Scientific Research Publishing

Open Journal of Epidemiology, 2024, 14, 221-237
https://www.scirp.org/journal/ojepi
ISSN Online: 2165-7467
ISSN Print: 2165-7459

Socio-Demographic and Economic Factors Associated with Uptake of COVID-19 Vaccine among Pregnant Women at Pumwani Maternity Hospital in Nairobi County, Kenya

Nyawela S. Nyibil[1*], Gideon Kikuvi[1], Isabel Kazanga Chiumia[2]

[1]Jomo Kenyatta University of Agriculture and Technology, School of Public Health, Department of Environmental Health and Disease Control, Nairobi, Kenya
[2]Department of Health Systems and Policy, Kamuzu University of Health Sciences, Lilongwe, The Republic of Malawi
Email: *nyawelasimon@gmail.com

How to cite this paper: Author 1, Author 2 and Author 3 (2024) Paper Title. *Open Journal of Epidemiology*, **14**, 221-237.
https://doi.org/10.4236/ojepi.2024.142015

Received: January 7, 2024
Accepted: March 26, 2024
Published: March 29, 2024

Abstract

Introduction: Pregnant women are a highly vulnerable population for COVID-19 with increased risk of hospitalization, intensive-care unit admission, invasive ventilation support, and mortality. **Objective:** This study determined the socio-demographic and economic factors associated with the uptake of COVID-19 vaccine among pregnant women utilizing antenatal care services in Pumwani Maternity Hospital, Nairobi County-Kenya. Methods: The study was carried out from 15 June to 23 July 2023. Systematic sampling was used to select 302 women from whom data was collected through face-to-face interviews using a pre-tested semi-structured questionnaire. Data was analyzed using SPSS software in which bivariate and multivariate logistic regression analyses were done at a significance level of $p < 0.05$. **Results:** A total of 302 pregnant women participated in the study. Of these, 105 (34.8%) were aged between twenty-six (26) and thirty (30) years. The mean age of the women was 28.60 ± (SD = 5.297). The uptake of the COVID-19 vaccine was 41.1%. The common side effects reported to be associated with the vaccines were fever, headache, joint pain, vomiting and skin rash. Uptake of the COVID-19 vaccine was significantly associated with being married (AOR = 3.65, 95% CI: 0.62 - 1.80, p = 0.001), having a secondary level of education (AOR = 3.78, 95% CI: 0.99 - 2.88, p = 0.001) and being employed (COR = 2.66, 95% CI: 1.31 - 3.06, p = 0.001). **Conclusion:** COVID-19 vaccination uptake remains low among pregnant women in seeking ANC in Nairobi. The individual factors associated with the uptake of COVID-19 vaccine among pregnant Women at Pumwani

maternity hospital in Nairobi County were being married, having secondary level of education and being employed. Integration of the COVID-19 vaccine with other routine vaccinations as per the national immunization program in Kenya and the enhancement of education regarding the safety and efficacy of the COVID-19 vaccine in pregnancy and breastfeeding and economic empowerment of women are recommended.

Keywords

COVID-19, Vaccine Uptake, Associated Factors, Pregnant Women

1. Introduction

The Coronavirus Disease 2019 (COVID-19) is caused by novel severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). This pandemic disease had a major impact on humans in terms of life loss, loss of economic benefits, and increased poverty [1]. Although vaccines were introduced to fight against the pandemic, acceptance has been a challenge [2]. The vaccination coverage at the global level has been estimated at 60.04% and 5.9% for fully and partially vaccinated populations respectively. In contrast, the African region had covered 17 % and 5.3% fully and partially vaccinated (ourworldindata.org).

In Kenya, there have been growing efforts to increase the uptake of COVID-19 even among pregnant women. The vaccination coverage for the country was 31% for those that are fully vaccinated and 9.2% being partially vaccinated, while in Nairobi County as of the end of May 2022, it was 48.9% for fully vaccinated [3]. Pregnant women are at high risk for severe illness and death from COVID-19 unlike non-pregnant ones [4] and also are at a higher risk of delivering a premature baby [5]. In mid-August 2021, the Kenya Obstetrical and Gynecological Society (KOGS) recommended access to the vaccines for pregnant and breastfeeding women noting that there is no evidence of adverse maternal or fetal effects from vaccinating pregnant women [6]. Pregnant women are at an expanded chance of risk of severe illness and passing on from COVID-19 unlike non-pregnant as the rates of admission to intensive care are three times greater in pregnant women compared to non-pregnant women, with a 25% greater likelihood of death [7]. In addition, women who contract COVID-19 during pregnancy have a higher risk of pre-eclampsia, preterm birth, stillbirth, and early neonatal death [8]. Despite Nairobi County having the highest prevalence of COVID-19 and a continuous supply of vaccines, vaccination coverage remains very low at 48%. Therefore, this study aimed to determine the level of uptake and socio-demographic and economic factors associated with the uptake of the COVID-19 vaccine among pregnant women utilizing antenatal care services at Pumwani Maternity Hospital in Nairobi County, Kenya.

2. Materials and Methods

2.1. Study Site

This study was carried out in Pumwani Maternity Hospital (PMH) which is located in Kamukunji Sub-county in Nairobi County, Kenya. PMH was purposely selected since it is a reference maternity hospital in the East African region, and the largest referral maternity hospital specializing in Obstetrics. This county covers an area of 703.9 Km^2 and a target population of 4,397 people [9].

2.2. Type and Period of Study

This was a facility-based cross-sectional study that was conducted from 15 June to 23 July 2023 and employed mixed methods approaches.

2.3. Study Population

The study population was pregnant women who were utilizing antenatal care services at PMH in Nairobi County.

2.3.1. Inclusion Criteria

Pregnant women written informed consent to participate in the study.

2.3.2. Exclusion Criteria

Pregnant women who were severely sick and those who had hearing difficulties or were mentally challenged were excluded.

2.4. Sample Size

The sample size for the study was determined using the Cochran, [10] Formula, 95% confidence, 5% margin of error, and 48.9% prevalence of COVID-19 vaccine uptake in the general population in Nairobi County as of May 2022. Since the average monthly ANC attendance at PMH was 900, the finite population correction factor was used to adjust the sample.

$$n_0 = \frac{1.96^2 (0.489)(1-0.489)}{0.05^2} = 383.97$$

The Adjusted sample size is estimated in the following equation

$$n = \frac{n_0}{1+\frac{(n_0-1)}{N}}$$

Adjusted sample size:

$$n = \frac{383.97}{1+383.97-1/900} = 269.7$$

Minimum sample size = 270

2.5. Study Variables

The independent variables studied included individual characteristics (age, marital status, educational level, occupation, personal income risk perception, fear

of injection & and side effects, trust & and confidence, concern about baby & and future pregnancy) and facility-level characteristics (availability of vaccination section, vaccine stock out, long queues at the vaccination site, vaccinator is not available and long distance to the facility). Knowledge and attitudes toward the COVID-19 vaccine were also studied. The dependent variable was COVID-19 vaccine uptake among pregnant utilizing antenatal care services.

2.6. Data Collection Tools, Training of Research Assistants and Pre-Testing of the Questionnaire

Quantitative data was collected using a semi-structured interviewer-administered questionnaire using the Kobo Toolbox application and a Key Informant Interview (KII) guide. Five students pursuing health-related courses were involved as research assistants after being trained on data collection by the researcher for two days. The questionnaire was pretested at Mama Lucy Kibaki Hospital in Nairobi County to evaluate the clarity of the questions. The questions that were not clearly understood during the pretest were revised before collecting data for the study.

2.7. Selection of Study Participants and Data Collection

Systematic random sampling was used to select study participants from among pregnant women utilizing antenatal care services at PMH. The sampling interval "K^{th}" pregnant woman to be selected was computed each day before administering the questionnaire depending on the number of women who were present at the MCH clinic on the day of data collection. Ten to fifteen questionnaires were administered each day. Quantitative data were collected using face-to-face interviews which were conducted in a designated room at the MCH clinic to ensure privacy and confidentiality. Data was collected on the participants' socio-demographic and cultural characteristics, knowledge, and attitudes toward the COVID-19 vaccine. The filled questionnaires were sent directly to the Kobo Toolbox server and checked daily by the researcher. Qualitative data was collected by conducting four KIIs with the MCH in charge, vaccinators, and midwives.

2.8. Data Management and Analysis

Data was downloaded from the Kobo toolbox server into an Excel sheet for cleaning and then exported to SPSS for analysis. The bi-variable Chi-square test and multivariable logistic regression models were applied to identify factors associated with the uptake COVID-19 vaccine among pregnant women utilizing antenatal care services. The difference was considered to be significant at $p < 0.05$. Thematic analysis was used to analyze the qualitative data.

2.9. Ethical Considerations

Ethical clearance was obtained from the Jomo Kenyatta University of Agriculture and Technology, Institutional Scientific and Ethics Review Committee and a research permit from the National Commission for Science and Innovation

(NACOSTI). Administrative approval was obtained from the County Director of Health, Nairobi County, and the Medical Superintendent of PMH and Mama Lucy Kibaki Hospital. Written Informed consent was obtained from all the study participants after explaining to them the nature of the study. Confidentiality and privacy of the responses were ensured throughout the process. Participants who had not been vaccinated were referred to the vaccination center to receive the COVID-19 vaccine.

3. Results

3.1. Socio-Demographic and Socio-Economic Characteristics of Respondents

A total of 302 pregnant women participated in the study. Of these, 105 (34.8%) were aged between twenty-six (26) and thirty (30) years. The mean age was 28.60 ± (SD = 5.297). The majority 212 (70.2%) of the respondents were married and more than fifty percent 161 (53.3%) had attained the secondary level of education. About eighty-two percent 246 (81.5%) of the respondents were Christians. Most 122 (40.4%) of the respondents were housewives and five fifty-five percent 166 (55.0%) had no monthly income (Table 1).

Table 1. Socio-demographic and socio-economic characteristics of respondents.

Characteristic	Categories	Frequency (N)	Percentage (%)
Age (years), mean ± (SD)		28.60 ± 5.297	
Age	18 - 25 years	92	30.5%
	26 - 30 years	105	34.8%
	31 - 35 years	67	22.2%
	36 - 40 years	34	11.3%
	>40 years	4	1.3%
Marital Status	Cohabiting	2	0.7%
	Divorce	9	3.0%
	Married	212	70.2%
	Not Married	79	26.2%
Highest level of education	No Formal Education	10	3.3%
	Primary Education	51	16.9%
	Secondary Education	161	53.3%
	Tertiary Education	80	26.5%
Religious Affiliation	Christian	246	81.5%
	Muslim	56	18.5%
Employment Status	Employed	84	27.8%
	Housewife	122	40.4%
	Not Employed	48	15.9%
	Self Employed	48	15.9%
Average Monthly Income	Ksh 10,000 - 50,00	120	39.7%
	Ksh 60,000 - 100,000	14	4.6%
	Above Ksh 100,000k	2	0.7%
	No Monthly Income	166	55.0%

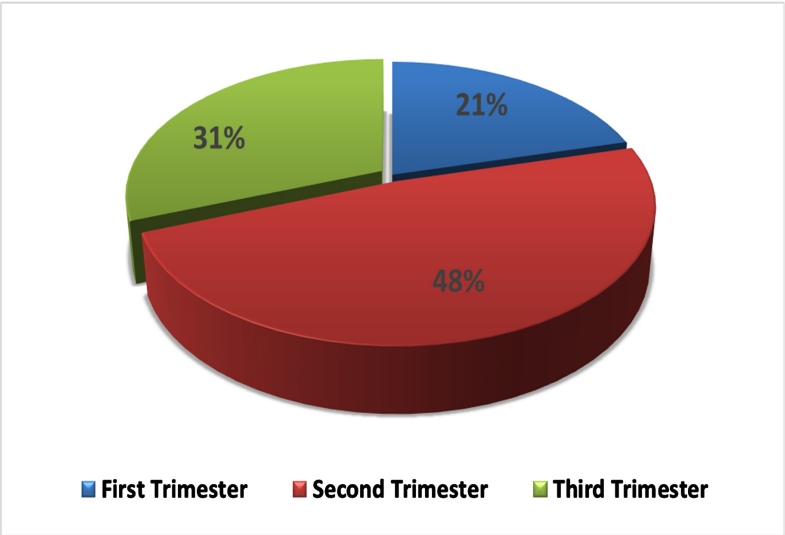

Figure 1. Stage of gestation of the respondents.

3.2. Stage of Gestation of the Respondents

Most 146 (48.3%) of the respondents were in the second trimester of the pregnancy (Figure 2) followed by 93 (30.8%) in the third trimester. Followed by 63 (20.9%) having their first trimester (Figure 1).

3.3. Uptake of COVID-19 Vaccine and Reported Side Effects

The uptake of the COVID-19 vaccine was 41.1% (124/302). Of these, 75 (60.5%) had received two doses of the COVID-19 vaccine. Moreover, 14 (11.3%) received more than two doses. Forty-nine 49 (39.5%) of the respondents were vaccinated with Johnson & Johnson, 27 (21.8%) with AstraZeneca, 16 (12.9%) and 11 (8.9%) were vaccinated with Pfizer and Moderna, respectively, while a small group of 11 (8.87%), 3 (2.42%), 3 (2.42%), 3 (2.43%), 3 (2.42%), 5 (4.03%), 2 (1.61%), 1 (0.81%) and 1 (0.81%) of the pregnant women were vaccinated with moderna, AstraZeneca + moderna, Johnson & Johnson + Pfizer, moderna + Pfizer, Pfizer + moderna, Pfizer + Johnson & Johnson, Johnson & Johnson + moderna, Moderna + AstraZeneca, and Pfizer + AstraZeneca, respectively. Majority 101 (81.5%) of the respondents were vaccinated from public health facilities. Three quarters 94 (75.8%) of the vaccinated study participants reported having experienced side effects after vaccination, which included headache, joint pain, abscess at the injection site, vomiting and skin rash (Table 2).

3.4. Individual-Level Factors Associated with the Uptake of the COVID-19 Vaccine among Pregnant Women at Pumwani Maternity Hospital in Nairobi County, Kenya

At bivariate analysis, uptake of the COVID-19 vaccine was significantly associated with marriage ($p < 0.001$), level of education ($p < 0.001$), average monthly income and religious affiliation ($p < 0.001$). There was no significant association with the other variable investigated in this study (Table 3).

Table 2. Uptake of COVID-19 vaccine and reported side effects among the respondents.

Variable	Categories	Frequency (N)	Percentage (%)
Number of respondents who had been vaccinated against COVID-19	Yes	124	41.1%
	No	178	58.9%
Number of doses of COVID-19 vaccine received by those vaccinated	One dose	35	28.23%
	Two doses	75	60.48%
	More than two doses	14	11.29%
	Total	124	100
Type of COVID-19 vaccine received	AstraZeneca	27	21.77%
	Johnson & Johnson	49	39.52%
	Pfizer	16	12.90%
	Moderna	11	8.87%
	AstraZeneca + Moderna	3	2.42%
	Johnson & Johnson + Moderna	2	1.61%
	Johnson & Johnson + Pfizer	3	2.42%
	Moderna + AstraZeneca	1	0.81%
	Moderna+ Pfizer	3	2.42%
	Pfizer + AstraZeneca	1	0.81%
	Pfizer + Johnson & Johnson	5	4.03%
	Pfizer + Moderna	3	2.42%
	Total	124	100
Places from where the respondents received the vaccine	Private health facility	14	11.3%
	Public health facility	101	81.5%
	Others	9	7.3%
	Total	124	100
The proportion of respondents that experienced side effects.	Yes	94	75.8%
	No	30	24.2%
	Total	124	100
	Headache	18	19.1%
	Joint pain	5	5.3%
	Generalized pain	4	4.3%
	Abscess at the injection site	3	3.2%
	Local reaction	2	2.1%
	Other	1	1.1%
	Skin rash	1	1.1%
	Vomiting	1	1.1%
	Total	94	100

Table 3. Individual-level factors associated with the vaccine uptake.

Variable	Categories	Taken Up COVID-19 Vaccine	Not Taken Up COVID-19 Vaccine	X^2 p-value
Marital Status	Cohabiting	2 (66.7%)	1 (33.3%)	Sig = 0.001
	Divorced	2 (25.0%)	6 (75.0%)	
	Married	91 (42.9%)	121 (57.1)	
	Not Married	29 (36.7%)	50 (63.3%)	
Highest level of education	No Formal Education	3 (30.0%)	7 (70.0%)	Sig = 0.001
	Primary Education	17 (33.3%)	34 (66.7%)	
	Secondary Education	66 (41.0%)	95 (59.0%)	
	Tertiary Education	38 (47.5%)	42 (52.5%)	

Continued

Employment Status	Employed	45 (54.9%)	37 (52.5%)	Sig = 0.480
	Housewife	44 (35.5%)	80 (64.5%)	
	Not Employed	35 (48.6%)	37 (51.4%)	
	Self Employed	0 (0.00%)	0 (0.00%)	
	Others	0 (0.00%)	24 (100.0%)	
Average Monthly Income	10,000 - 50,000 ksh	60 (48.8%)	63 (51.2%)	Sig = 0.001
	60,000 - 100,000 ksh	7 (53.8%)	6 (46.2%)	
	Above 100,000 ksh	2 (66.7%)	1 (33.3%)	
	Non	55 (33.7%)	108 (66.7%)	
Religious Affiliation	Christian	104 (42.4%)	141 (57.6%)	Sig = 0.001
	Muslim	20 (35.1%)	37 (64.9%)	

Table 4. Multi-variable logistic regression analysis.

Variable	Categories	COVID-19 Vaccine up taken		COR (95% CI)	AOR (95% CI)
		Yes	No		
Marital Status	Not Married	29	50	1	1
	Married	91	121	3.22 (0.98 - 3.01)	3.65 (0.62 - 1.80)
	Divorced	2	6	0.66 (0.31 - 1.76)	1.45 (0.99 - 2.56)
	Cohabiting	2	1	1.45 (0.31 - 2.22)	0.93 (0.99 - 2.22)
Highest level of education	No Formal Education	3	7	1	1
	Primary Education	17	34	1.98 (0.24 - 1.76)	1.88 (0.43 - 1.45)
	Secondary Education	66	95	3.50 (0.31 - 2.11)	3.78 (0.99 - 2.88)
	Tertiary Education	38	42	2.32 (0.50 - 3.07)	1.83 (0.44 - 1.76)
Employment Status	Not Employed	35	37	1	1
	Employed	45	37	2.66 (1.31 - 3.06)	1.80 (0.99 - 2.88)
	Housewife	44	80	1.58 (1.36 - 2.11)	2.48 (0.81 - 8.33)
Average Monthly Income	Non	55	108	1	1
	10,000 - 50,000ksh	60	63	2.31 (1.43 - 212)	2.77 (0.99 - 2.90)
	60,000 - 100,000ksh	7	6	1.23 (0.98 - 2.76)	0.67 (0.84 - 1.96)
	Above 100,000ksh	2	1	0.66 (0.31 - 3.22)	0.89 (0.99 - 2.56)

3.5. Individual Factors Independently Associated with the Uptake of COVID-19 Vaccine among Pregnant Women at Pumwani Maternity Hospital in Nairobi County, Kenya

Married pregnant women were 3.65 times more likely to take up COVID-19 vaccine than unmarried (AOR = 3.65, 95% CI: 0.62 - 1.80, p = 0.001). Also, pregnant women who had a secondary education level had 3.78 times the likelihood of taking the COVID-19 vaccine than those without formal education (AOR = 3.78, 95% CI: 0.99 - 2.88, p = 0.001). Furthermore, pregnant women who had Jobs or were employed were more likely to take up the COVID-19 vaccine than those not employed (COR = 2.66, 95% CI: 1.31 - 3.06, p = 0.001) (Table 4).

The factors reported by all the Key Informants to be contributing to low uptake of COVID-19 vaccine were lack of knowledge about the COVID 19 vaccine, fear of injection, traditional and cultural beliefs and chronic illnesses within the population (Figure 2).

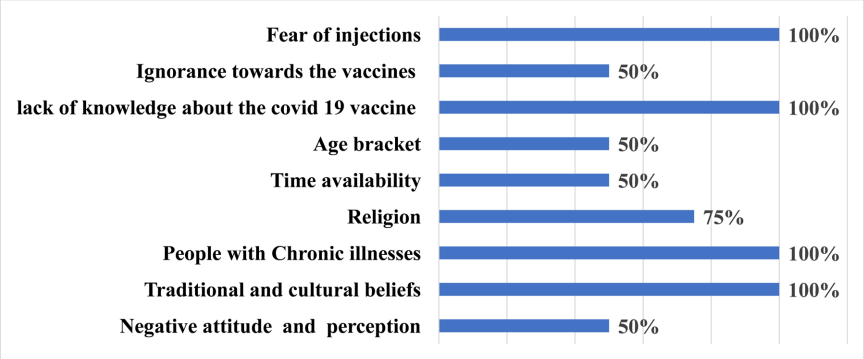

Figure 2. Factors reported by KIs to influence the uptake of the COVID-19 vaccine.

4. Discussion

This study estimated the COVID-19 vaccine uptake among pregnant women as 41.1% of whom 60.5% had received two doses. Despite the well-defined maternal and neonatal COVID-19 risks and the vaccine's proven benefits, the vaccine uptake among pregnant women was lower than among the Nairobi County population, which was 48% as of 2022. The fact that 48.3% of the respondents in the current study were in the second trimester of the pregnancy agrees with studies done in Wales [11] [12] and Saudi Arabia [13] which showed that pregnant women at later gestation are more likely to accept the vaccine. The most common side effects of COVID-19 vaccines experienced by respondents in our study which were headache, generalized pain and joint pain were similar to those reported by other researchers [14] [15], and [16]. The findings contrast those reported by [17] and [18] who found the most common side effects for Pfizer, AstraZeneca and Sinopharm COVID-19 vaccines to be local effects, including pain, redness, and swelling at the injection site.

Uptake of the COVID-19 vaccine was significantly associated with marriage ($p < 0.001$), level of education ($p < 0.001$), average monthly income and religious affiliation ($p < 0.001$). Those who were married were 3.65 times more likely to take up COVID-19 vaccine than the unmarried. Pregnant women who had a secondary education level had 3.78 times likelihood of taking the COVID-19 vaccine than those without formal education. Pregnant women who had a secondary education level had 3.78 times likelihood of taking the COVID-19 vaccine than those without formal education. The findings agree with reports from studies conducted in Ireland, Norway, Switzerland, the Netherland and United Kingdom which found that participants who were not married and those who low level of education (no formal education and primary education) were less likely to receive COVID-19 vaccine because of less income to cover the treatment of the side effects associated with the vaccinated [19]. Uptake of COVID-19 vaccine was found to be associated with higher levels of education in studies by [7] [20] [21].

Our study showed that having a job was significantly ($p = 0.001$) associated

with uptake of the COVID-19 vaccine. This finding is in line with results from studies on socioeconomic disparities and COVID-19, socio-economic gradients in COVID-19, association of race, ethnicity, other demographic, and socio-economic factors with vaccine conducted in Norway and United States [21]-[24].

From the qualitative findings, the factors reported to contribute to low uptake of COVID-19 vaccine were lack of knowledge about the COVID-19 vaccine, fear of injection, traditional and cultural beliefs and chronic illnesses within the population. These results agree with findings by [25] [26], and [27] who reported that level of knowledge about COVID-19, fear of needles or injection, as well as susceptibility to COVID-19 infection decreased the likelihood of accepting COVID-19 infection.

5. Conclusions

The study concluded that the uptake of the COVID-19 vaccine among pregnant women utilizing antenatal care services at Pumwani Maternity Hospital in Nairobi County was low compared to Kenya's national COVID-19 vaccination target by the end of 2022. The socio-demographic and economic factors associated with the uptake of the COVID-19 vaccine among pregnant women in antenatal care services at Pumwani Maternity Hospital in Nairobi County were being married, having secondary level of education, or being employed.

Acknowledgements

The authors would like to thank the Second European and Developing Countries Clinical Trials Partnership (EDCTP2) Supported by the European Union (EU) for funding this research.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Authors' contribution

All authors participated in the study's design and the paper's writing.

Limitations of the study

This study was conducted on participants attending ANC clinic at a referral hospital which limits generalizability of the findings. Therefore, community-based studies are needed to give a general picture of COVID-19 vaccine uptake among pregnant women in Nairobi county.

References

[1] Ciotti, M., Ciccozzi, M., Terrinoni, A., Jiang, W.C., Wang, C.B. and Bernardini, S.

(2020) The COVID-19 Pandemic. *Critical Reviews in Clinical Laboratory Sciences*, **57**, 365-388. https://doi.org/10.1080/10408363.2020.1783198

[2] Solís Arce, J.S., Warren, S.S., Meriggi, N.F., Scacco, A., McMurry, N., Voors, M., Omer, S.B., *et al.* (2021) COVID-19 Vaccine Acceptance and Hesitancy in Low- and Middle-Income Countries. *Nature Medicine*, **27**, 1385-1394. https://doi.org/10.1038/s41591-021-01454-y

[3] Ministry of Health-Republic of Kenya (2022) https://www.health.go.ke/nation https://allafrica.com/stories/202111250053.html.

[4] Centres for Disease Control and Prevention (CDC) (2022) Pregnant and Recently Pregnant People. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/pregnant-people.html

[5] World Health Organization (2021) Aide-Memoire: Infection Prevention and Control (IPC) Principles and Procedures for COVID-19 Vaccination Activities.

[6] Obiria, M. (2021) Kenya: COVID-19 Raises Risks of Pregnant Women. The Nation. https://allafrica.com/stories/202111250053.html

[7] Kadiwar, S., Smith, J.J., Ledot, S., Johnson, M., Bianchi, P., Singh, N. and Ukor, E.F. (2021) Were Pregnant Women More Affected by COVID-19 in the Second Wave of the Pandemic? *The Lancet*, **397**, 1539-1540. https://doi.org/10.1016/S0140-6736(21)00716-9

[8] Stock, S.J., Carruthers, J., Calvert, C., Denny, C., Donaghy, J., Goulding, A. and Wood, R. (2022) SARS-CoV-2 Infection and COVID-19 Vaccination Rates in Pregnant Women in Scotland. *Nature Medicine*, **28**, 504-512. https://doi.org/10.1038/s41591-021-01666-2

[9] Kenya National Bureau of Statistics (2019) Kenya Bureau of Statistics, 2019. Nairobi.

[10] Cochran, W.G. (1977) Sampling Techniques. 3rd Edition, John Wiley & Sons, New York.

[11] Caspi, G., Dayan, A., Eshal, Y., Liverant-Taub, S., Twig, G., Shalit, U. and Caspi, O. (2021) Socioeconomic Disparities and COVID-19 Vaccination Acceptance: A Nationwide Ecologic Study. *Clinical Microbiology and Infection*, **27**, 1502-1506. https://doi.org/10.1016/j.cmi.2021.05.030

[12] Kim, D. (2021) Associations of Race/Ethnicity and Other Demographic and Socioeconomic Factors with Vaccination during the COVID-19 Pandemic in the United States. *Preventive Medicine Reports*, **31**, Article 102021. https://doi.org/10.1016/j.pmedr.2022.102021

[13] Nguyen, K.H., Nguyen, K., Corlin, L., Allen, J.D. and Chung, M. (2021) Changes in COVID-19 Vaccination Receipt and Intention to Vaccinate by Socioeconomic Characteristics and Geographic Area, United States, January 6-March 29, 2021. *Annals of Medicine*, **53**, 1419-1428. https://doi.org/10.1080/07853890.2021.1957998

[14] Saban, M., Myers, V., Ben-Shetrit, S. and Wilf-Miron, R. (2021) Socioeconomic Gradient in COVID-19 Vaccination: Evidence from Israel. *International Journal for Equity in Health*, **20**, Article No. 242. https://doi.org/10.1186/s12939-021-01566-4

[15] Whiteman, A., Wang, A., McCain, K., Gunnels, B., Toblin, R., Lee, J.T., Barbour, K.E., *et al.* (2021) Demographic and Social Factors Associated with COVID-19 Vaccination Initiation among Adults Aged ≥ 65 Years—United States, December 14, 2020-April 10, 2021. *Morbidity and Mortality Weekly Report*, **70**, 725-730.

https://doi.org/10.15585/mmwr.mm7019e4

[16] Nguyen, L.H., Joshi, A.D., Drew, D.A., Merino, J., Ma, W., Lo, C.H., Chan, A.T., *et al.* (2021) Racial and Ethnic Differences in COVID-19 Vaccine Hesitancy and Uptake. *Nature Communications*, **13**, Article No. 636. https://doi.org/10.1038/s41467-022-28200-3

[17] Mhereeg, M., Jones, H., Kennedy, J., Seaborne, M., Parker, M., Kennedy, N. and Brophy, S. (2022) COVID-19 Vaccination in Pregnancy: Views and Vaccination Uptake Rates Pregnancy, a Mixed Methods Analysis from SAIL and the Born-in-Wales Birth Cohort. *BMC Infectious Diseases*, **22**, Article No. 932. https://doi.org/10.1186/s12879-022-07856-8

[18] Habbash, A.S. and Siddiqui, A.F. (2023) Factors Affecting COVID-19 Vaccine Acceptance among Pregnant Women: A Cross Sectional Study from Abha City, Saudi Arabia. *Vaccines*, **11**, Article 1463. https://doi.org/10.3390/vaccines11091463

[19] Goncu Ayhan, S., Oluklu, D., Atalay, A., *et al.* (2021) COVID-19 Vaccine Acceptance in Pregnant Women. *International Journal of Gynecology & Obstetrics*, **154**, 291-296. https://doi.org/10.1002/ijgo.13713

[20] Battarbee, A.N., Stockwell, M.S., Varner, M., *et al.* (2022) Attitudes toward COVID-19 Illness and COVID-19 Vaccination among Pregnant Women: A Cross-Sectional Multicenter Study during August-December 2020. *American Journal of Perinatology*, **39**, 75-83. https://doi.org/10.1055/s-0041-1735878

[21] Hosokawa, Y., Okawa, S., Hori, A., *et al.* (2022) The Prevalence of COVID-19 Vaccination and Vaccine Hesitancy in Pregnant Women: An Internet-Based Cross-Sectional Study in Japan. *Journal of Epidemiology*, **32**, 188-194. https://doi.org/10.2188/jea.JE20210458

[22] Beatty, A.L., Peyser, N.D., Butcher, X.E., Cocohoba, J.M., Lin, F., Olgin, J.E. and Marcus, G.M. (2021) Analysis of COVID-19 Vaccine Type and Adverse Effects Following Vaccination. *JAMA Network Open*, **4**, e2140364. https://doi.org/10.1001/jamanetworkopen.2021.40364

[23] Appiah, F. (2022) Individual and Community-Level Factors Associated with Early Initiation of Antenatal Care: Multilevel Modelling of 2018 Cameroon Demographic and Health Survey. *PLOS ONE*, **17**, e0266594. https://doi.org/10.1371/journal.pone.0266594.

[24] Ceulemans, M., Foulon, V., Panchaud, A., Winterfeld, U., Pomar, L., Lambelet, V., Cleary, B., O'Shaughnessy, F., Passier, A., Richardson, J.L., *et al.* (2021) Vaccine Willingness and Impact of the COVID-19 Pandemic on Women's Perinatal Experiences and Practices Multinational, Cross-Sectional Study Covering the First Wave of the Pandemic. *International Journal of Environmental Research and Public Health*, **18**, Article 3367. https://doi.org/10.3390/ijerph18073367

[25] Aniyeloye, A.O., Okedare, O.O., Akintunde, F.E., Otovwe, A., Olarinmoye, A. and Eniade, O.D. (2021) Willingness to Accept COVID-19 Vaccine and Its Determinants among Nigeria Citizens: A Web-Based Cross-Sectional Study. *Journal of Advances in Medicine and Medical Research*, **33**, 13-22. https://doi.org/10.9734/jammr/2021/v33i830881

[26] Orangi, S., Pinchoff, J., Mwanga, D., Abuya, T., Hamaluba, M., Warimwe, G., Barasa, E., *et al.* (2021) Assessing the Level and Determinants of COVID-19 Vaccine Confidence in Kenya. *Vaccines*, **9**, Article No. 936. https://doi.org/10.3390/vaccines9080936

[27] Tobin, E.A., Okonofua, M., Adeke, A. and Obi, A. (2021) Willingness to Accept a

COVID-19 Vaccine in Nigeria: A Population-Based Cross-Sectional Study. *Central African Journal of Public Health*, **7**, 53-60.
https://doi.org/10.11648/j.cajph.20210702.12

Appendix 1

Participant Questionnaire

Socio-demographic and Economic Factors Associated with Uptake of COVID-19 Vaccine Among Pregnant Women at Pumwani Maternity Hospital in Nairobi County, Kenya.

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH (SoPH)
PO BOX 62000-00200 NAIROBI TEL. (067) 52711 EXT 2226.

The information obtained will be treated confidentially and it will be used anonymously.

Section 1: Sociodemographic Characteristics

1. Date: _____
2. Hospital: _____
3. Age: _____
4. Marital status:
   a. Married b. Not Married c. Divorce d. Cohabiting
5. Residential area _____
6. Highest Level of Education
   a. No formal education b. Primary education
   c. Secondary education d. Tertiary Education
7. Employment status
   a. Employed b. Not employed c. Housewife
   d. Other specify: _____
8. Average monthly income
   a. 10,000 – 50,000 ksh b. 60,000 – 100,000 ksh c. above 100,000 ksh
9. Religious Affiliation_____
10. Gestation:
    a. First Trimester b. Second Trimester c. Third Trimester

Section 2: individual knowledge and attitude toward uptake of COVID-19 vaccine:

11. Have you heard about the COVID-19 vaccine?
    a. Yes b. No
12. Do you think COVID-19 is safe for pregnant women?
    a. Yes b. No
13. Do you think the COVID-19 vaccine is very important for pregnant women?
    a. Yes b. No
14. From which Sources of information did you hear about the COVID-19 vaccine
    a. Midwife
    b. Health-related website (National Health Services)
    c. TV
    d. Radio

e. Newspaper
f. Friends and family
g. Social media e.g. (Facebook, Instagram, YouTube, WhatsApp).
h. Other specify_____

15. Which COVID-19 vaccine information source did you trust
a. Midwife
b. Health-related website (National Health Services)
c. TV
d. Radio
e. Newspaper
f. Friends and family
g. Social media (e.g., Facebook, Instagram, YouTube, WhatsApp)
h. Other specify_____

Section 2: uptake of COVID-19 vaccine:

16. Have you been vaccinated against COVID-19?
a. Yes b. No

17. If yes is Q11, when was vaccination date: _____
Unknown

18. If Q11 is Yes. The number of doses of the COVID-19 vaccine you received?
a. One dose b. Two doses c. More than two doses or a boost dose

19. If the answer is Yes in Q11 which type of COVID-19 vaccine, did you receive?
a. AstraZeneca b. Pfizer c. Moderna d. Johnson & Johnson

20. Where did you receive it?
a. Public facility b. Private facility c. Others specify: _____

21. Did you experience any side effects after vaccination:
a. Yes b. No

22. If the answer is yes in Q 16 what were the side effects:
a. Fever b. headache c. joint pain d. general body pain

23. If the answer is No in Q11 what is the reason for not being vaccinated?
a. Concern about baby/ future pregnancies
b. Lack of data on vaccine
c. Concerns about breastfeeding
d. The midwife/ doctor did not offer vaccines.
e. Planning to receive it later.
f. Vaccine stock out
g. Fearing of injection
h. Long queues at vaccination sites
i. Vaccinators are not available.
j. Other specify _____

24. How long does it take you to reach a health facility to get a vaccination:
a. Less the 30 minutes b. One hour
c. One hour and a half d. More the two hours

25. What means of transport do you use?

a. Matatu b. Boda boda

c. Foot d. other specify_____236

Appendix 2

Key Informant Interview Guide

Socio-demographic and Economic Factors Associated with Uptake of COVID-19 Vaccine Among Pregnant Women at Pumwani Maternity Hospital in Nairobi County, Kenya

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH (SoPH)

PO BOX 62000-00200 NAIROBI TEL. (067) 52711 EXT 2226.

The information obtained will be treated confidentially and it will be used anonymously.

Health facility key informant interview.

Staff interviewed Cadre/Qualification …….

Position ……. Years in the position …….

1. Explain whether this health facility provides COVID-19 vaccination services.
2. State the types of COVID-19 vaccines you are offering to your clients.
3. Describe some of the challenges you face during offering COVID-19
4. Can you tell us the population catchment area for this facility?
5. Does the facility have a defaulter's tracking system, for the second dose vaccines, and what are mechanisms put in place to address this problem
6. What do think are factors that influence vaccine uptake among pregnant women?

(a) individuals (b) level facility-level factors

7. What should be done to improve COVID-19 vaccine uptake in pregnancy?237