 777(86.l4%) |
| 5) Are there other pressures in your life that prevent you from getting your child immunized on time? | Yes | 127(14.1%) |
| | No | 772(85.9%) |
| 6) Are there any reasons you think children should not be vaccinated? | Yes | 167(18.6%) |
| | No | 732(81.4%) |
| 7) Have you ever received or heard negative information about vaccination? | Yes | 418(46.5%) |
| | No | 481(53.5%) |
| 8) If yes, did you still take your child to get vaccinated after you heard the negative information? | Yes | 246(27.4%) |
| | No | 331(36.8%) |
| 9) Do you think that it is difficult for some ethnic or religious groups in your community/region to get vaccination for their children? | Yes | 227 (25.3%) |
| | No | 672(74.7%) |
| 10) Do political leaders in your community support vaccines for infants and children? | Yes | 678(75.4%) |
| | No | 221(24.6%) |
| 11) Do religious leaders in your community support vaccines for infants and children? | Yes | 708(78.8%) |
| | No | 191(21.2%) |
| 12) Do teachers in your community support | Yes | 756(84.1%) |

| | | |
|---|---|---|
| vaccines for infants and children? | No | 143(15.9%) |
| 13) Do health care workers in your community support vaccines for infants and children? | Yes | 788(87.7%) |
| | No | 111(12.3%) |

The study recorded that "distance to clinic" and "waiting in the clinic" have prevented only 10.6% and 13.5%, respectively, from getting their children vaccinated. In addition, most of the total studied population (81.4%) have no other pressures in their life that prevent them from vaccination; meanwhile, only 18.6% think there are other reasons to not let their child vaccinated. Almost half of the studied populations (46.5%) have received negative information about vaccination. However, 27.4% of the population still takes their children to get vaccinated after this negative information.

The study reports that only 25.3% of the studied population thinks it's difficult for some religious groups in the community to get their child vaccinated. However, between 78% and 87% of the participants think that political leaders, religious leaders, teachers, and health care workers support vaccination for children, with the highest percentage among teachers and health care workers. The total hesitancy score among the studied population calculated from the above questions ranged from 0 to 14, where 0 stands for maximum vaccine acceptance, and14 stands for maximum vaccine hesitancy, with a mean of 3.41 ± 2.87. This indicates that most parents are not hesitant to give vaccines to their children.

Table 5 shows that the hesitancy score is higher among residents of cities other than Riyadh and Dammam, non-parent guardians who are looking after children, divorced parents, fathers and mothers who have below university education, families who have 4 or more children, and those in the middle-income group (5,001-10,000 SR) with a statistically significant difference. Conversely, the hesitancy score is higher among Saudis, fathers and mothers ≥ 46 years old age group, and in families with 1 preschool child with no statistically significant difference. The cut-off valve of> 50% hesitancy score indicates the hesitancy of parents to give vaccines to their children. In this respect, 13.3% of total studied populations were found to be hesitant to give vaccines to their children. The lowest hesitancy perspective was in Dammam at 7%, compared with 16% in Riyadh. The highest percentage was 22.5% among resident of cities other than Riyadh and Dammam.

**Table 5** Hesitancy scores among the studied population:

| Variable | category | Hesitancy score (mean ± SD) | P value |
|---|---|---|---|
| City | Riyadh<br>Dammam<br>Other | 3.66±3.01<br>2.80±2.37<br>4.78±3.42 | ≤0.01* |
| Nationality | Saudi<br>Non-Saudi | 3.42±2.71<br>3.38±2.71 | 0.86 |
| Guardian | Mother<br>Father<br>Other | 3.14±2.60<br>3.95±3.26<br>4.37±3.76 | ≤0.01* |
| Marital status | Marred<br>Divorced | 1.42±0.57<br>1.51±0.66 | ≤0.01* |
| Father's age | 20-35 years<br>36-45 years<br>≥46 | 1.42±0.58<br>1.42±0.58<br>1.46±0.58 | 0.43 |
| Mother's age | 20-35 years<br>36-45 years<br>≥46 | 1.42±0.59<br>1.42±0.56<br>1.53±0.59 | 0.55 |
| Income per month | ≤5,000<br>5,001-10,000<br>≥10,001 | 1.39±0.55<br>1.53±0.61<br>1.37±0.55 | 0.01* |
| Mother's education | Below university<br>Bachelor's or postgraduate | 1.51±0.61<br>1.38±0.55 | ≤0.01* |

| | | | |
|---|---|---|---|
| Father's education | Below university<br>Bachelor's or postgraduate | 1.48±0.61<br>1.40±0.56 | ≤0.01* |
| Number of children | 1-3<br>≥4 | 1.42±0.57<br>1.46±0.59 | 0.01* |
| Number of preschool children | 0<br>1<br>≥2 | 1.44±0.55<br>1.44±0.60<br>1.40±0.55 | 0.11 |

*P value ≤ 0.05 is considered significant

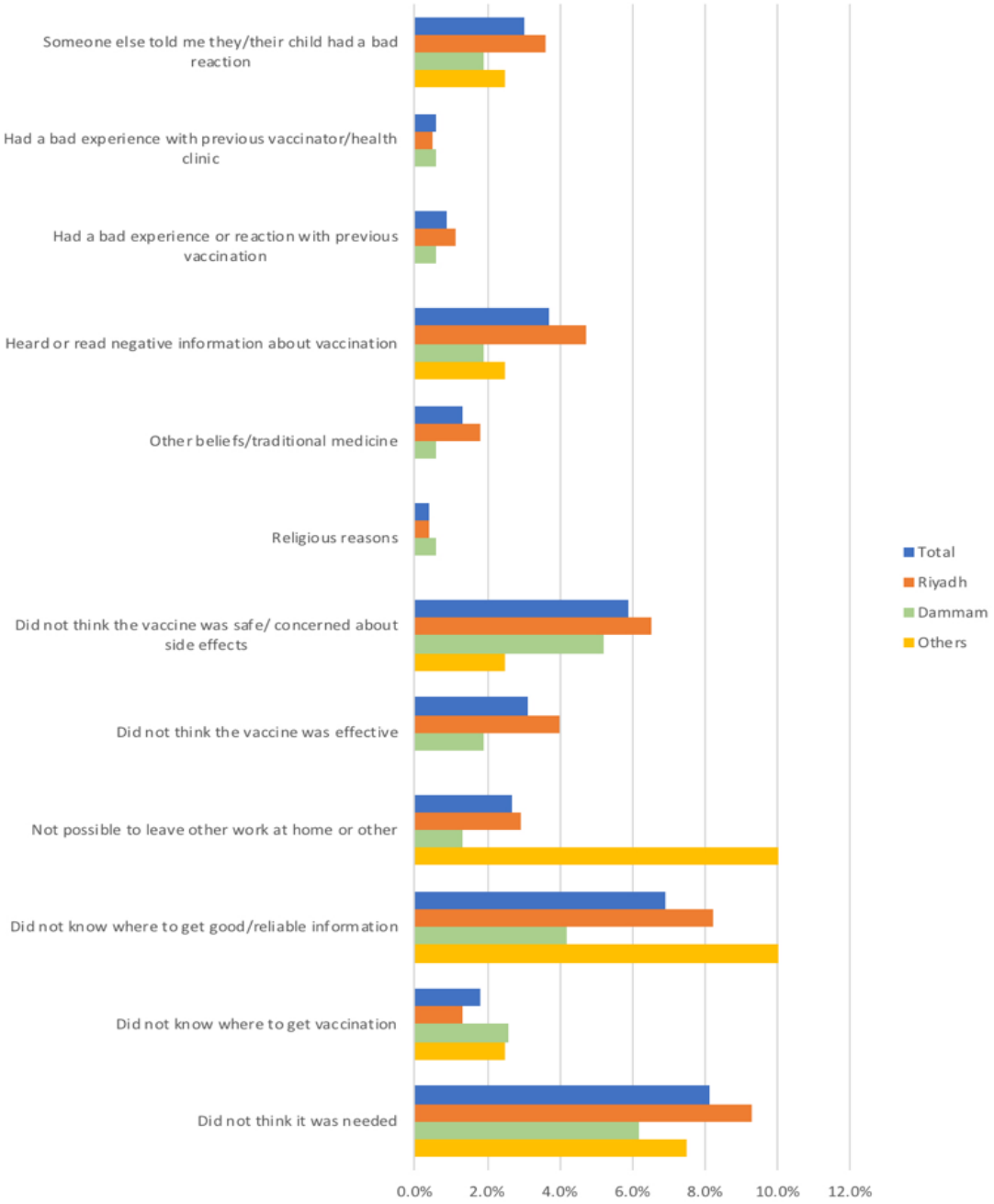


**Figure 1** Barriers/reasons for vaccine refusal or hesitancy

Regarding the practices of the studied population toward vaccination, the study shows that most of the studied populations (87.2%) were keen to complete all doses of vaccines when there is more than one dose. The highest percentage was reported in other

cities (92.5%), followed by Dammam (91.6%), and finally Riyadh (84.4%). In addition, 41.3% of the studied populations were giving their children additional vaccines outside the vaccination program. A similar percentage was recorded in Riyadh (42.8%) and in Dammam (39.6%), whereas in other cities, a lower percentage was recorded (32.5%). Most of the studied population (90.0%) agreed to vaccinate their children. The highest percentage was in Dammam (95.5%), followed by Riyadh (87.5%), and finally other cities (82.5). However, 14.5% were reluctant to get a vaccination for their children, with the highest percentage for vaccine refusal and hesitancy reported in residents in other cities (25.0%), followed by Riyadh (17.8%), and then Dammam (7.1%). Only 10% of the studied populations have declined to vaccinate their children, and the highest percentage was reported in other cities (17.5%), followed by Riyadh (12.5%), and then Dammam (4.5%).

Among compulsory vaccines, parents reported that the most commonly refused vaccine among the total population was BCG (5.1%), followed by IPV (5%), and then DTPw (4.9%), whereas the least refused vaccines was hepatitis A (3.2%), varicella (3.7%), and MCV4 (3.9%). Moreover, parents reported that the most commonly hesitated vaccine among the total population was Hepatitis B (10.5%), then BCG, (8.8%), and finally MMR (8.1%), whereas the least hesitated vaccines was PCV(6.3%), followed by DTaP (6.7%),then OPV and Rota (7% each).

Figure 1 show that the most common barrier for vaccination among the studied population was that parents didn't think vaccination was needed for their children (8.1%). In the 2nd place, 6.9% of parents say that they do not know where to get good and reliable information about vaccines. Next, 5.9% of parents didn't think the vaccine was safe for their children. Only 0.4% of parents believed that it's difficult to give a vaccine to their children because of some religious reasons (the least commonly reported barrier). The highest percentage was reported in Dammam (0.6%), then Riyadh (0.4%), and then none (0%) in other cities. In addition, only 0.5% of parents had a bad experience with a vaccinator or clinic. In Riyadh and Dammam, barriers follow almost the same pattern as in the total population. In other cities, parents reported that the most common barrier for vaccine hesitancy was either that parents did not know where to get reliable information (10%) or that it is not possible for them to leave their work or home (also 10%), followed by parents not thinking vaccination was needed for their children (7.5%). Minor barriers include parents having heard negative information about vaccines (3.7%) and parents not thinking that vaccination is effective for their children (3.1%). Some parents say that "someone told them that their child had a bad reaction for vaccines" (3%) and fewer parents are not able to leave their work or home to give vaccines to their children (2.7%). In addition, 1.8% of parents have reported that they did not know where to get vaccinations, 1.3% of parents have other beliefs that prevent them from getting their child vaccinated, 0.9% of parents have had a bad experience with previous vaccinations, and 0.6% of parents have had a bad experience with a previous vaccinator or health clinic.

## 4. DISCUSSION

Immunization has a direct impact on the prevention and reduction of vaccine-preventable infectious diseases in future generation. Parental decisions on vaccination have its influence on both the vaccination rate and child immunity. Recent parent vaccine hesitancy has become a challenging problem, which encourages researchers to assess the problem of vaccine hesitancy and investigate its cause. This study was conducted to assess the knowledge about and attitude toward childhood vaccines and to investigate the level of vaccine hesitancy among parents in Riyadh and Dammam. It is a cross-sectional questionnaire-based study that has been conducted in Riyadh, Dammam, and other cities among 899 parents who have children in the vaccination age group.

The demographic characteristics of parents who participated in our study showed that mothers constituted the majority of the sample. Understanding mothers' knowledge about and attitudes toward immunization is important, though fathers' involvement was also shown to be associated with the child's vaccination status. More than half the parents who participated had a higher education (bachelor and postgraduate), which may be explained by the fact that most of the participants were living in a city and had better chances to complete higher education. Higher educational level, no doubt, helps parents to understand the educational messages. Moreover, such parents have better chances to come across considerable knowledge about immunization in the media; this finding coincides with the results of other studies (Ahmed Abdulrahman, 2014).

Regarding parents' knowledge about vaccines, this study shows that the mean knowledge score among the studied population was 7.76 out of 18, which indicates poor knowledge among the studied population. In addition, only 24.2% of the total studied population had a good knowledge score when a cut-off of 60% of the knowledge score was used to define good knowledge. A higher knowledge score was recorded among residents of Riyadh, followed by those of Dammam, and then those of other cities, with a statistically significant difference. Similar results were reported in a cross-sectional study conducted among 458 pregnant women in Rome, Italy, where 26.1% of the studied population had good knowledge about vaccines; however, a cut-off of 75% of the knowledge score was used to define good knowledge (Rosso et al., 2019). Conversely, a better level of knowledge was reported in a

cross-sectional study conducted among 143 mothers in Bangalore, South India, where 50.43% of the studied population had a good knowledge about vaccines; however, they calculated the knowledge score based on only 3 questions that assessed basic knowledge about vaccines (Sankar et al., 2018).

In the current study, the knowledge score was highest among mothers in the age group of 20-35, parents with a high income, mothers and fathers with a bachelor's or postgraduate education, and with those who have only one preschool child with a statistically significant difference. It was also higher among non-Saudis, married persons, and fathers in the age group of 20-35, and parents who have 1 to 3 children but with no statistically significant difference. Similarly, in the Italian study, higher age, having a university degree, and having received information on vaccinations from institutional websites or through education (e.g., school, university) were associated with good knowledge (Rosso et al., 2019).

Regarding parents' knowledge about the purpose of vaccination, only 38.4% of the studied population understood that the purpose of vaccination is to prevent disease. By contrast, in a local cross-sectional study conducted among 731 parents in Taif, Saudi Arabia, most parents (91.9%) knew the role of routine vaccination (Ahmed Abdulrahman, 2014). Furthermore, a study in Bangalore, South India, reported that most of its participants (91.86%) knew the purpose of vaccination (Sankar et al., 2018). Poor knowledge among the studied population regarding the purpose of vaccination may be attributed in part to the fact that one of the answers to the question about the purpose of vaccination was all of the above options (Table 1), and about 43.2% of parents chose this option.

The current study shows that 78.2% of the total populations recognize the timing of first dose of vaccines, which is at birth. A comparable result (86.9%) was reported in Taif, whereas a study from South India reported that 94.22% of its participants provided the correct answer (Ahmed Abdulrahman, 2014; Sankar et al., 2018). Additionally, our study shows that most of the studied population (82.9%), understood that poliomyelitis is a disease that can be prevented by a compulsory vaccine. In addition, a great deal of people knows that measles and hepatitis B are among the compulsory vaccines: with 61.6% and 51.8%, respectively. Conversely, a minority of the studied population recognizes that the mumps, rubella, pertussis, tetanus, hepatitis A, tuberculosis, diphtheria, and rotavirus vaccines are among the compulsory vaccines in Saudi Arabia. Lack of knowledge about the compulsory vaccines in the current study can partially account for the poor knowledge score reported among the studied population.

Regarding the possible side effects of vaccines, this work shows that most of the studied population realize that fever and pain around the shot are possible side effects of vaccine (65.2% and 50.6%, respectively), and a larger majority (82.6%) did not think that autism is a possible side effect of vaccination. Similar results were observed in a study in Taif, which reported that out of the total parents, 70.0% denied that there is an association between immunization and autism (Ahmed Abdulrahman, 2014). In addition, the current study illustrates that 46.7% of the total population believe that the frequency of the serious side effects of vaccination is rare, and 37.6% of the population realize that this is actually very rare. Regarding the contraindications for vaccination, 45.7% of our studied populations recognize the history of a serious allergic reaction to a vaccine or its component as a contraindication for vaccination, whereas a study in Taif, reported that common colds, ear infection, and diarrhea were considered by parents as contraindications for vaccination (38.3%). In this regard, our study shows that 48.4% of the studied populations consider fever to be a contraindication for vaccine, and 11.9% consider diarrhea to be one.

Parents' source of knowledge about vaccines affects their decision regarding vaccinating their children. Untrustworthy sources may deliver false knowledge and thus negatively affect parents' decisions. This study reported that most of the studied population trust reliable sources of information, with MOH messages as the most common source of knowledge for participants (43.8%). However, the 2nd most common source of knowledge was family and friends (36.4%). Other studies show that more than half of studied populations rely on unreliable sources of information about vaccination. In a cross sectional study conducted among 238 parents in Riyadh, Saudi Arabia, the main information sources about vaccines were the internet and social media (both 56%), personal experience and contact with medical staff (25%), friends and relatives (13%), and books (only 6%), (Al-Saeed et al., 2018); Another study from Rome shows that the most frequently reported source of information about vaccines was word of mouth (62.6% of the sample), followed by traditional media, such as TV and newspapers (33.6%). Unofficial web sources (e.g., blogs, forums, and non-institutional websites) were consulted with approximately the same frequency (Rosso et al., 2019).

Although the results of this survey revealed that parents had poor knowledge, they also had positive attitudes toward childhood immunization and low vaccine hesitancy. The current study shows that the majority of the studied populations have a positive attitude toward childhood vaccines, with the best attitude reported among residents of Riyadh, followed by other cities, and last Dammam. The attitude score ranged from 1 to 4 with a mean of 2.80±0.66 SD, where 1 indicates negative attitudes toward vaccines and 4 indicates positive attitudes. This is likely to be due to higher education, socio-economic status, and awareness among the participants, in addition to using a trust worthy source of knowledge for the majority of the studied population.

This study shows that most (77.5%) of the studied population agreed that childhood vaccines are important for their children's health because they prevent serious illness. Similar findings were reported in another study conducted during 2013 in Taif, Saudi

Arabia, where 73.9% of the parents agreed with the importance of vaccinating children during immunization campaigns (Ahmed Abdulrahman, 2014). In contrast, a study conducted in Uganda found that parents avoided vaccination because they think vaccines aren't important for their children's health and might be expired or contaminated, which may cause harm to their children (Ahmed Abdulrahman, 2014).

Furthermore, when the participating parents in the current study were asked about their concern for the adverse effects of vaccines, less than half of them (36%) were concerned about catastrophic side effects following vaccination. In addition, 35% felt that children today receive unnecessary vaccines for uncommon diseases, and 36.5% were skeptical about newer vaccines regarding their safety because they may carry more risks than previous vaccines. A previous study assessing attitudes toward vaccination in Chennai, India, reported that only 21% of the parents were concerned about adverse effects of vaccines, and one of the major reasons found in this study was concerns regarding safety: "they felt that children nowadays receive more vaccines than necessary, and instead they should be allowed to acquire natural immunity against infections" (Gopichandran et al., 2018).

By contrast, this study reported that 72.8% of parents trust the government vaccination program, and 72.2% trust the information they get from medical sources, such as doctors and health care providers. In addition, 75.1% do what doctors or health care providers recommend about vaccines and believe that this is beneficial for their children's health. This could be explained by the high level of confidence in these trusted medical sources. Unlike a study conducted in the Netherlands, where the general population exhibits high levels of distrust in the information they get from doctors, health care provider, and the government program, the cause for some of these conditions were related to a lack of awareness and information about vaccination or even misinformation. Additionally, for many, it was related to distrust of doctors and government sources (Yaqub et al., 2014). In a study in Romania, participants were suspiciousabout vaccines because in Eastern Europe, vaccines were delivered free of charge (Yaqub et al., 2014).

The reported positive attitude of participants toward vaccines was reflected in the low hesitancy score for most of the studied population. The mean of hesitancy score among the studied population was 3.41 out of 14. In addition, only 13.3% of the total population received a vaccine hesitancy score above 50%. The highest percentage of hesitant parents was recorded in cities other than Riyadh and Dammam (22.5%), followed by Riyadh (16%), and last Dammam (7%). In another study done in Riyadh, vaccine hesitancy among the population was 15.5% which is comparable to this study (Al-Saeed et al., 2018). Compared to the low hesitancy score reported in Saudi Arabia, a higher hesitancy score was reported in studies from Europe (Larson et al., 2016). According to our study, parents who have below a university education were parents in the age group ≥46 years, or were in the middle-income group have a higher tendency for vaccine hesitancy, which indicates that lower education levels and the older age group increases the tendency for vaccine hesitancy. Conversely, another study done in Riyadh found that higher educational level, living in wealthier neighborhoods, and the middle age group increases the likelihood of vaccine hesitancy (Al-Saeed et al., 2018), whereas in India, a study documented an increase in hesitancy toward vaccination among parents who are educated, middle class, and among them working population (Gopichandran et al., 2018).

The current study showed that approximately 12% of parents complained that distance and waiting in the clinic impeded them from getting their child vaccinated, whereas the percentage was slightly higher (15.6%) in a study conducted in Skakah, Saudi Arabia (Alrowaili et al., 2019). By contrast, Brazil reported a lower percentage in the studied population (4%) who complained about the distance (Vaccines National Strategic Plan, 2017). In the current study, 46.5% of the studied population have heard negative information about vaccination, and 36.8% of those decided to stop giving vaccines to their children; however, a lower percentage (11%) was reported in Brazil (Brown et al., 2018). Regarding the reported practices toward vaccines in this study, 87.2% were keen to complete all doses of vaccines when there is more than one dose, and 41.3% were giving their children additional vaccines outside the government vaccination program. Similar results were recorded in a study in Arar, Saudi Arabia, where 77.9% of participants follow the child's compulsory immunization schedule, and 86.2% of respondents strongly agreed that their children had received all vaccines that were recommended by the MOH in Saudi Arabia for their children (Alrowaili et al., 2019). In addition, the latter study reported that 79.6% were keen to complete all doses of vaccination when there is more than one dose, whereas only 30% of parents were looking for additional immunizations for their child.

In this study, when asking parents directly if they were ever hesitant to vaccinate their children, overall vaccine hesitancy was reassuringly low (14.5%) in this population. In addition, the rate of those who refused to give vaccines to their children was only 10%. The rate of vaccine hesitancy and refusal were higher among residents of cities other than Riyadh and Dammam, followed by Riyadh, and they were the least in Dammam. A slightly higher rate of vaccine refusal was reported in a study in Arar, Northern Saudi Arabia, which reported that, 28.9% of parents were not giving their children all the mandatory vaccines (Alruwaili et al., 2018). Higher rates of vaccine hesitancy were reported in Western studies. A study in Italy found that 43% of participants were hesitant to give vaccines to their children, and another study in New York reported that 30% of participants had vaccine hesitancy.

The most common cause of vaccine refusal in the latter study was vaccine safety and efficacy. Some of the participants reported that the delay in being vaccinated was due to hardship with access and the price of the vaccine (Alabbad et al., 2018; Alshammari et al., 2018).

Among compulsory vaccines, in the current study, parents reported that the most commonly refused vaccine among the total population was BCG (5.1%), followed by IPV (5%), and then DTPw (4.9%), whereas the least refused vaccines was hepatitis A (3.2%), varicella (3.7%), and then MCV4 (3.9%). In addition, the most commonly hesitated vaccine among the total population was hepatitis B (10.5%), then BCG, (8.8%) and last MMR (8.1%), whereas the least hesitated vaccines was PCV (6.3%). A study done in Karachi, Bangladesh, and Burkina Faso revealed that the vaccination delay rate observed in was 24.2%, and the most common reason for vaccination delay was lack of time or knowledge among parents (Alshammari et al., 2018). Another study reported that vaccination delay was observed in 24.2% of the participants. Most had only one vaccination delay (69.4%), whereas 30.5% had delayed vaccination on multiple occasions (Banjari et al., 2018). Vaccination delay in the latter study was most frequent for MMR, the 4th dose of PCV, the 2nd dose of MCV, and the 2nd dose of OPV. Traveling at the time of vaccination was the most common reason for delay (21.3%). A study in Italy (2019) investigating the attitude and practices of parents toward MCV4 and PCV vaccinations reported that 81.1% of parents were not hesitant toward them, whereas 18.9% thought that these vaccinations are unnecessary (Facciolà et al., 2019). Compared to our study, 7.1% and 6.3% were hesitant toward MCV4 and PCV respectively. Another study in Saudi Arabia found that 5.3% of the study participants believed that vaccination was not safe, and 2% believed it was harmful (Alruwaili et al., 2018).

Regarding barriers against childhood vaccination, our study reported that the most common reason for vaccine hesitancy was that people thought it was not needed for their children (8.1%). A similar percentage (8.0%) was reported in a study done in Europe (Larson et al., 2016); however, a higher percentage (14%) was reported in Brazil (Brown et al., 2018). In the current study, only 3.3% of parents thought that vaccines were not effective, whereas higher percentages were recorded in Quebec, Canada (10%), and Brazil 14% (Dubé et al., 2018; Brown et al., 2018). The concern about side effects in this study was 5.9% of total population, whereas higher percentages were in Makkah, Saudi Arabia (13.7%), and Brazil (19%) (Albarakati et al., 2019; Brown et al., 2018); in the current study, religion was not reported as a barrier for vaccination because only 0.4% of parents were hesitant to give vaccines to their children due to religious reasons. A study done in Hail, Saudi Arabia, noted that most parents said that childhood immunizations were not prohibited by their religious beliefs (Alshammari et al., 2018). In addition, an international study done in 2016 addressed that vaccine hesitancy due to religious reasons were lower in Saudi Arabia (2.3%), Finland (2.6%), and Brazil (3.2%), whereas Mongolia (50.5%), Thailand (44.4%), and Vietnam (31.8%) have the highest level of vaccine hesitancy due to religious beliefs (Vaccines National Strategic Plan, 2017). The current study found that 1.3% of the total population said that other beliefs/traditional medicine were reasons for vaccine hesitancy whereas; in Brazil it was higher (5%), (Brown et al., 2018).

**Limitations**

This study was a cross-sectional design, with self-reported data rather than revealed or observed data. Therefore, it could be influenced by the memories of the participants. Also, the participants may have been prompted into offering reasons they believed the questioners wanted to hear. Additionally, this study was conducted in the cities Riyadh and Dammam; therefore, the results cannot be generalized to the whole country. must be kept in mind that people living in poorly accessible areas or newcomers from rural areas might have lower level of education and knowledge about vaccinations because of the poorer access to vaccine provision and awareness-raising interventions; therefore, they are more likely to be influenced by some determinants of hesitancy and were less represented in our sample.

**Recommendations**

The current study discloses a poor knowledge among most of the studied population regarding compulsory vaccines. It is recommended to conduct awareness campaigns to raise parents' awareness about this important issue, which in turn will be reflected in better vaccine compliance to reach the 100% coverage. Because MOH messages are the most dependable source of information among the studied population, the MOH should increase the flow of messages and instructions about the time and dosage of vaccines. Moreover, further studies including residents of other cities in the kingdom, and especially rural and less developed regions, should be conducted to generalize the results for the whole kingdom.

## 5. CONCLUSION

The current study reported poor knowledge among the studied population, with messages from the MOH as the main source of information. However, a positive attitude toward vaccination and low level of vaccine hesitancy were recorded. The highest percentage of good knowledge and best attitude toward vaccination were reported among residents of Riyadh, whereas the lowest vaccine hesitancy level was recorded in Dammam. Among compulsory vaccines, the most refused vaccine among the studied population was BCG, whereas the most hesitated vaccine was Hepatitis B. The most important reported barrier for vaccines among the studied population was that parents thought vaccines were not needed for their children.

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**Author Contributions**

Dalia ElFeky was the person who conceptualized the idea of the research and has monitored the research process from the beginning to the end. Amal Alsaif and Alhanouf Alkhuwaylidi were the ones responsible for writing the introduction and methods. Dalal Alkalthem was responsible for getting the ethical approval, data collection and the publication process. Shahad Alharthi and Norah Bajunaid were the ones responsible for statistical analysis process and results writing. Fatima Aldhaferi and Batool Almuhaysin were the ones responsible for discussion and conclusion writing.

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**Conflicts of Interests**

The authors declare that there are no conflicts of interests.

**Ethical approval**

The study was approved by the Medical Ethics Committee of Princess Nourah Bint Abdul Rahman University (IRB registration number: HAP-01-R-059, IRB log number: 19-0231).

**Data and materials availability**

All data associated with this study are present in the paper.

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