



Do pregnant persons want influenza vaccines? Knowledge, attitudes, perceptions, and practices toward influenza vaccines in 8 low- and middle-income countries

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Main Point: We explored knowledge, attitudes, and practices of pregnant persons about seasonal influenza vaccines to inform actions to improve vaccine uptake among this priority population.

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Abstract

Background: While vaccination is the most effective way to prevent influenza infection and adverse outcomes, and despite WHO recommendations to vaccinate pregnant persons, access to seasonal influenza vaccines remains low. We explored knowledge, attitudes, and practices of pregnant persons about seasonal influenza vaccines to inform actions to improve vaccine uptake among this priority population.

Methods: We pooled individual-level data from cross-sectional surveys assessing pregnant persons' attitudes toward seasonal influenza vaccines in eight low- and middle-income countries during 2018-2019. The eight countries used a standard protocol and questionnaire to measure attitudes and intents toward influenza vaccination. We stratified by country-level (presence/absence of a national influenza vaccination program, country income group, geographic region) and individual-level factors.

Findings: Our analysis included 8,556 pregnant persons from eight low- and middle-income countries with and without seasonal influenza vaccination programs. Most pregnant persons (6,323, 74%) were willing to receive influenza vaccine if it was offered for free. Willingness differed by presence of an existing influenza vaccination program; acceptance was higher in countries without influenza vaccination programs (2,383, 89%) than in those with such programs (3,940, 67%, $p < 0.001$).

Interpretation: Most pregnant persons in middle-income countries, regardless of influenza vaccination program status, were willing to be vaccinated against influenza if the vaccine was provided free of charge. National investments in influenza vaccination programs may be well-

received by pregnant persons, leading to averted illness both in pregnant persons themselves and in their newborn babies.

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Keywords

Infectious disease prevention; Influenza; Vaccination

BACKGROUND

A substantial body of evidence demonstrates that pregnant persons are at higher risk of hospitalization from influenza during pregnancy. Moreover, persons with severe influenza illness are more likely to have adverse pregnancy and birth outcomes, including stillbirth, preterm birth and infants who are small for gestational age (1-6). Seasonal influenza vaccination protects their fetus and infant, providing up to six months of conferred immunity to infants (4, 7-9). As a result, the World Health Organization's (WHO) Strategic Advisory Group of Experts on Immunization (SAGE) includes pregnant persons among their priority groups for seasonal influenza vaccination. (10, 11). Despite these recommendations and the well-documented safety of seasonal influenza vaccines during pregnancy (12, 13), some pregnant persons (14-16) and their maternal care providers (17, 18) are hesitant to accept and recommend influenza vaccines. Their concerns center around lack of awareness of influenza illness or perceptions of influenza as a mild illness and lack of knowledge about influenza vaccine safety (17-19).

Influenza vaccine coverage among pregnant persons in low- and middle-income countries remains very low (20), largely due to low access to vaccines. During the past ten years, the US Centers for Disease Control and Prevention (CDC) and the Task Force for Global Health (TFGH) have worked with ministries of health to support expanded access to seasonal influenza vaccines in some low- and middle-income countries (21). Considering their hesitancy to accept influenza vaccines, successfully reaching pregnant persons requires interventions that effectively address barriers, raise awareness, and counteract negative perceptions of seasonal influenza vaccines. Surveys that collect knowledge, attitudes, perceptions, and practices (KAP) related to influenza and influenza vaccines have been valuable tools in the past, both to predict uptake among populations (22) as well as to craft impactful awareness campaigns and design strategies aimed at reducing barriers to vaccination. We describe the findings of KAP surveys administered to pregnant persons in eight low- and middle-income countries to inform actions to improve vaccine uptake among this priority population.

METHODS

We pooled individual-level data from cross-sectional surveys about seasonal influenza vaccine conducted among pregnant persons in 8 countries with existing CDC collaborations to establish or strengthen influenza vaccination programs and/or policies (Albania, Armenia, Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia, Uganda) during 2018–2019. The surveys used a common protocol based on the Health Belief Model (23). Standardized

questionnaires measured perceptions of susceptibility, severity, benefits, barriers, and cues to action for influenza vaccination, with minor modifications reflecting local data needs. Datasets from each country were translated and aligned by matching question and answer choices to create a core analytic dataset.

A purposive, nationally representative sample of health facilities was selected in each country; within each selected facility, a convenience sample of pregnant persons presenting for routine antenatal care visits during any trimester of pregnancy and during the period of data collection were selected for interviews; respondents were representative of urban and rural settings, and ethnic and linguistic groups. Minor differences in study site type and selection criteria reflect local health delivery systems and infrastructure and may include public or private health facilities (antenatal care clinics, general health clinics, or vaccination clinics).

A mix of countries with (Albania, Armenia, Lao PDR, Morocco, Tunisia) and without (Cote d'Ivoire, Kyrgyzstan, Uganda) seasonal influenza vaccine programs for pregnant persons were included in our analysis. Countries reporting introduction of seasonal influenza vaccine among pregnant persons via the WHO/UNICEF Joint Reporting Form (JRF) (24) for two consecutive years, including the year of data collection, were classified as those with vaccination programs. Country income status was assigned using the World Bank (WB) lending group classification (25) during the year the surveys were administered.

We analyzed attitudes and perceptions toward seasonal influenza vaccine among pregnant persons, stratified by presence/absence of an influenza vaccination program, to explore differences between country groups (i.e., practice vs. intent). We analyzed data by WHO region based on the assumption of shared cultural norms and values within a region. Responses to KAP survey questions were provided on 5-point Likert scales. We dichotomized Likert scale responses into two categories: responses > 3 were classified as "positive" (i.e., good knowledge, positive attitude, good practices); responses that were ≤ 3 were classified as "negative" (i.e., poor knowledge, negative attitude, poor practices). We created composite ratings (i.e., positive, or negative) for overall perceived severity, safety, and benefit scores, calculated by summing positive or negative responses, or correct or incorrect responses, to relevant survey questions. Additional details regarding the calculation of scores are available in the associated table.

We performed logistic regression variable selection to identify key factors that were associated with acceptance of influenza vaccines. Variables in the selection process included those related to demographics (e.g., age and education), previous pregnancies and pregnancy care (e.g., number of pregnancies, hospitalizations, and antenatal visits), knowledge of influenza and/or influenza vaccines, potential barriers (e.g., cost and travel time), knowledge gaps, and misinformation (e.g., shortage of information and negative rumors about influenza vaccination).

Respondents were also asked how much they would be willing to pay for the seasonal influenza vaccine if it were available for purchase. Responses were recorded in local currency, and converted to US dollars (US\$) using the OANDA currency converter (26)

as of the last date the survey was administered to approximate the exchange rate at the time of the survey. Willingness to pay data were also presented as a percent of the country's health expenditure per capita (in USD), using a World Bank dataset summarizing data from the WHO Global Health Expenditure database (27). Data was stratified by World Bank lending group, and whether the country had a seasonal influenza vaccine program for pregnant persons during the study period. These data were analyzed using descriptive statistics and bivariate non-parametric tests (Kruskal-Wallis, Wilcoxon rank sum). Analyses were conducted using SAS 9.4.

Each implementing partner obtained ethical approvals in accordance with local regulations. All participants provided written informed consent.

RESULTS

Study population

Our analysis included 8,556 pregnant persons from 8 countries representing four of the six WHO regions; 27% (2,312) of respondents were from the African region, 27% from the Eastern Mediterranean (2,309), 21% from the European (1,835), and 25% from the Western Pacific (2,100). Sixty percent (60%, 5,155) of participants were from lower-middle income countries (LMIC), 23% (1,920) from low-income countries (LIC), and 17% (1,481) from upper-middle income countries (UMIC).

Five of the eight countries (63%) had seasonal influenza vaccine programs for pregnant persons at the time of data collection (Table 1), accounting for 69% of respondents (5,890); 31% (2,666) came from countries with no seasonal influenza vaccine program. All respondents in UMICs (Albania, Armenia), most (86%) in LMICs (Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia) and no respondents in LICs (Uganda) lived in countries where influenza vaccines were available free of charge to pregnant persons at the time of the survey. Twenty-three percent (1,943) of respondents in our study were aged between 18 and 24 years, 36% (3,062) between 25 and 29, 24% (2,009) between 30 and 34, 12% (1,024) between 35 and 39, and 4% (352) above the age of 40 years (Table 1).

Influenza and influenza vaccine knowledge, perceptions, and information channels

Most pregnant persons across both country groups had heard of seasonal influenza illness (5,945, 70%) (Table 2). Over half agreed or strongly agreed that influenza is more dangerous for pregnant persons than non-pregnant persons (5,017, 59%); a greater proportion of respondents from countries without influenza vaccination programs (2,004, 75%) believed that influenza is more dangerous for pregnant persons than respondents in countries with programs (3,013, 52%, $p < 0.001$) (Figure 1). About one third of respondents believed that people who have influenza are never sick enough to be hospitalized (2,830, 34%) or knew someone who had been severely ill with influenza (3,090, 36%). One quarter (2,197, 26%) believed that influenza does not cause a lot of illness in their country, and nearly half were unsure whether influenza vaccine is safe for a newborn baby (3,724, 44%), unborn baby (3,666, 43%), or pregnant persons (3,522, 41%).

There were similar differences in beliefs about the benefits of vaccination for new or unborn babies: among pregnant persons in countries with an influenza vaccination program 24% and 25% believed their own vaccination could protect their newborn or unborn baby, respectively. In contrast, pregnant persons in countries with no such program strongly believed in the protection for newborn (64%, $p<0.001$) or unborn babies (71%, $p<0.001$) (Figure 1). More than one third of pregnant persons across all settings were unsure whether their own vaccination helps protect their unborn (3,071, 36%) or newborn babies (3,265, 38%) (Figure 1). About one quarter (26%) of pregnant persons believed that influenza vaccine is unsafe for newborn or unborn babies, or for pregnant persons (25%) (Figure 1), however most responded that they did not receive enough information about the safety of influenza vaccines (6,307, 74%; Table 3). Although 10% (860) of pregnant persons had heard or read reports in media or social media that made them hesitate to receive influenza vaccines, only 4% (338) knew someone who had experienced a bad reaction to an influenza vaccine (Table 3). Fourteen percent (854) of pregnant persons from countries with influenza program in our study received an influenza vaccine recommendation from any source during their pregnancy, and thirteen percent (738) were discouraged from receiving influenza vaccine (Table 2).

The primary source of information about influenza vaccines for pregnant persons in countries with seasonal influenza vaccine programs was a doctor or other medical professional (1,583, 48%; Table 2); most pregnant persons had the greatest trust in information from a doctor or other medical professional (5,372, 91%) above all other sources; few trusted information from a family member (457, 8%), media (523, 9%), or friends (69, 1%) (Table 3).

Vaccine-related practices & intentions

Across all countries, most pregnant persons were willing to receive influenza vaccine if it was offered to them for free (6,323, 74%) with differences across country groups: among those in countries with a seasonal influenza vaccination program acceptance was lower (3,940, 67%) than in countries without influenza vaccination programs (2,383, 89%, $p<0.001$) (Table 4). The most trusted sources of recommendations were from healthcare personnel; two-thirds (5,751, 67%) of pregnant persons were willing to accept an influenza vaccine recommendation from a doctor, one quarter from midwives (1,950, 23%) and one fifth from nurses (1,495, 18%). Few respondents accepted vaccine recommendations from other sources: 8% (669) would accept a recommendation from a family member and 5% (396) from an international body (i.e., WHO). Recommendations from other sources were of minimal importance (Table 4). Most respondents were willing to take time off from work or away from home to receive an influenza vaccine (5,949, 70%), and were willing to spend up to 60 minutes (interquartile range [IQR] 15–120) to do so (Table 4).

Despite their willingness to accept their recommendation and the existence of a seasonal influenza vaccine program targeted to them, only 11% (659) of respondents recalled receiving an influenza vaccine recommendation from a medical provider during their pregnancy. (Table 2).

Predictors of vaccine acceptance in pregnant persons

Respondents who were willing to take time off from work to receive vaccines were more likely to accept vaccines than pregnant persons who were not, with an adjusted odds ratio (aOR) of 29.0 [22.3–37.7] ($p<0.001$) in countries with influenza vaccination programs and an aOR of 9.2 [5.5–15.3] ($p<0.001$) in countries without. Pregnant persons who believed that there were better ways to prevent influenza than through vaccination were less likely to accept vaccines than those who did not, with an aOR of 0.7 [0.6–0.9] ($p=0.001$) for countries with influenza vaccine programs and 0.6 [0.4–0.9] ($p=0.008$) for countries without. Respondents who perceived greater benefits of vaccination (benefit score) were more likely to accept influenza vaccine compared to those with a lower perception of benefits (aOR 1.2 [1.1–1.3] ($p<0.001$) for countries with influenza programs and 1.4 [1.2–1.5] ($p<0.001$) for countries without. Respondents who heard or read reports in the media or social media that would make pregnant persons hesitant about vaccination were less likely to accept influenza vaccines than those who had not heard or read such reports (0.5 [0.4–0.7], $p<0.001$). Respondents who were willing to pay were 1.9 times more likely to accept a vaccine than those who were unwilling to pay [1.4–2.6] ($p<0.001$) in countries with influenza vaccination programs; in countries with no program, those willing to pay were 3.9 [1.9–7.9] ($p<0.001$) times more likely to accept a vaccine than those who were unwilling to pay (Table 5).

Willingness to pay for vaccines

Respondents were asked how much they would be willing to pay for seasonal influenza vaccine if it was available for purchase. Sixty-one percent of those queried (5,221 (61%)) provided a price (median US\$1.30 [IQR: \$0.30–\$5.20]) (Table 6). Of those, 3,359 (64%) were in countries with influenza vaccination programs for pregnant persons, while 1,862 (36%) were in countries without a program. Pregnant persons in upper-middle income countries reported a higher median price (US\$9.40 [IQR: \$4.70–\$10.50]), compared with lower prices in lower-middle and low income countries (US\$1.50 [IQR: \$0.10–\$5.30] and US\$1.30 [IQR: \$0.50–\$2.60]) ($p<0.001$) respectively). The price in low-income countries represented a higher percentage of their country's annual health expenditure per capita relative to the other income groups ($p<0.001$). The amount respondents in countries lacking national influenza vaccination programs were willing to pay represented a higher percentage of their country's health expenditure per capita (median 4.10% [IQR: 1.60–8.10]) relative to the price pregnant persons in countries with vaccination programs were willing to pay (median 1.00% [IQR: 0.20–3.00]) ($p<0.001$) (Table 6).

DISCUSSION

We found an overall very high willingness to receive seasonal influenza vaccines among pregnant persons. High acceptance by pregnant persons in countries lacking influenza vaccination programs is perhaps not surprising, as global evidence shows a widespread acceptance of vaccines among pregnant persons in lower-middle income countries for influenza and other vaccines such as tetanus toxoid and pertussis (28–30).

Our analysis highlights the critical role that healthcare workers play in patient vaccine uptake. Indeed, health worker recommendation is a significant driver of vaccine acceptance among pregnant persons (15, 16, 31). Likewise, a recommendation against vaccination by a healthcare worker is a significant barrier to uptake or intent (32, 33). A 2020 review by Kilich et al. found that pregnant persons who had received a recommendation were ten to twelve times more likely to receive a pertussis or an influenza vaccine (15), and a 2017 multi-country study found an eight-fold increase in likelihood to accept a vaccine upon receipt of a recommendation (34). A 2019 Tunisian study found that a healthcare worker recommendation carried the connotation of vaccine safety, thus facilitating trust in the vaccine (14). Among pregnant persons in our analysis who were unsure if they would receive influenza vaccine, 80% could not recall receiving a recommendation to be vaccinated from a healthcare worker (Supp. Table 1). Nearly half of pregnant persons in our study were unsure if influenza vaccine was safe to infants and themselves (Supp. Table 2). A 2018 qualitative study in China found that few pregnant persons had received a recommendation; physicians in the study did not recommend vaccines, citing the lack of a national policy to vaccinate pregnant persons (32, 35). Such hesitancy to make a recommendation often leads to hesitancy on the part of pregnant persons to accept vaccines (36).

Most pregnant persons in our study did not feel they received enough information about the safety of seasonal influenza vaccines, one of the most common barriers to acceptance among pregnant persons observed (16, 37, 38). Common concerns both in our sample and in the literature included fears about vaccine safety for a newborn or unborn baby, and concerns about the safety for oneself (15, 37, 39). Healthcare workers who are aware of the benefits and importance of influenza vaccines for pregnant persons and confident making recommendations (14) may serve to increase uptake in pregnant persons.

High perceived benefits for themselves and/or their babies were predictive of vaccine acceptance in both groups of countries in our study. Similar trends are described in a 2022 review of acceptance in lower-middle income countries (38). Perceived benefits or lack thereof were paired with awareness of the risks of infection to mother and baby in our survey; pregnant persons with low perceived risk of influenza illness were less likely to accept a vaccine while belief in risks to mother or baby was associated with higher acceptance, consistent with current evidence (38, 40). While we found generally high awareness of influenza illness among pregnant persons, awareness of the risks associated with influenza was lower, suggesting that raising awareness of personal risk and risk to ones' newborn or unborn baby is a necessary first step toward increasing uptake among this population (41).

Pregnant persons in countries with no influenza vaccine program were willing to pay more for a vaccine, as a percentage of health expenditure per capita, than those in countries where influenza vaccine is offered for free. Contributing to a higher price willing to pay among pregnant persons in low- and middle-income countries might be their higher perceived threat of influenza illness, higher perceived benefits of protection, and higher perception of the need to vaccinate. Future assessment of willingness to pay for seasonal influenza vaccine might consider a bidding game question format as it is less sensitive to bias (42). Our

findings suggest that in the absence of a publicly funded influenza vaccination program, a subsidized national program may be an effective strategy to reduce the financial barriers to access.

Limitations

We are unaware of any equivalent analysis of primary data collected from pregnant persons across such a large group of countries, making our study unique. Our study was subject to several limitations. Fidelity of some questions may have been compromised by minor survey modifications in some countries; we believe that our careful matching of questions and answers across all country datasets was accurate enough to overcome this limitation. Surveys may have been subject to response bias, with respondents providing responses thought to be favorable to interviewers. Our estimates of willingness to seek vaccination based on intent may be higher than actual practice. Our study population may have been subject to selection bias due to data collection in clinical settings; not all pregnant persons seek antenatal care in a clinical setting, however WHO Global Health Observatory (43) data confirms that a mean of 89% of births in our study countries are medically attended. Finally, respondents who had not heard of influenza vaccine may have been ill-equipped to answer questions about their perceived safety or impact of influenza vaccine.

Conclusions & Recommendations

Our analysis shows that pregnant persons report a strong intent to accept influenza vaccines. Evidence collected since the COVID-19 pandemic variably shows both a decrease (44) and an increase (45, 46) in uptake in maternal vaccinations overall, these findings generally represent data from high-income settings. While the overall acceptance of vaccines may have diminished, that is unlikely to have made a significant change in the need for accessible vaccines for pregnant persons throughout low- and middle-income countries.

We propose several strategies to reduce vaccine hesitancy and remove modifiable barriers to vaccination. We propose actions to reduce healthcare workers' hesitancy to recommend vaccines to pregnant persons, including updating vaccine package inserts with current clinical care recommendations (47), establishing and updating national influenza vaccine policies to include pregnant persons. Importantly, increasing healthcare worker knowledge and awareness about the risks of influenza infection and safety of influenza vaccine is critical to build confidence in making vaccine recommendations for pregnant persons.

Removing logistical barriers to vaccination both for pregnant persons and healthcare workers may facilitate increased uptake. Offering in-office vaccination during antenatal care (ANC) visits may reduce time and travel-related barriers, thus increasing uptake among pregnant persons who are unwilling or unable to dedicate time for vaccination (48). Straightforward service delivery in ANC clinics, while ensuring well-coordinated efforts between health services (e.g., ANC and national immunization programs) may establish influenza vaccination as a standard of care (49).

The pronounced differences we observed in beliefs about protection conferred to newborn and unborn babies via maternal vaccination between pregnant persons in countries with and without influenza vaccine programs are notable. While our survey was not able to explain

this difference, our observation does suggest opportunities for greater dialogue between healthcare workers and their patients during antenatal care visits. Immunization programs in countries with influenza vaccine may consider training ANC providers in communicating the benefits of vaccination for pregnant persons and their babies. This may be accomplished via motivational interviewing or similar techniques (50).

After healthcare workers' recommendations, the second most important barrier to coverage among pregnant persons in low and lower-middle income countries, where acceptance of vaccines is very high, is access to vaccines. Investments in supporting the review of evidence, policy development and implementation in countries without an influenza vaccine program for pregnant persons are critical to increasing protection of pregnant persons and their babies.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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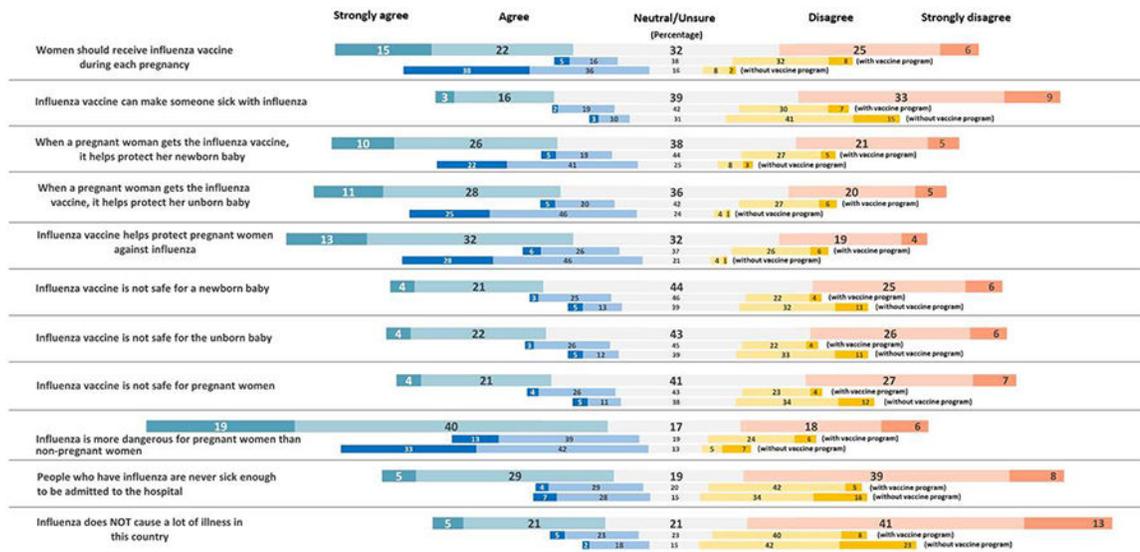


Figure 1. Reported beliefs and perceptions surrounding influenza and influenza vaccines among pregnant persons

Table 1.

Characteristics of respondents to Knowledge, attitudes, perceptions, and practices survey among pregnant persons in 8 countries*, 2018-2019

| | Vaccine Program (n=5890) | No Vaccine Program (n=2666) | Total (n=8556) | P-values [†] |
|---|-----------------------------|--------------------------------|----------------|-----------------------|
| World Health Organization Region, n (%) | | | | <0.001 |
| African | 0 (0) | 2312 (86.7) | 2312 (27.0) | |
| Eastern Mediterranean | 2309 (39.2) | 0 (0) | 2309 (27.0) | |
| European | 1481 (25.1) | 354 (13.3) | 1835 (21.4) | |
| Western Pacific | 2100 (35.7) | 0 (0) | 2100 (24.5) | |
| World Bank Income Group, n(%) | | | | <0.001 |
| Lower income | 0 (0) | 1920 (72.0) | 1920 (22.4) | |
| Lower-middle income | 4409 (74.9) | 746 (28.0) | 5155 (60.3) | |
| Upper-middle income | 1481 (25.1) | 0 (0) | 1481 (17.3) | |
| Age group (years), n (%) | | | | <0.001 |
| <18 | 133 (2.3) | 12 (0.5) | 145 (1.7) | |
| 18–24 | 1708 (29.0) | 235 (8.8) | 1943 (22.7) | |
| 25–29 | 1960 (33.3) | 1102 (41.3) | 3062 (35.8) | |
| 30–34 | 1297 (22.0) | 712 (26.7) | 2009 (23.5) | |
| 35–39 | 627 (10.6) | 397 (14.9) | 1024 (12.0) | |
| >40 | 157 (2.7) | 195 (7.3) | 352 (4.1) | |
| Missing/not provided | 8 (0.1) | 13 (0.5) | 21 (0.2) | |
| Education level, n (%) | | | | <0.001 |
| No formal education | 430 (7.3) | 158 (5.9) | 588 (6.9) | |
| Completed primary/secondary school | 3539 (60.1) | 2034 (76.3) | 5573 (65.1) | |
| Completed college/university | 820 (13.9) | 368 (13.8) | 1188 (13.9) | |
| Graduate school or higher | 89 (1.5) | 27 (1.0) | 116 (1.4) | |
| Other (Vocational training, etc.) | 0 (0) | 54 (2.0) | 54 (0.6) | |
| Missing/not provided | 1012 (17.2) | 25 (1.0) | 1037 (12.1) | |
| Marital status, n (%) | | | | <0.001 |
| Single/never married | 57 (1.0) | 319 (12.0) | 376 (4.4) | |
| Married/civil partnership/cohabitating | 4610 (78.3) | 2304 (86.4) | 6914 (80.8) | |
| Other | 53 (0.9) | 24 (0.9) | 77 (0.9) | |
| Missing/not provided | 1170 (19.8) | 19 (0.7) | 1189 (13.9) | |
| Gestational age at time of survey (months), median (IQR) | 6 (4–7) | 6 (5–8) | 6 (4–8) | <0.001 |
| Number of antenatal care visits during pregnancy, median (IQR) | 3 (2–5) | 2 (1–4) | 3 (2–5) | <0.001 |
| Underlying medical condition | | | | |
| Diabetes | 84 (1.4) | 3 (0.1) | 87 (1.1) | <0.001 |
| Heart disease | 24 (0.4) | 15 (0.6) | 39 (0.5) | 0.141 |
| High blood pressure | 129 (2.2) | 48 (1.8) | 177 (2.1) | 0.810 |
| Anemia | 361 (6.1) | 120 (4.5) | 481 (5.6) | 0.134 |
| Asthma | 34 (0.6) | 24 (0.9) | 58 (0.7) | 0.022 |

| | Vaccine Program (n=5890) | No Vaccine Program (n=2666) | Total (n=8556) | P-values[†] |
|----------------------|-------------------------------------|--|-----------------------|-----------------------------|
| Allergies | 119 (2.0) | 76 (2.8) | 195 (2.3) | 0.001 |
| Other | 208 (3.5) | 256 (9.6) | 464 (5.4) | <0.001 |
| None | 4959 (84.2) | 1784 (66.9) | 6743 (78.8) | <0.001 |
| Missing/not provided | 20 (0.3) | 392 (14.7) | 412 (4.8) | |

* Albania, Armenia, Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia, Uganda

[†] P-values were obtained from Pearson's Chi-squared test and Wilcoxon rank sum test

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Table 2.

Seasonal influenza and influenza vaccine knowledge among pregnant persons (n=8 countries *)

| | Vaccine Program (n=5890) | No Vaccine Program (n=2666) | Total (n=8556) |
|---|-----------------------------|-----------------------------------|----------------|
| Previously heard about seasonal influenza or flu, n (%) | | | |
| Yes | 3940 (66.9) | 2005 (75.2) | 5945 (69.5) |
| No | 1281 (21.7) | 654 (24.5) | 1935 (22.6) |
| Don't know/missing | 669 (11.4) | 7 (0.3) | 676 (7.9) |
| Previously heard about influenza vaccine, n (%) | | | |
| Yes | 3300 (56.0) | 565 (21.2) | 3865 (45.2) |
| No | 2426 (41.2) | 2086 (78.2) | 4512 (52.7) |
| Don't know/missing | 164 (2.8) | 15 (0.6) | 179 (2.1) |
| First source of information on influenza vaccine, n (%) | | | |
| Spouse/partner | 56 (1.7) | 8 (1.4) | 64 (1.7) |
| Other family member | 606 (18.4) | 57 (10.1) | 663 (17.2) |
| Friend(s) | 485 (14.7) | 7 (1.2) | 492 (12.7) |
| Doctor/other medical professional | 1583 (48.0) | 276 (48.9) | 1859 (48.1) |
| Television/radio | 1153 (34.9) | 73 (12.9) | 1226 (31.7) |
| Books/other printed materials (e.g., newspaper) | 183 (5.6) | 9 (1.6) | 192 (5.0) |
| Internet | 356 (10.8) | 24 (4.3) | 380 (9.8) |
| Other | 107 (3.2) | 11 (2.0) | 118 (3.1) |
| Was recommended to receive influenza vaccine during pregnancy, n (%) | | | |
| Yes | 854 (14.5) | 208 (7.8) | 1062 (12.4) |
| No | 4896 (83.1) | 572 (21.5) | 5468 (63.9) |
| Don't know/missing | 140 (2.4) | 1886 (70.7) | 2026 (23.7) |
| Person who recommended influenza vaccine, n(%) | | | |
| Any medical provider | 659 (77.2) | 157 (75.5) | 816 (76.8) |
| Doctor | 592 (69.3) | 81 (38.9) | 673 (63.4) |
| Nurse | 107 (12.5) | 86 (41.4) | 193 (18.2) |
| Midwife | 55 (6.4) | 15 (7.2) | 70 (6.6) |
| Family member | 80 (9.4) | 14 (6.7) | 94 (8.9) |
| Friend(s) | 27 (3.2) | 2 (1.0) | 29 (2.7) |
| Media | 50 (5.9) | 4 (1.9) | 54 (5.1) |
| Other | 10 (1.2) | 13 (6.3) | 23 (2.2) |
| Discouraged to receive influenza vaccine during pregnancy, n(%) | | | |
| Yes | 738 (12.5) | 53 (2.0) | 791 (9.2) |
| No | 5058 (85.9) | 2598 (97.5) | 7656 (89.5) |
| Don't know/missing | 94 (1.6) | 15 (0.5) | 109 (1.3) |
| Person who discouraged influenza vaccine, n(%) | | | |
| Any medical provider | 83 (11.3) | 21 (39.6) | 104 (13.2) |
| Doctor | 69 (9.3) | 13 (24.5) | 82 (10.4) |
| Nurse | 13 (1.8) | 10 (18.9) | 23 (2.9) |

| | Vaccine Program (n=5890) | No Vaccine Program (n=2666) | Total (n=8556) |
|---------------|-----------------------------|-----------------------------------|----------------|
| Midwife | 16 (2.2) | 4 (7.6) | 20 (2.5) |
| Family member | 82 (11.1) | 13 (24.5) | 95 (12.0) |
| Friend(s) | 32 (4.3) | 4 (7.6) | 36 (4.6) |
| Media | 14 (1.9) | 0 (0) | 14 (1.8) |
| Other | 3 (0.4) | 1 (1.9) | 4 (0.5) |

* Albania, Armenia, Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia, Uganda

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Table 3.

Attitudes and perceptions about influenza and influenza vaccines among pregnant persons (n=8 countries *)

| | Vaccine Program (n=5890) | No Vaccine Program (n=2666) | Total (n=8556) |
|--|-----------------------------|-----------------------------------|----------------|
| Who/what source would trust the most to give accurate information on influenza vaccines, n(%) | | | |
| Family member | 457 (7.8) | 226 (8.5) | 683 (8.0) |
| Friend(s) | 69 (1.2) | 98 (3.7) | 167 (2.0) |
| Doctor/other medical professional | 5372 (91.2) | 2348 (88.1) | 7720 (90.2) |
| Media | 523 (8.9) | 185 (6.9) | 708 (8.3) |
| Other | 113 (1.9) | 282 (10.6) | 395 (4.6) |
| Receive enough information about safety of influenza vaccines, n (%) | | | |
| Yes | 1050 (17.8) | 357 (13.4) | 1407 (16.4) |
| No | 4291 (72.9) | 2016 (75.6) | 6307 (73.7) |
| Don't know/missing | 549 (9.3) | 293 (11.0) | 842 (9.8) |
| Heard/read reports in the media/social media that cause hesitation to receive influenza vaccine, n(%) | | | |
| Yes | 612 (10.4) | 248 (9.3) | 860 (10.1) |
| No | 3015 (51.2) | 2156 (80.9) | 5171 (60.4) |
| Don't know/missing | 2263 (38.4) | 262 (9.8) | 2525 (29.5) |
| Know someone who has been severely ill with influenza, n(%) | | | |
| Yes | 1945 (33.0) | 1145 (43.0) | 3090 (36.1) |
| No | 3687 (62.6) | 1427 (53.5) | 5114 (59.8) |
| Don't know/missing | 258 (4.4) | 94 (3.5) | 352 (4.1) |
| Know someone who has had a bad reaction to the influenza vaccine, n(%) | | | |
| Yes | 287 (4.9) | 51 (1.9) | 338 (4.0) |
| No | 5225 (88.7) | 2532 (95.0) | 7757 (90.7) |
| Don't know/missing | 378 (6.4) | 83 (3.1) | 461 (5.4) |
| Believe there are other, better ways to prevent disease than through vaccination, n (%) | | | |
| Yes | 1581 (26.8) | 491 (18.4) | 2072 (24.2) |
| No | 2649 (45.0) | 1683 (63.1) | 4332 (50.6) |
| Don't know/missing | 1660 (28.2) | 492 (18.5) | 2152 (25.2) |

* Albania, Armenia, Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia, Uganda

Table 4.Attitudes and perceptions about receiving influenza vaccines among pregnant persons (n=8 countries^{*})

| | Vaccine Program (n=5890) | No Vaccine Program (n=2666) | Total (n=8556) |
|---|-----------------------------|--------------------------------|----------------|
| Would receive influenza vaccine during pregnancy if recommended and free, n (%) | | | |
| Yes | 3940 (66.9) | 2383 (89.4) | 6323 (73.9) |
| No | 1589 (27.0) | 222 (8.3) | 1811 (21.2) |
| Don't know/missing | 361 (6.1) | 61 (2.3) | 422 (4.9) |
| Reasons would accept to receive influenza vaccine during pregnancy, n (%) | | | |
| Recommended by a doctor | 4245 (72.1) | 1506 (56.5) | 5751 (67.2) |
| Recommended by a nurse | 739 (12.6) | 756 (28.4) | 1495 (17.5) |
| Recommended by a midwife | 1054 (17.9) | 896 (33.6) | 1950 (22.8) |
| Recommended by another healthcare worker | 745 (12.7) | 644 (24.2) | 1389 (16.2) |
| Recommended by the Ministry of Health | 635 (10.8) | 357 (13.4) | 992 (11.6) |
| Recommended by an international organization (e.g., World Health Organization) | 305 (5.2) | 91 (3.4) | 396 (4.6) |
| Recommended by an NGO | 45 (0.8) | 36 (1.4) | 81 (1.0) |
| Recommended by family member (who is not a doctor) | 401 (6.8) | 268 (10.0) | 669 (7.8) |
| Recommended by a friend (who is not a doctor) | 60 (1.0) | 73 (2.7) | 133 (1.6) |
| Recommended by media | 195 (3.3) | 107 (4.0) | 302 (3.5) |
| Don't know/other | 272 (4.6) | 695 (26.1) | 967 (11.3) |
| Reasons would refuse to receive influenza vaccine during pregnancy, n (%) | | | |
| Had concerns that the vaccine would weaken immune system | 1873 (31.8) | 420 (15.8) | 2293 (26.8) |
| Believed that it is better to suffer the natural disease than to be vaccinated | 576 (9.8) | 73 (2.7) | 649 (7.6) |
| Believed that influenza is not dangerous to self | 677 (11.5) | 110 (4.1) | 787 (9.2) |
| Believed that influenza is not dangerous to baby | 473 (8.0) | 84 (3.2) | 557 (6.5) |
| Believed vaccine is not effective | 960 (16.3) | 380 (14.3) | 1340 (15.7) |
| Had ethical, moral, or religious reasons | 188 (3.2) | 163 (6.1) | 351 (4.1) |
| Had concerns that the vaccine might harm self during pregnancy | 965 (16.4) | 595 (22.3) | 1560 (18.2) |
| Had concerns that the vaccine might harm fetus during pregnancy | 1807 (30.7) | 474 (17.8) | 2281 (26.7) |
| Was not authorized to get vaccine by husband or household member | 587 (10.0) | 117 (4.4) | 704 (8.2) |
| Don't know/other | 1912 (32.5) | 796 (29.7) | 2708 (31.7) |
| Willing to take time off work or away from home to receive influenza vaccine, n (%) | | | |
| Yes | 3869 (65.7) | 2080 (78.0) | 5949 (69.5) |
| No | 1169 (19.9) | 113 (4.2) | 1282 (15.0) |
| Don't know/missing | 852 (14.5) | 473 (17.7) | 1325 (15.5) |
| Maximum of time able/willing to spend to receive influenza vaccine (minutes), median (IQR) | | | |
| | 30 (15–60) | 60 (15–180) | 60 (15–120) |

* Albania, Armenia, Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia, Uganda

Table 5.

Adjusted odds ratios of pregnant persons to accept influenza vaccines (n=8 countries*)

| | Vaccine Program (n=5,890) | No Vaccine Program (n=2,666) |
|---|------------------------------|---------------------------------|
| World Health Organization (WHO) region | | |
| African | N/A | 13.1 (6.8, 25.2) |
| Eastern Mediterranean | 0.7 (0.5, 1.2) | N/A |
| European | 0.3 (0.2, 0.4) | ref |
| Western Pacific | ref | N/A |
| World Bank Income Group | | |
| Low Income | N/A | ref |
| Lower Middle Income | | 4.4 (2.1, 8.9) |
| Ever heard of influenza | | |
| No | N/A | ref |
| Yes | | 1.8 (1.3, 2.6) |
| Willing to pay for vaccine | | |
| No | ref | ref |
| Yes | 1.9 (1.4, 2.6) | 3.9 (1.9, 7.9) |
| Willing to take time off from work to receive vaccine | | |
| No | ref | ref |
| Yes | 29.0 (22.3, 37.7) | 9.2 (5.5, 15.3) |
| Believe that there are better ways to prevent influenza than through vaccination | | |
| No | ref | ref |
| Yes | 0.7 (0.6, 0.9) | 0.6 (0.4, 0.9) |
| Heard reports in media or social media causing vaccine hesitancy | | |
| No | ref | N/A |
| Yes | 0.5 (0.4, 0.7) | |
| Number of pregnancies | | |
| 1 | ref | N/A |
| 2-4 | 1.0 (0.8, 1.1) | |
| 5 or more | 1.6 (1.1, 2.1) | |
| Perceived severity from influenza virus ^a | 1.1 (1.0, 1.2) | N/A |
| Perceived safety from influenza vaccination ^b | 1.0 (1.0, 1.1) | N/A |
| Perceived benefits from influenza vaccination ^c | 1.2 (1.1, 1.3) | 1.4 (1.2, 1.5) |

** Albania, Armenia, Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia, Uganda

^aScore (0-3) generated from the survey questions: 1) influenza does not cause a lot of illness in this country, 2) people who have influenza are never sick enough to be admitted to the hospital, and 3) influenza is more dangerous for pregnant persons than non-pregnant persons.

^bScore (0-4) generated from the survey questions: 1) influenza vaccine is not safe for pregnant persons, 2) influenza vaccine is not safe for the unborn baby, 3) influenza vaccine is not safe for a newborn baby, and 4) influenza vaccine can make someone sick with influenza.

^cScore (0-4) generated from the survey questions: 1) influenza vaccine helps protect pregnant persons against influenza, 2) when a pregnant persons gets the influenza vaccine, it helps protect her unborn baby, 3) when a pregnant person gets the influenza vaccine, it helps protect her newborn baby, and 4) pregnant persons should receive influenza vaccine during each pregnancy.

Table 6.Willingness to Pay (WTP) for influenza vaccines among pregnant persons (8 countries ^{**})

| | n (%) [*] | WTP | | WTP as % of health expenditure per capita [†] | |
|--|--------------------|------------------|-----------------|--|-----------------|
| | | Median USD [IQR] | <i>p</i> -value | Median % [IQR] | <i>p</i> -value |
| Overall | 5221 (61.0) | 1.3 (0.3–5.2) | | 2.1 (0.4–4.1) | |
| Country income classification[‡] | | | | | |
| Low (n=1) | 1443 (27.6) | 1.3 (0.5–2.6) | <0.0001 | 4.1 (1.6–8.1) | <0.0001 |
| Lower-middle (n=5) | 3308 (63.4) | 1.5 (0.1–5.3) | | 1.2 (0.2–3.0) | |
| Upper-middle (n=2) | 470 (9.0) | 9.4 (4.7–10.5) | | 3.4 (1.2–3.4) | |
| National vaccine program[§] | | | | | |
| Present (n=5) | 3359 (64.3) | 2.1 (0.1–6.4) | 0.4287 | 1.0 (0.2–3.0) | <0.0001 |
| Absent (n=3) | 1862 (35.7) | 1.3 (0.8–2.6) | | 4.1 (1.6–8.1) | |

* Inclusive of all pregnant persons who provided a price for how much they would be willing to pay for the influenza vaccine, excluding those reporting they would pay US\$0.

** Albania, Armenia, Cote d'Ivoire, Kyrgyzstan, Lao PDR, Morocco, Tunisia, Uganda

[†] Current health expenditure per capita (USD), World Bank (2018).

[‡] Country income defined using World Bank lending group designation during the year of and year preceding of survey administration in each country.

[§] Presence of a national influenza vaccination programs defined as existence of a program in the year or an year preceding survey administration.