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Knowledge and attitudes among Lebanese pregnant women and women seeking fertility treatment during the COVID-19 outbreak: a cross sectional survey

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Abstract

Objectives: Coronavirus disease (COVID-19) has been recognized as a global health emergency necessitating collaborative efforts to halt further spread. Success of public health interventions and vaccination campaigns is contingent on the knowledge and awareness level of the public. We aim to assess COVID-19 knowledge and attitude among Lebanese pregnant women and women seeking fertility treatment.

Design: Cross sectional study utilizing telehealth administered survey.

Setting: University affiliated tertiary care center.

Participants: The data of 402-Lebanese women pregnant or seeking fertility treatment aged 20-45 years were analyzed.

Outcome measures: Extent of COVID-19 general knowledge, pregnancy-specific knowledge, and attitude toward COVID-19 practices.

Results: All participants reported being knowledgeable about COVID-19, 70 % of which rated their knowledge as 7 or more on a numerical scale of 0 to 10. The mean general COVID-19 knowledge was 22.15 (SD 2.44, range 14-27) indicating high level of knowledge. The mean pregnancy specific COVID-19 knowledge 6.84 (SD 2.061, range 0-10) indicating poorer pregnancy specific knowledge compared to general COVID-19 knowledge. A trend of higher knowledge was noted with higher income status. Reproductive age women with higher pregnancy specific knowledge had more positive attitudes toward COVID-19 pregnancy practices.

Conclusion: Our findings suggest a deficiency in pregnancy specific COVID-19 knowledge indicating the need for targeted public health education interventions. It highlight the need for enhancing COVID-19 pregnancy-specific awareness raising which can serve as a stepping-stone in the success of COVID-19 vaccination campaigns and halting further disease spread.

Key words: COVID-19; Lebanon; pregnancy; pandemic reaction; health; preventive measure; maternal health

Strengths and limitations of this study

- First study to explore knowledge and attitude toward COVID-19 among the Lebanese population, particularly reproductive age women pregnant or seeking fertility treatments
- Highlights the need for targeted public health education interventions and enhancing COVID-19 pregnancy-specific awareness
- The study's design was susceptible to reporting, desirability bias
- Under-representation of women from rural areas and from lower educational attainments

Introduction

Human race has relentlessly suffered only to conquer innumerable epidemics throughout history. In December 2019, the story of yet another outbreak with the highly infectious new coronavirus disease began to unravel starting from Wuhan, China. While initial epidemiological investigations suspected zoonotic origins associating the outbreak to a Chinese seafood market, as the outbreak progressed, person-to-person dissemination became the main mode of transmission. In February 2020, the World health organization (WHO) designated this novel coronavirus disease COVID-19, short for coronavirus disease 2019.[1] Soon after, the WHO declared COVID-19 a pandemic on March 12th,2020.[2] COVID-19 became the emerging disease of the 21st century and a global health emergency of international concern demanding collaborative efforts to halt its further spread.[3]

The disease is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 is a single stranded RNA virus belonging to the large family of coronavirus leading to spectrum of illness ranging from common cold to more morbid presentations such as the Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS).[4,5] The most common symptoms of

COVID-19 include fever, cough, myalgias, fatigue, and shortness of breath.[6,7] As the scope of disease spread increased, more knowledge was gained via experience with COVID-19. Spread was initially believed to occur mainly via respiratory droplets. Viruses released in the respiratory secretions of an infected person while coughing, sneezing, or even talking have the potential of infecting others when in immediate contact with mucus membranes. Though droplets typically do not travel more than two meters, infection can still occur if contact is made with an infected surface questioning the time-frame sustainability of the virus through different media and on different surfaces.[8] Today, COVID-19 is known to have contact, droplet, and airborne transmission. The possibility of additional transmission routes could not however be overlooked especially considering finding of "coronavirus-like particles" by electron microscopy in stool samples reported in earlier studies which suggested additional fecal-oral viral transmission mode.[9] This was supported by detection of live virus cultured from stool of some COVID-19 patients.[10,11] Yet, according to the joint WHO-China report, droplet transmission remains the main mode, whereby fecal-oral transmission did not appear to be a significant contributor in the spread of infection.[12] The detection of SARS-CoV-2 RNA in blood samples[13] implied additional major concerns regarding possibility of sexual transmission of the virus or even vertical transmission during pregnancy. These concerns were amplified by the dilemma imposed not only by who can transmit the novel corona virus but also for how long they can transmit it, the role of asymptomatic and pre-symptomatic viral shedding of infected individuals, [14] and the prognosed morbidity for infected individuals.

As details on COVID-19 evolved, the devastating impact of its high transmission capability and associated morbidity and mortality became apparent particularly in vulnerable groups. In response, countries around the world including Lebanon, intensified their efforts to spread awareness and control the spread of this disease which has echoed fear in every human encounter and disrupted social harmony. Various countries including China,[15] Kingdom of Saudi Arabia[16] and Egypt[17] have looked at their populations' knowledge and attitudes regarding COVID-19 to evaluate initiatives in raising awareness

and limiting disease spread. However, none evaluated COVID-19 knowledge among expectant mothers where anxieties are intensified by potential maternal and fetal morbidities.

To the best of our knowledge, this is the first study to assess the knowledge and attitudes of Lebanese pregnant women and women seeking fertility treatment regarding COVID-19 infection. This data is much needed whereby success of public health interventions and vaccination campaigns is contingent of knowledge and awareness level of the public. Findings may aid policy makers in the formulation of recommendations tailored for this specific population, improve awareness to best tackle the COVID-19 pandemic and facilitate realization of vaccination campaigns.

Materials and Methods

Study design and Population

This cross-sectional study was conducted over two-month period, June and July 2020, at the American University of Beirut Medical Center (AUBMC), a large tertiary care academic hospital well-recognized in Lebanon and the Middle East. Lebanese women of reproductive age group, between 20 and 45 years of age, followed at AUBMC Women's Health Center or Haifa Idriss Fertility unit for antenatal care or seeking fertility treatment, were eligible for recruitment.

All participants were identified using the hospital's EPIC electronic Health Care System. Given the widespread imposed quarantine, lockdown, and social distancing measures, eligible participants were contacted, by our research assistant, over the phone in the listed order generated from EPIC until targeted sample size was achieved. Our choice of recruitment method was to best accommodate the current COVID-19 health situation while still obtaining a representative sample. Considering the noticeable decline in number of patients physically presenting to clinics since the onset of COVID-19 pandemic, administering our questionnaire in paper form would have introduced major selection bias to our collected data, limited representativeness of our targeted population apart from violating recommended health care measures designed to limit COVID-19 disease spread. Similarly, choosing an online survey format would

have failed to include women of low socioeconomic status and lower educational background who have limited online network access. The study was designed to maximize reach and amass the perspective of as many respondents as possible. As such, our study was devised utilizing telehealth to minimize in-person interactions embracing published American Society for Reproductive medicine (ASRM) Patient Management and Clinical Recommendations during the Coronavirus (COVID-19) Pandemic published on March17, 2020.

Study Tool and validation

A questionnaire was developed for this current study to assess our target population's knowledge and attitude towards COVID-19. Items of the questionnaire were developed based on previous knowledge and attitudes questionnaires on ZIKA[18] and SARS virus[19] and according to guidelines published for the community on COVID-19 by the major scientific societies during the study period: Centers for Disease Control and Prevention (CDC),[20] ASRM,[21] European Society of Human Reproduction and Embryology (ESHRE),[21] and Royal College of Obstetrics and Gynecology (RCOG).[22]

The questionnaire was divided into four main portions. The first section of the questionnaire gathered information on the woman's socio-demographic characteristics including age, area of residence, socioeconomic status/income level, educational attainment, parity, fertility status (pregnant with corresponding gestational age at the time of recruitment versus seeking fertility treatment for primary or secondary infertility). The second section included the respondent's self-rated perceived level of COVID-19 knowledge scored 0 (not knowledgeable) to 10 (extremely knowledgeable) and primary source of attained knowledge (social media/community including family and friends or governmental and scientific authorities). This section also assessed participant's knowledge of COVID-19 using 28 items on clinical symptoms, mode of transmission, diagnosis, control, and prevention. The third section consisted of 10-items assessing the participant's pregnancy specific COVID-19 knowledge (maternal morbidity, neonatal morbidity, delivery modes and breastfeeding). The fourth section assessed the participant's attitude towards COVID-19 infection during pregnancy using a five-point Likert scale. Whereby respondents

were asked to state their level of agreement on each of six statements at "1 strongly disagree", "2 disagree", "3 neutral/undecided", "4 agree", or "5 strongly agree". Participants who answered 4 or 5 were categorized as agreeing for subsequent correlation of attitude with level of knowledge. Questions where higher scores indicated more negative attitude were flipped to preserve directionality across questions.

The questionnaire was initially drafted in English then translated into Arabic and back to English by different authors to ensure the meaning of the content is comprehended. We then conducted a pre-liminary phase of testing our questionnaire for validity and reliability on a pilot of 15 participants who were excluded from the final analysis. The results showed adequate internal consistency reliability with a Cronbach alpha of 0.71.

Ethical approval:

This study was designed and coordinated in accordance with ethical principles regarding research involving human participants. Therefore, ethical approval of American University of Beirut Institutional Review Board (IRB) approval was secured prior to conducting the study including a waiver for written informed consent amended by oral/telephone consent. All participants' responses were anonymous with no identifiable data collected.

Patient and public involvement:

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans for this research.

Sampling

There are currently no registries in Lebanon estimating the number of reproductive age women whether pregnant or seeking fertility treatment. Also, in the absence of similar studies related to coronavirus disease in women of reproductive age group, our calculations of the sample size assumed that probability of good knowledge on COVID-19 is 50 %.[23] As such, a minimum of 384 participants are needed to have a representative sample. This is calculated using margin of error of 5% and an assumed probability of 0.5

designed to obtain maximum sample size. Accordingly, recruitment was halted after a total of 402 respondents.

Statistical Analysis

Descriptive statistical analyses were performed to summarize data on socio-demographic factors. reported for categorical variables as frequency (n) and percentage (%).

Two composite COVID-19 knowledge scores were calculated, a general and pregnancy specific COVID-19 knowledge scores. The COVID-19 general knowledge score was calculated for each participant based on 28 general COVID-19 knowledge items on the questionnaire. Similarly, pregnancy specific knowledge score was calculated based on 10 items regarding COVID-19 infection during pregnancy. Knowledge questions were given one point for each correct response and zero points to each incorrect response. The median value for the cumulative general knowledge score and pregnancy specific knowledge score were used as a cut-off to assess the difference in extent of knowledge (poor versus good knowledge) and correlate it with sociodemographic characteristics, self-rated perception, and attitude using Pearson chi-square test or Fisher's exact test. A participant's self-rated extent of knowledge was dichotomized to low perception (values of 0 to 6 inclusive) versus high perception (values 7 to 10 inclusive) to facilitate analysis.

All data analyses were performed using SPSS 26 statistical software package (IBM, USA). A P-value of < 0.05 was considered statistically significant.

Results

A total of 402 women completed the questionnaire with an average of 30.69 ± 4.88 years of age, 46% of which lived in the capital Beirut. The socio-demographic characteristics of the participants are summarized in table 1. Almost two-third of our sample were pregnant women with a comparable representation for each trimester of pregnancy. The majority of the sample (91.8%) had a college degree or higher educational attainment. The respondents were grouped according to their reported household's

monthly income in dollars, converted from Lebanese pounds based on Lebanon's official exchange rate for uniformity in light of the Lebanon's economic crisis and the labile market exchange rates. Almost a third of the sample earned approximately the minimum monthly wage, a third had a monthly household income between 1000-2000$, while remaining participants reported income above 2000$.

All participants reported being knowledgeable about COVID-19, 70 % of which rated their knowledge as 7 or more on a numerical scale of 0 to 10, 0 representing no knowledge at all. General COVID-19 knowledge score ranged between a minimum of 14 and maximum of 27, with an average score of 22.15 (SD 2.44) and a median score of 22. Table 2 show responses to the general COVID-19 knowledge questions. The most frequently identified symptom of COVID-19 infection was fever (99.5%) followed by shortness of breath (96.5%) and cough (95%). Sputum production and rhinorrhea were erroneously missed as possible symptoms by 71.1% and 57.5% of the respondents. Majority of participants correctly identified COVID-19 mode of transmission, prevention and availability of approved treatment and vaccination at time of questionnaire administration. Remarkably, all participants deemed personal hygiene, social distancing and use of face mask as ideal measurements to limit disease spread reinforcing their knowledge of COVID-19 epidemiology.

Tables 3 and 4 summarize responses to pregnancy specific knowledge questions and attitude regarding management strategies of COVID-19 infection during pregnancy and post-partum. Pregnancy specific knowledge ranged from a minimum of zero to a maximum of 10 with an average score of 6.84 (SD 2.061) and a median score of 7. The percentage of correct responses on each of the pregnancy specific items of coronavirus disease in relation to pregnancy varied between 39.9% to 89.8%. About a third of the participants agreed that cesarean delivery should be performed to avoid vertical transmission of the virus and 40% to avoid exposure of health care workers to the virus. The majority showed positive attitudes to breastfeeding if there is no risk of viral transmission through breastmilk (78.3%) and negative attitude towards breastfeeding in light of possible respiratory transmission during lactation. 75.1% of women agreed on the importance of telehealth for follow up during COVID-19 pandemic. Remarkably, all

women agreed that they needed more information specifically on COVID-19 infection during pregnancy.

Although there was no significant difference in extent of general COVID-19 knowledge among pregnant women versus women seeking pregnancy, pregnant women had greater extent of knowledge regarding COVID-19 infection during pregnancy (Table 5). Extent of general and pregnancy specific COVID-19 knowledge was noted to be higher among women with higher reported monthly income. In addition, women with good pregnancy specific knowledge had significantly higher positive attitude towards measures related to COVID-19 infection during pregnancy and lactation (Table 6).

Discussion

The novel coronavirus disease has become a global health emergency threatening not only health care systems but the political, economic, and social stability of countries globally. It is noteworthy that none of the respondents in our study reported total ignorance about COVID-19. All our sample conveyed being knowledgeable about COVID-19 with an average accuracy rate of general COVID knowledge about 79% (22/28 *100). These results are not surprising given the majority had high educational attainments. Moreover, this serves as attestation of the collaborative governmental and communal efforts to spread awareness and control the spread of the disease. Since the confirmation of first COVID-19 case in Lebanon on February 21,2020, extraordinary measures have been put in action to control the spread of the disease. Campaigns were intensified to promote awareness on the transmission, symptoms, diagnosis, and prevention of this emerging illness whether through social media platforms, television ads, documentaries, brochures, or fliers posted in public. The ministry of health prudently monitored disease spread and updated their recommendations in accordance with WHO guidelines to deal with this outbreak. These measures included reinforcement of lockdown practices including suspension of internal and external flights, withholding gatherings, emphasizing online teaching in schools and universities, and abiding by strict nationwide curfews.

Available evidence stresses the importance of knowledge as a key element in tackling disease outbreaks.[24,25] Despite data from our sample indicative of high degree of COVID-19 general knowledge, the rise in number of COVID-19 cases in Lebanon[26] might deceivingly undermine the power of this knowledge and efficiency of public health measures in dictating the public behavioral practices. Yet, special circumstances in Lebanon should be contemplated as contributary to the spread of COVID-19 in spite of the extent of general COVID-19 knowledge. Lebanon has been a crisis-stricken nation before the first confirmed COVID-19 case in the country. The economic crisis which preceded COVID-19 has led to massive business closures and drastic drop in Gross Domestic Product (GDP) with substantial increase in poverty.[27,28] This headed the premature uplifting of the lockdown measures with the subsequent increase in COVID-19 spread. Add to that the crowded refugee conditions with already deranged limited health capacity[29] and of course the capital's port blast which only added insult to injury.[30,31]

General COVID-19 knowledge scores were more impressive in our population compared to the pregnancy specific COVID-19 knowledge. The least general knowledge score was 50% of correct responses compared to 0% least pregnancy specific knowledge score. This is also manifested in a lower pregnancy specific average and median knowledge score (table 3). Such findings are partly a reflection of role of information technology and the data made available during COVID-19 awareness campaigns. While efforts focused on spreading awareness among the general population regarding COVID-19 transmission, symptoms and preventive measures, governmental and public health measure had only modest emphasis on vulnerable populations particularly pregnant women and women desirous of conception. Therefore, we can fairly presume that accessibility to data on COVID-19 infection during pregnancy was mainly through scientific platforms. As such, restricting this peculiar knowledge mainly to women of higher educational background and socioeconomic status (table 5). Moreover, acquisition of such knowledge is tricky being highly contingent on regularly updated scientific resources. This is especially challenging given the uncertainty of the impact of COVID-19 during pregnancy with more data unrevealing with the spread of the disease.

Based on available evidence on COVID-19 infection during pregnancy and lactation, our data demonstrated more positive attitude among women with higher pregnancy specific knowledge. This essentially stresses the importance of spreading awareness and evidence-based knowledge adapted to the needs of the masses. This is particularly crucial as part of vaccine campaigns. Our data point the importance of tailoring platforms to educate reproductive age women on the essence and safety of available COVID-19 vaccines.

To the researcher's knowledge this is the first study to explore knowledge and attitude toward COVID-19 among the Lebanese population, particularly reproductive age women pregnant or seeking fertility treatments. One limitation of our study is that data used is self-reported with inherent reporting bias. Furthermore, identification of patients via the hospital's electronic health care system restricted the sampled population to women who have presented for care at least once during the COVID-19 pandemic which is limited by convenience during lockdown measures. This is essentially reflected by larger representation of women from Beirut Governorate, over 90% of which had a college degree or higher educational attainment, limiting generalizability of our results. However, the nature of this study in light of COVID-19 social constraints precludes acquisition of such data otherwise. Moreover, the value of our findings to promote COVID-19 awareness among reproductive age women pregnant and/or desirous of conception are expected to be amplified among women of lower socioeconomic status, educational background and/or from rural areas.

Conclusion

This study suggests a deficiency in pregnancy specific COVID-19 knowledge indicating the need for targeted public health education interventions addressed to this vulnerable population. Though our data comes almost a year since the first documented COVID-19 case in Lebanon and does not address causation, however it aims through its findings to bridge deficiencies in public health interventions and promote awareness-raising among reproductive age women pregnant and/or desirous of conception which

might be instrumental to the success of COVID-19 vaccination and consequently eradication of covid-19 pandemic. The main conclusion of our paper is not new, yet a year has elapsed since the onset of the COVID-19 pandemic and we are not yet corona-free. As such it stresses the importance of tailoring our health education programs to promote knowledge needed to best overcome what we hope will one day become a part of our history. If we want to reach a solution, the public knowledge including that of vulnerable populations, attitudes and practices showed be in alignment. This is best accomplished by raising awareness and being self-responsible.

Author's contributions:

LE contributed to the main design of the study, development of research questions, analysis, data interpretation, manuscript drafting and final amendments of the manuscript. CB contributed to development of research questions, data collection and interpretation. HT contributed to study design, data analysis and interpretation. GG was responsible for overseeing the full development of the study design and data collection, data analysis and interpretation, development and final sign-off of the manuscript. All authors reviewed and approved the final version of the manuscript.

Declaration of Competing Interests:

The authors declare that they have no conflict of interest.

Data availability statement:

Data are available upon reasonable request. Data may be made available by contacting the corresponding author.

Ethical approval:

This study was reviewed and approved by institutional review board of the American University of Beirut, Beirut, Lebanon (approval number SBS-2020-0167, approval date April,22,2020).

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Table 1: Socio-demographic characteristics of participants

Socio-demographic characteristic	Number of women	Percentage
Age, years		
20-30	210	52.2
31-39	169	42
≥40	23	5.7
Participant		
Pregnant	263	65.4
Seeking pregnancy	139	34.6
Parity		
Nulliparous	245	60.9
Parous	151	37.6
Trimester of Pregnancy		
First trimester	77	29.3
Second trimester	89	33.8
Third trimester	97	36.9
Education		
High school or below	31	7.7
College/university degree	222	55.2
Post-graduate degree	147	36.6
Monthly income		
Less than $1000	117	29.1
Between $1000-$2000	130	32.3
Between $2000-$3000	50	12.4
More than $3000	77	19.2
Primary source of knowledge		
Media/Social media/Internet	193	48.0
MoPH/WHO/CDC/Hospital	194	48.3

Table 2: Responses to general knowledge questions about COVID-19 among participants

Knowledge items	Correct response N (%)	Incorrect response N (%)
Symptoms include		
Fever	400 (99.5)	2 (0.5)
Dry Cough	382 (95)	20 (5)
Wet cough/sputum production	112 (27.9)	286 (71.1)
Shortness of breath/difficulty breathing	388 (96.5)	14 (3.5)
Fatigue	356 (88.6)	46 (11.4)
Myalgia	257 (63.9)	143 (35.6)
Rhinorrhea	167 (41.5)	231 (57.5)
Sora throat	298 (74.1)	102 (25.4)
Chest pain	293 (72.9)	103 (25.6)
Loss of taste/decreased appetite	217 (54)	179 (44.5)
Primary COVID-19 transmission mode is contact with infected surfaces	112 (27.9)	284 (70.6)
Primary COVID-19 transmission mode is respiratory droplets	378 (94)	21 (5.2)
All positive COVID-19 patients are symptomatic	377 (93.8)	23 (5.7)
All COVID-19 patients have upper respiratory symptoms	323 (80.3)	76 (18.9)
COVID-19 is preventable	380 (94.5)	20(5)
COVID-19 is highly infectious	387 (96.3)	14 (3.5)
COVID-19 is less infectious/contagious than flu	341 (84.8)	56 (13.9)
COVID-19 has high mortality than flu	196 (48.8)	191 (47.5)
There is no need to repeat COVID-19 testing if negative in symptomatic patients	340 (84.6)	58 (14.4)
COVID-19 infection spread can be reduced by education/spreading awareness	402 (100)	0
COVID-19 can spread by close person to person contact	399 (99.3)	3 (0.7)
COVID -19 can be cured	383 (95.3)	19 (4.7)
Approved treatment for COVID-19 is available	389 (96.8)	12 (3)
Approved Vaccination against COVID-19 virus is available	397 (98.8)	1 (0.2)
Best approach to decrease viral spread is personal hygiene, social distancing and use of face mask	402 (100)	0
Incubation period/period between infection & onset of symptoms	341 (84.8)	61 (15.2)
Duration of viral shedding	117 (29.1)	266 (66.2)
Symptomatic patients with negative COVID-19 testing should self-quarantine for 14 days	370 (92)	27 (6.7)
General Knowledge score **Min-Max** **Mean ±SD** **Median- IQR**	 14-27 22.15 ± 2.44 22-3	
Poor general knowledge score **Good general knowledge score**	195 (48.5%) 207 (51.5%)	

Table 3: Responses to pregnancy specific knowledge questions about COVID-19 among participants

Knowledge items	Correct response N (%)	Incorrect response N (%)
Pregnant women have similar risk of being infected like non-pregnant women	292 (72.6)	108 (26.9)
Pregnant COVID-19 positive women have increased maternal morbidity	160 (39.8)	231 (57.5)
Coronavirus infected mothers are at higher risk of miscarriage	250 (62.2)	142 (35.3)
Coronavirus infected mothers are at higher risk of preterm delivery	186 (46.3)	200 (49.8)
Pregnant women infected with COVID-19 late in pregnancy have been shown to transmit the virus to the fetus through the placenta	303 (75.4)	82 (20.4)
Pregnant women infected with COVID-19 late in pregnancy have been shown to transmit the virus to the fetus during delivery	265 (65.9)	118 (29.4)
Only delivery mode for COVID-19 ladies is via cesarean delivery	256 (63.7)	131 (32.6)
Virus was shown to transmit through breastmilk	324 (80.6)	62 (15.4)
COVID-19 infection during pregnancy was shown to cause congenital birth defects	361 (89.8)	31 (7.7)
Maternal and neonatal risks of COVID-19 infection during pregnancy are not completely known	353 (87.8)	40 (10)
Pregnancy specific knowledge score **Min-Max** **Mean ±SD** **Median- IQR**	 0-10 6.84 ± 2.061 7-2	
Poor pregnancy specific knowledge score **Good pregnancy specific knowledge score**	242 (60.2%) 160 (39.8%)	

Table 4: Responses to attitude statements regarding pregnancy measures during COVID-19 pandemic

	Strongly disagree n(%)	Disagree n(%)	Neutral n(%)	Agre n(%
k a pregnant woman with positive COVID-19 infection should undergo cesarean section to prevent fetal e infection	35 (8.7)	152(37.8)	80 (19.9)	97 (24.1
k a pregnant woman with positive COVID-19 infection should undergo cesarean section to decrease health care workers to the virus	28 (7)	140 (34.8)	68 (16.9)	127 (31.6
k you need routine COVID-19 screening during pregnancy	35 (8.7)	161 (40)	51 (12.7)	112 (27.9
told the virus does not spread to the infant	13 (3.2)	53 (13.2)	19 (4.7)	138 (34.3
ast milk of an infected COVID-19 positive mother, would you breastfeed				
told, the virus can spread while breastfeeding	110 (27.4)	139 (34.6)	30 (7.5)	82 (20.4
piratory droplets and contact with COVID-19 infected mother, would you breastfeed				
s essential due to the current situation	7 (1.7)	46 (11.4)	40 (10)	169 (42)

Table 5: Association between COVID-19 general knowledge score versus pregnancy specific COVID-19 knowledge and sociodemographic characteristics

	Knowledge score			Pregnancy specific Knowledge score		
	Poor general	Good general	p-value	Poor pregnancy	Good pregnancy	

	COVID-19 knowledge N=195	COVID-19 knowledge N=207		specific COVID-19 knowledge N=242	specific COVID-19 knowledge N=160	p-value
Age, years						
20-30	114 (55.1)	96 (49.2)		128 (52.9)	82 (51.3)	
31-39	80 (38.6)	89 (45.6)	0.358	98 (40.5)	71 (44.4)	0.539
40-45	13 (6.3)	10 (5.1)		16 (6.6)	7 (4.4)	
Gestational age						
First trimester	32 (24.8)	45 (33.6)		39 (27.3)	38 (31.7)	
Second trimester	42 (32.6)	47 (35.1)	0.127	54 (37.8)	35 (29.2)	0.338
Third trimester	55 (42.6)	42 (31.3)		50 (35)	47 (39.2)	
Parity						
Nulliparous	129 (63.2)	116 (60.4)	0.564	154 (64.4)	91 (58)	0.195
Parous	75 (36.8)	76 (39.6)		85 (35.6)	66 (42)	
Participant						
Pregnant	130 (62.8)	133 (68.2)	0.255	144 (59.5)	119 (74.4)	0.002*
Seeking pregnancy	77 (37.2)	62 (31.8)		98 (40.5)	41 (25.6)	
Education						
Primary/high school	15 (7.3%)	16 (8.2)	0.887	23 (9.5)	8 (5)	0.026*
College	116 (56.6)	106 (54.4)		141 (58.5)	81 (50.9)	
Higher education	74 (36.1)	73 (37.4)		77 (32)	70 (44)	
Monthly income						
Less than $1000	71 (36.2)	46 (25.8)		83 (36.6)	34 (23.1)	
Between $1000-2000	70 (35.7)	60 (33.7)	0.008*	72 (31.7)	58 (39.5)	0.025*
Between $2000- 3000	16 (8.2)	34 (19.1)		32 (14.1)	18 (12.2)	
More than $3000	39 (19.9)	38 (21.3)		40 (17.6)	37 (25.2)	
Type of infertility						
Primary	49 (79)	35 (76.1)	0.716	56 (72.7)	28 (90.3)	0.047*
Secondary	13 (21)	11 (23.9)		21 (27.3)	3 (9.7)	
Self-rated level of knowledge			0.245			0.586
Low perception	53 (26.1)	60 (31.4)		65 (27.7)	48 (30.2)	
High perception	150 (73.9)	131 (68.6)		170 (72.3)	111 (69.8)	
Source of knowledge						
Community/Media	106 (52.7)	87 (46.8)	0.241	115 (49.8)	78 (50)	0.967
MoPH/WHO/CDC/ Hospital	95 (47.3)	99 (53.2)		116 (50.2)	78 (50)	

Data presented as n (%).
*Significant p-value<0.05

Table 6: Association between pregnancy specific COVID-19 knowledge score and positive attitude towards COVID-19 dilemmas

	Pregnancy specific Knowledge score	

	Poor pregnancy specific COVID-19 knowledge N=242	Good pregnancy specific COVID-19 knowledge N=160	p-value
Pregnant woman with positive COVID-19 infection should undergo cesarean section to prevent fetal intra-uterine infection	102 (42.1)	31 (19.4)	<0.001*
Pregnant woman with positive COVID-19 infection should undergo cesarean section to decrease exposure of health care workers to the virus	108 (45.2)	55 (34.4)	0.031*
Routine COVID-19 screening during pregnancy is needed	100 (41.7)	53 (33.1)	0.085
If you were told the virus does not spread to the infant through breast milk of an infected COVID-19 positive mother, you would breastfeed	178 (74.2)	137 (85.6)	0.006*
If you were told, the virus can spread while breastfeeding through respiratory droplets and contact with COVID-19 infected mother, you would breastfeed	67 (28.2)	52 (32.5)	0.353
Telehealth is essential due to the current situation	100 (41.3)	130 (81.3)	<0.001*

Data presented as n (%).
*Significant p-value<0.05

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9, tables

		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	10,11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Knowledge and attitudes among Lebanese pregnant women and women seeking fertility treatment during the COVID-19 outbreak: a cross-sectional survey

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Abstract

Objectives: Coronavirus disease (COVID-19) has been recognized as a global health emergency necessitating collaborative efforts to halt further disease spread. The success of public health interventions and vaccination campaigns is contingent on the knowledge and awareness level of the public. We aim to assess COVID-19 knowledge and attitudes among Lebanese pregnant women and women seeking fertility treatment.

Design: Cross-sectional study utilizing telehealth administered survey.

Setting: University-affiliated tertiary care center.

Participants: The data of 402-Lebanese women pregnant or seeking fertility treatment aged 20-45 years were analyzed.

Outcome measures: Extent of COVID-19 general knowledge, pregnancy-specific knowledge, and attitudes toward COVID-19 practices.

Results: All participants reported being knowledgeable about COVID-19, 70 % of which rated their knowledge as 7 or more on a numerical scale of 0 to 10. The mean general COVID-19 knowledge was 22.15 (SD 2.44, range 14-27) indicating a high level of knowledge. The mean pregnancy-specific COVID-19 knowledge 6.84 (SD 2.061, range 0-10) indicated poorer pregnancy-specific knowledge compared to general COVID-19 knowledge. A trend towards higher knowledge was noted with higher income status. Reproductive age women with higher pregnancy-specific knowledge had more positive attitudes toward COVID-19 pregnancy practices.

Conclusion: Our findings suggest a deficiency in pregnancy-specific COVID-19 knowledge stressing the necessity for targeted public health education interventions. It highlights the need for enhancing COVID-19 pregnancy-specific awareness which can serve as a stepping-stone in the success of COVID-19 vaccination campaigns and in halting further disease spread.

Keywords: COVID-19; Health; Lebanon; Maternal health; Pandemic reaction; Pregnancy; Preventive measures

Strengths and limitations of this study

- First study to explore knowledge and attitudes toward COVID-19 among reproductive age women pregnant or seeking fertility treatments.
- The survey responses may have been susceptible to reporting bias, in the form of participant self-reporting and social-desirability bias.
- Cross-sectional study design precludes establishing a causal association.
- Under-representation of women from rural areas and lower educational attainments.
- Knowledge and attitudes toward COVID-9 are provisional and may change over time.

Introduction

Throughout history, the human race has fought and conquered innumerable epidemics. In December 2019, the story of yet another outbreak with the highly infectious new coronavirus disease began to unravel starting from Wuhan, China. While initial epidemiological investigations suspected zoonotic origins associating the outbreak to a Chinese seafood market, as the outbreak progressed, person-to-person dissemination became the main mode of transmission. In February 2020, the World health organization (WHO) designated this novel coronavirus disease COVID-19, short for coronavirus disease 2019.[1] Soon after, the WHO declared COVID-19 a pandemic on March 12th,2020.[2] COVID-19 became the emerging disease of the 21st century and a global health emergency of international concern demanding collaborative efforts to halt its further spread.[3]

The disease is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). SARS-CoV-2 is a single-stranded RNA virus belonging to the large family of coronavirus leading to a spectrum of illnesses ranging from the common cold to more morbid presentations such as the Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS).[4,5] The most common symptoms of COVID-19 include fever, cough, myalgias, fatigue, and shortness of breath.[6,7] As the scope of disease spread increased, more knowledge was gained via experience with COVID-19. Spread was initially believed to occur mainly via respiratory droplets. Viruses released in the respiratory secretions of an infected person while coughing, sneezing, or even talking have the potential of infecting others when in immediate contact with mucus membranes. Though droplets typically do not travel more than two meters, infection can still occur if contact is made with an infected surface questioning the time-frame sustainability of the virus through different media and on different surfaces.[8] Today, COVID-19 is known to have contact, droplet, and airborne transmission. The possibility of additional transmission routes could not however be overlooked especially considering the detection of "coronavirus-like particles" by electron microscopy in stool samples reported in earlier studies which suggested additional fecal-oral viral transmission mode.[9] This was supported by the detection of live virus cultured from stool of some COVID-19 patients.[10,11] Yet, according to the joint WHO-China report, droplet transmission remains the main mode, whereby fecal-oral transmission did not appear to be a significant contributor to the spread of infection.[12] The detection of SARS-CoV-2 RNA in blood samples[13] implied additional major concerns regarding the possibility of sexual transmission of the virus or even vertical transmission during pregnancy. These concerns were amplified by the dilemma imposed not only by who can transmit the novel coronavirus but also for how long they can transmit it, the role of asymptomatic and pre-symptomatic viral shedding of infected individuals, [14] and the prognosed morbidity for infected individuals.

As details on COVID-19 evolved, the devastating impact of its high transmission capability and associated morbidity and mortality became apparent, particularly in vulnerable groups. In response,

countries around the world including Lebanon intensified their efforts to spread awareness and control the spread of this disease which has disrupted social harmony. Various countries including China,[15] Kingdom of Saudi Arabia[16] and Egypt[17] have looked at their populations' knowledge and attitudes regarding COVID-19 to evaluate initiatives in raising awareness and limiting disease spread. However, none evaluated COVID-19 knowledge among expectant mothers where anxieties are intensified by potential maternal and fetal morbidities.

To the best of our knowledge, this is the first study to assess the knowledge and attitudes of Lebanese pregnant women and women seeking fertility treatment regarding COVID-19 infection. This data is much needed whereby the success of public health interventions and vaccination campaigns are contingent on the knowledge and awareness level of the public. Findings may aid policymakers in the formulation of recommendations tailored for this specific population, improve awareness to best tackle the COVID-19 pandemic, and facilitate the realization of vaccination campaigns.

Materials and Methods

Study Design and Population

This cross-sectional study was conducted over a two-month period, June and July 2020, at the American University of Beirut Medical Center (AUBMC), a large tertiary care academic hospital well-recognized in Lebanon and the Middle East. Lebanese women of reproductive age group, between 20 and 45 years of age, followed at AUBMC Women's Health Center or Haifa Idriss Fertility unit for antenatal care or seeking fertility treatment, were eligible for recruitment.

All participants were identified using the hospital's EPIC Electronic Health Care System. Given the widespread imposed quarantine, lockdown, and social distancing measures, eligible participants were contacted, by our research assistant, over the phone in the listed order generated from EPIC until the targeted sample size was achieved. Our choice of recruitment method was to best accommodate the current COVID-19 health situation while still obtaining a representative sample. Given the noticeable

decline in the number of patients physically presenting to clinics, we anticipated a major selection bias in administering our questionnaire in paper form instead. In addition, it would have limited the representativeness of our targeted population apart from violating recommended health care measures designed to limit COVID-19 disease spread. Similarly, choosing an online survey format would have failed to include women of low socioeconomic status and lower educational background who have limited online network access especially with Lebanon's economic crisis.[18,19] The study was designed to maximize reach and amass the perspective of as many respondents as possible. Therefore, it was devised utilizing telehealth to minimize in-person interactions. This is in accordance with the American Society for Reproductive medicine (ASRM) Patient Management and Clinical Recommendations during the Coronavirus (COVID-19) Pandemic published on March 17, 2020.

Study Tool and validation

A questionnaire was developed for this current study to assess our target population's knowledge and attitudes towards COVID-19 (supplementary file). Items of the questionnaire were developed based on previous knowledge and attitudes questionnaires on ZIKA[20] and SARS virus[21] and according to guidelines published for the community on COVID-19 by the major scientific societies during the study period: Centers for Disease Control and Prevention (CDC),[22] ASRM,[23] European Society of Human Reproduction and Embryology (ESHRE),[23] and Royal College of Obstetrics and Gynecology (RCOG).[24]

The questionnaire was divided into four main portions. The first section of the questionnaire gathered information on the woman's socio-demographic characteristics including age, area of residence, socioeconomic status/income level, educational attainment, parity, fertility status (pregnant with corresponding gestational age at the time of recruitment versus seeking fertility treatment for primary or secondary infertility). The second section included the respondent's self-rated perceived level of COVID-19 knowledge scored from 0 (not knowledgeable) to 10 (extremely knowledgeable) and primary source of attained knowledge (social media/community including family and friends or governmental and scientific authorities). This section also assessed participant's knowledge of COVID-19 using 28 items on clinical

symptoms, mode of transmission, diagnosis, control, and prevention. The third section consisted of 10-items assessing the participant's pregnancy-specific COVID-19 knowledge (maternal morbidity, neonatal morbidity, delivery modes, and breastfeeding). The fourth section assessed the participant's attitudes towards COVID-19 infection during pregnancy using a five-point Likert scale. Respondents indicated their level of agreement on each of six statements using "1 strongly disagree", "2 disagree", "3 neutral/undecided", "4 agree", or "5 strongly agree". Participants who answered 4 or 5 were categorized as agreeing for subsequent correlation of attitudes with the level of knowledge.

The questionnaire was initially drafted in English then translated into Arabic and back to English by different authors to ensure the meaning of the content is comprehended. We then conducted a preliminary phase of testing our questionnaire for validity and reliability on a pilot of 15 participants who were excluded from the final analysis. The results showed adequate internal consistency reliability with a Cronbach alpha of 0.71.

Ethical approval:

This study was designed and coordinated in accordance with ethical principles regarding research involving human participants. Therefore, ethical approval of American University of Beirut Institutional Review Board (IRB) approval was secured prior to conducting the study including a waiver for written informed consent amended by oral/telephone consent. All participants' responses were anonymous with no identifiable data collected.

Patient and public involvement:

Patients and/or the public were not involved in the design, conduct, reporting, or dissemination plans for this research.

Sampling

There are currently no registries in Lebanon estimating the number of reproductive age women whether pregnant or seeking fertility treatment. Also, in the absence of similar studies related to coronavirus

disease in women of the reproductive age group, our calculations of the sample size assumed that the probability of good knowledge on COVID-19 is 50 %.[25] As such, a minimum of 384 participants are needed to have a representative sample. This is calculated using a margin of error of 5% and an assumed probability of 0.5 designed to obtain the maximum sample size. Accordingly, recruitment was halted after a total of 402 respondents.

Statistical Analysis

Descriptive statistical analyses were performed to summarize data on socio-demographic factors. reported for categorical variables as frequency (n) and percentage (%).

Two composite COVID-19 knowledge scores were calculated, general and pregnancy-specific COVID-19 knowledge scores. The COVID-19 general knowledge score was calculated for each participant based on 28 general COVID-19 knowledge items on the questionnaire. Similarly, a pregnancy-specific knowledge score was calculated based on 10 items regarding COVID-19 infection during pregnancy. Knowledge questions were given one point for each correct response and zero points for each incorrect response. The median values for the cumulative general knowledge score and pregnancy-specific knowledge score were used as a cut-off to assess the difference in the extent of knowledge (poor versus good knowledge) and correlate it with sociodemographic characteristics, self-rated perception, and attitudes using Pearson chi-square test or Fisher's exact test. A participant's self-rated extent of knowledge was dichotomized to low perception (values of 0 to 6 inclusive) versus high perception (values 7 to 10 inclusive) to facilitate analysis.

All data analyses were performed using SPSS 26 statistical software package (IBM, USA). A P-value of < 0.05 was considered statistically significant.

Results

A total of 402 women completed the questionnaire with an average of 30.69 ± 4.88 years of age, 46% of which lived in the capital Beirut. The socio-demographic characteristics of the participants are

summarized in table 1. Almost two-thirds of our sample were pregnant women with a comparable representation for each trimester of pregnancy. The majority of the sample (91.8%) had a college degree or higher educational attainment. The respondents were grouped according to their reported household's monthly income in dollars, converted from Lebanese pounds based on Lebanon's official exchange rate for uniformity in light of Lebanon's economic crisis and the labile market exchange rates. Almost a third of the sample earned approximately the minimum monthly wage, a third had a monthly household income between 1000-2000$, while remaining participants reported income above 2000$.

All participants reported being knowledgeable about COVID-19, 70 % of which rated their knowledge as 7 or more on a numerical scale of 0 to 10, 0 representing no knowledge at all. General COVID-19 knowledge score ranged between a minimum of 14 and a maximum of 27, with an average score of 22.15 (SD 2.44) and a median score of 22. Table 2 shows responses to the general COVID-19 knowledge questions. The most frequently identified symptom of COVID-19 infection was fever (99.5%) followed by shortness of breath (96.5%) and cough (95%). Sputum production and rhinorrhea were erroneously missed as possible symptoms by 71.1% and 57.5% of the respondents. The majority of participants correctly identified COVID-19 mode of transmission, prevention, and availability of approved treatment and vaccination at the time of questionnaire administration. All participants deemed personal hygiene, social distancing, and the use of face masks as ideal measurements to limit disease spread reinforcing their knowledge of COVID-19 epidemiology.

Tables 3 and 4 summarize responses to pregnancy-specific knowledge questions and attitudes regarding management strategies of COVID-19 infection during pregnancy and post-partum. Pregnancy-specific knowledge ranged from a minimum of zero to a maximum of 10 with an average score of 6.84 (SD 2.061) and a median score of 7. The percentage of correct responses on each of the pregnancy-specific items of coronavirus disease in relation to pregnancy varied between 39.9% to 89.8%. About a third of the participants agreed that cesarean delivery should be performed to avoid vertical transmission of the virus and 40% to avoid exposure of health care workers to the virus. The majority showed positive attitudes to

breastfeeding if there is no risk of viral transmission through breastmilk (78.3%) and negative attitudes towards breastfeeding in light of possible respiratory transmission during lactation. 75.1% of women agreed on the importance of telehealth for follow-up during the COVID-19 pandemic. All respondents agreed that they needed more information specifically on COVID-19 infection during pregnancy.

Although there was no significant difference in the extent of general COVID-19 knowledge among pregnant women versus women seeking pregnancy, pregnant women had a greater extent of knowledge regarding COVID-19 infection during pregnancy (Table 5). The extent of general and pregnancy-specific COVID-19 knowledge was noted to be higher among women with higher reported monthly income. In addition, women with good pregnancy-specific knowledge had significantly higher positive attitudes towards measures related to COVID-19 infection during pregnancy and lactation (Table 6).

Discussion

The novel coronavirus disease has become a global health emergency threatening not only health care systems but the political, economic, and social stability of countries globally. It is noteworthy that none of the respondents in our study reported total ignorance about COVID-19. All our sample conveyed being knowledgeable about COVID-19 with an average accuracy rate of general COVID knowledge about 79% (22/28 *100). These results are not surprising given the majority had high educational attainments. Moreover, this serves as an attestation of the collaborative governmental and communal efforts to spread awareness and control the spread of the disease. Since the confirmation of the first COVID-19 case in Lebanon on February 21, 2020, extraordinary measures have been put in action to control the spread of the disease. Campaigns were intensified to promote awareness on the transmission, symptoms, diagnosis, and prevention of this emerging illness whether through social media platforms, television ads, documentaries, brochures, or flyrs posted in public. The Ministry of Health prudently monitored disease spread and updated their recommendations in accordance with WHO guidelines to deal with this outbreak[26]. These measures included reinforcement of lockdown practices including suspension of

internal and external flights, withholding gatherings, emphasizing online teaching in schools and universities, and abiding by strict nationwide curfews.

Available evidence stresses the importance of knowledge as a key element in tackling disease outbreaks.[27,28] Despite data from our sample indicative of a high degree of COVID-19 general knowledge, the rise in the number of COVID-19 cases in Lebanon[29] might deceivingly undermine the power of this knowledge and efficiency of public health measures in dictating the public behavioral practices. Yet, special circumstances in Lebanon should be contemplated as contributory to the spread of COVID-19 despite the extent of general COVID-19 knowledge. Lebanon has been a crisis-stricken nation before the first confirmed COVID-19 case in the country. The economic crisis which preceded COVID-19 has led to mass business closures and a drastic drop in Gross Domestic Product (GDP) with a substantial increase in poverty.[30,31] This headed the premature uplifting of the lockdown measures with the subsequent increase in COVID-19 spread. Add to that the crowded refugee conditions with already deranged limited health capacity[32] and of course the capital's port blast which only added insult to injury.[33,34]

General COVID-19 knowledge scores were more impressive in our population compared to the pregnancy-specific COVID-19 knowledge. The least general knowledge score was 50% of correct responses compared to 0% least pregnancy-specific knowledge score. This is also manifested in a lower pregnancy-specific average and median knowledge score (table 3). Such findings are partly a reflection of the role of information technology and the data made available during COVID-19 awareness campaigns. While efforts focused on spreading awareness among the general population regarding COVID-19 transmission, symptoms, and preventive measures, governmental and public health measures had only modest emphasis on vulnerable populations particularly pregnant women and women desirous of conception. Therefore, we can fairly presume that accessibility to data on COVID-19 infection during pregnancy was mainly through scientific platforms. As such, restricting this peculiar knowledge mainly to women of higher educational background and socioeconomic status (table 5). Moreover, acquisition of such knowledge is tricky being highly contingent on regularly updated scientific resources. This is

especially challenging given the uncertainty of the impact of COVID-19 during pregnancy with more data unraveling with the spread of the disease.

Based on available evidence on COVID-19 infection during pregnancy and lactation, our data demonstrated more positive attitudes among women with higher pregnancy-specific knowledge. This essentially stresses the importance of spreading awareness and evidence-based knowledge adapted to the needs of the masses. This is particularly crucial as part of vaccine campaigns. Our data point the importance of tailoring platforms to educate reproductive age women on the essence and safety of available COVID-19 vaccines.

To the researcher's knowledge, this is the first study to explore knowledge and attitudes toward COVID-19 among the Lebanese population, particularly reproductive age women pregnant or seeking fertility treatments. One limitation of our study is that the data used is self-reported with inherent reporting bias. Furthermore, identification of patients via the hospital's electronic health care system restricted the sampled population to women who have presented for care at least once during the COVID-19 pandemic which is limited by convenience during lockdown measures. This is essentially reflected by a larger representation of women from Beirut Governorate, over 90% of which had a college degree or higher educational attainment, limiting the generalizability of our results. However, the nature of this study in light of COVID-19 social constraints precludes acquisition of such data otherwise. Moreover, the value of our findings to promote COVID-19 awareness among reproductive age women pregnant and/or desirous of conception is expected to be amplified among women of lower socioeconomic status, educational background, and/or from rural areas.

Conclusion

This study suggests a deficiency in pregnancy-specific COVID-19 knowledge indicating the need for targeted public health education interventions addressed to this vulnerable population. Though our data comes almost a year since the first documented COVID-19 case in Lebanon and does not address

causation, it aims through its findings to bridge deficiencies in public health interventions and promote awareness-raising among reproductive age women pregnant and/or desirous of conception which might be instrumental to the success of COVID-19 vaccination and consequently the eradication of Covid-19 pandemic. Over a year has elapsed since the onset of the COVID-19 pandemic and we are not yet corona-free. As such, this paper stresses the importance of tailoring our health education programs to promote knowledge needed to best overcome what we hope will one day become a part of our history. If we want to reach a solution, the public knowledge including that of vulnerable populations, attitudes and practices should be in alignment. This is best accomplished by raising awareness and being self-responsible.

Author's contributions:

LE contributed to the main design of the study, development of research questions, analysis, data interpretation, manuscript drafting, and final amendments of the manuscript. CB contributed to the development of research questions, data collection, and interpretation. HT contributed to study design, data analysis, and interpretation. GG was responsible for overseeing the full development of the study design and data collection, data analysis and interpretation, development, and final sign-off of the manuscript. All authors reviewed and approved the final version of the manuscript.

Declaration of Competing Interests:

The authors declare that they have no conflict of interest.

Data availability statement:

Data are available upon reasonable request. Data may be made available by contacting the corresponding author.

Ethical approval:

This study was reviewed and approved by the institutional review board of the American University of Beirut, Beirut, Lebanon (approval number SBS-2020-0167, approval date April,22,2020).

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Table 1: Socio-demographic characteristics of participants

Socio-demographic characteristic	Number of women	Percentage
Age, years		
20-30	210	52.2
31-39	169	42
≥40	23	5.7
Participant		
Pregnant	263	65.4
Seeking pregnancy	139	34.6
Parity		
Nulliparous	245	60.9
Parous	151	37.6
Trimester of Pregnancy		
First trimester	77	29.3
Second trimester	89	33.8
Third trimester	97	36.9
Education		
High school or below	31	7.7
College/university degree	222	55.2
Post-graduate degree	147	36.6
Monthly income		
Less than $1000	117	29.1
Between $1000-$2000	130	32.3
Between $2000-$3000	50	12.4
More than $3000	77	19.2
Primary source of knowledge		
Media/Social media/Internet	193	48.0
MoPH/WHO/CDC/Hospital	194	48.3

Table 2: Responses to general knowledge questions about COVID-19 among participants

Knowledge items	Correct response N (%)	Incorrect response N (%)
Symptoms include		
Fever	400 (99.5)	2 (0.5)
Dry Cough	382 (95)	20 (5)
Wet cough/sputum production	112 (27.9)	286 (71.1)
Shortness of breath/difficulty breathing	388 (96.5)	14 (3.5)
Fatigue	356 (88.6)	46 (11.4)
Myalgia	257 (63.9)	143 (35.6)
Rhinorrhea	167 (41.5)	231 (57.5)
Sora throat	298 (74.1)	102 (25.4)
Chest pain	293 (72.9)	103 (25.6)
Loss of taste/decreased appetite	217 (54)	179 (44.5)
Primary COVID-19 transmission mode is contact with infected surfaces	112 (27.9)	284 (70.6)
Primary COVID-19 transmission mode is respiratory droplets	378 (94)	21 (5.2)
All positive COVID-19 patients are symptomatic	377 (93.8)	23 (5.7)
All COVID-19 patients have upper respiratory symptoms	323 (80.3)	76 (18.9)
COVID-19 is preventable	380 (94.5)	20(5)
COVID-19 is highly infectious	387 (96.3)	14 (3.5)
COVID-19 is less infectious/contagious than flu	341 (84.8)	56 (13.9)
COVID-19 has high mortality than flu	196 (48.8)	191 (47.5)
There is no need to repeat COVID-19 testing if negative in symptomatic patients	340 (84.6)	58 (14.4)
COVID-19 infection spread can be reduced by education/spreading awareness	402 (100)	0
COVID-19 can spread by close person to person contact	399 (99.3)	3 (0.7)
COVID -19 can be cured	383 (95.3)	19 (4.7)
Approved treatment for COVID-19 is available	389 (96.8)	12 (3)
Approved Vaccination against COVID-19 virus is available	397 (98.8)	1 (0.2)
Best approach to decrease viral spread is personal hygiene, social distancing and use of face mask	402 (100)	0
Incubation period/period between infection & onset of symptoms	341 (84.8)	61 (15.2)
Duration of viral shedding	117 (29.1)	266 (66.2)
Symptomatic patients with negative COVID-19 testing should self-quarantine for 14 days	370 (92)	27 (6.7)
General Knowledge score **Min-Max** **Mean ±SD** **Median- IQR**	 14-27 22.15 ± 2.44 22-3	
Poor general knowledge score **Good general knowledge score**	195 (48.5%) 207 (51.5%)	

Table 3: Responses to pregnancy-specific knowledge questions about COVID-19 among participants

Knowledge items	Correct response N (%)	Incorrect response N (%)
Pregnant women have similar risk of being infected like non-pregnant women	292 (72.6)	108 (26.9)
Pregnant COVID-19 positive women have increased maternal morbidity	160 (39.8)	231 (57.5)
Coronavirus infected mothers are at higher risk of miscarriage	250 (62.2)	142 (35.3)
Coronavirus infected mothers are at higher risk of preterm delivery	186 (46.3)	200 (49.8)
Pregnant women infected with COVID-19 late in pregnancy have been shown to transmit the virus to the fetus through the placenta	303 (75.4)	82 (20.4)
Pregnant women infected with COVID-19 late in pregnancy have been shown to transmit the virus to the fetus during delivery	265 (65.9)	118 (29.4)
Only delivery mode for COVID-19 ladies is via cesarean delivery	256 (63.7)	131 (32.6)
Virus was shown to transmit through breastmilk	324 (80.6)	62 (15.4)
COVID-19 infection during pregnancy was shown to cause congenital birth defects	361 (89.8)	31 (7.7)
Maternal and neonatal risks of COVID-19 infection during pregnancy are not completely known	353 (87.8)	40 (10)
Pregnancy-specific knowledge score **Min-Max** **Mean ±SD** **Median- IQR**	 0-10 6.84 ± 2.061 7-2	
Poor pregnancy-specific knowledge score **Good pregnancy-specific knowledge score**	242 (60.2%) 160 (39.8%)	

Table 4: Responses to attitude statements regarding pregnancy measures during COVID-19 pandemic

	Strongly disagree n(%)	Disagree n(%)	Neutral n(%)	Agr n(%
k a pregnant woman with positive COVID-19 infection should undergo cesarean section to prevent fetal e infection	35 (8.7)	152(37.8)	80 (19.9)	97 (24.
k a pregnant woman with positive COVID-19 infection should undergo cesarean section to decrease health care workers to the virus	28 (7)	140 (34.8)	68 (16.9)	127 (31.
k you need routine COVID-19 screening during pregnancy	35 (8.7)	161 (40)	51 (12.7)	112 (27.
told the virus does not spread to the infant	13 (3.2)	53 (13.2)	19 (4.7)	138 (34.
east milk of an infected COVID-19 positive mother, would you breastfeed				
told, the virus can spread while breastfeeding	110 (27.4)	139 (34.6)	30 (7.5)	82 (20.
piratory droplets and contact with COVID-19 infected mother, would you breastfeed				
s essential due to the current situation	7 (1.7)	46 (11.4)	40 (10)	169 (42

Table 5: Association between COVID-19 general knowledge score versus pregnancy-specific COVID-19 knowledge and sociodemographic characteristics

	Knowledge score		Pregnancy-specific Knowledge score	

	Poor general COVID-19 knowledge N=195	Good general COVID-19 knowledge N=207	p-value	Poor pregnancy-specific COVID-19 knowledge N=242	Good pregnancy-specific COVID-19 knowledge N=160	p-value
Age, years						
20-30	114 (55.1)	96 (49.2)		128 (52.9)	82 (51.3)	
31-39	80 (38.6)	89 (45.6)	0.358	98 (40.5)	71 (44.4)	0.539
40-45	13 (6.3)	10 (5.1)		16 (6.6)	7 (4.4)	
Gestational age						
First trimester	32 (24.8)	45 (33.6)		39 (27.3)	38 (31.7)	
Second trimester	42 (32.6)	47 (35.1)	0.127	54 (37.8)	35 (29.2)	0.338
Third trimester	55 (42.6)	42 (31.3)		50 (35)	47 (39.2)	
Parity						
Nulliparous	129 (63.2)	116 (60.4)	0.564	154 (64.4)	91 (58)	0.195
Parous	75 (36.8)	76 (39.6)		85 (35.6)	66 (42)	
Participant						
Pregnant	130 (62.8)	133 (68.2)	0.255	144 (59.5)	119 (74.4)	0.002*
Seeking pregnancy	77 (37.2)	62 (31.8)		98 (40.5)	41 (25.6)	
Education						
Primary/high school	15 (7.3%)	16 (8.2)	0.887	23 (9.5)	8 (5)	0.026*
College	116 (56.6)	106 (54.4)		141 (58.5)	81 (50.9)	
Higher education	74 (36.1)	73 (37.4)		77 (32)	70 (44)	
Monthly income						
Less than $1000	71 (36.2)	46 (25.8)		83 (36.6)	34 (23.1)	
Between $1000-2000	70 (35.7)	60 (33.7)	0.008*	72 (31.7)	58 (39.5)	0.025*
Between $2000- 3000	16 (8.2)	34 (19.1)		32 (14.1)	18 (12.2)	
More than $3000	39 (19.9)	38 (21.3)		40 (17.6)	37 (25.2)	
Type of infertility						
Primary	49 (79)	35 (76.1)	0.716	56 (72.7)	28 (90.3)	0.047*
Secondary	13 (21)	11 (23.9)		21 (27.3)	3 (9.7)	
Self-rated level of knowledge			0.245			0.586
Low perception	53 (26.1)	60 (31.4)		65 (27.7)	48 (30.2)	
High perception	150 (73.9)	131 (68.6)		170 (72.3)	111 (69.8)	
Source of knowledge						
Community/Media	106 (52.7)	87 (46.8)	0.241	115 (49.8)	78 (50)	0.967
MoPH/WHO/CDC/ Hospital	95 (47.3)	99 (53.2)		116 (50.2)	78 (50)	

Data presented as n (%).
*Significant p-value<0.05

Table 6: Association between pregnancy-specific COVID-19 knowledge score and positive attitudes towards COVID-19 dilemmas

	Pregnancy-specific Knowledge score		
	Poor pregnancy-specific COVID-19 knowledge N=242	**Good pregnancy-specific COVID-19 knowledge N=160**	**p-value**
Pregnant woman with positive COVID-19 infection should undergo cesarean section to prevent fetal intra-uterine infection	102 (42.1)	31 (19.4)	<0.001*
Pregnant woman with positive COVID-19 infection should undergo cesarean section to decrease exposure of health care workers to the virus	108 (45.2)	55 (34.4)	0.031*
Routine COVID-19 screening during pregnancy is needed	100 (41.7)	53 (33.1)	0.085
If you were told the virus does not spread to the infant through breast milk of an infected COVID-19 positive mother, you would breastfeed	178 (74.2)	137 (85.6)	0.006*
If you were told, the virus can spread while breastfeeding through respiratory droplets and contact with COVID-19 infected mother, you would breastfeed	67 (28.2)	52 (32.5)	0.353
Telehealth is essential due to the current situation	100 (41.3)	130 (81.3)	<0.001*

Data presented as n (%).
*Significant p-value<0.05

Part 1: Sociodemographic Information

Age: ---------- (years) Nationality: ○ Lebanese ○ Non-Lebanese	Educational level: ○ Illiterate ○ Primary/High school ○ College ○ Higher education	Occupation: ----------	Monthly income: ○ < 1000$ ○ 1000-2000$ ○ 2000-3000$ ○ > 3000$
Place of residency: ○ Beirut ○ North ○ Mount Lebanon ○ Akkar ○ South ○ Beqaa ○ Nabatieh ○ Baalbeck/Hermel	Do you consider yourself knowledgeable about COVID-19? ○ Yes ○ No	How well do you rate your knowledge about Coronavirus COVID-19 on a scale from 1 to 10? **1 2 3 4 5 6 7 8 9 10**	What are your sources of knowledge? ----------

Part 2: General knowledge about the disease, level of awareness, precautions

What are the earliest symptoms of COVID-19? ----------

Knowledge of signs and symptoms:	**Yes**	**No**
Fever		
Dry cough		
Shortness of breath or difficulty breathing		
Fatigue		
Aches/myalgias		
Runny nose		
Sore throat		
Persistent pain or pressure in the chest		
Sputum production		
Anorexia/ decreased appetite		

	Yes	**No**
Primary COVID-19 transmission mode is contact with infected surfaces		
Primary COVID-19 transmission mode is respiratory droplets		
All positive COVID-19 patients are symptomatic		
All COVID-19 patients have upper respiratory symptoms		
COVID-19 is preventable?		
COVID-19 is less infectious/contagious than flu		
COVID-19 has 10-15 times mortality rate of flu		
There is no need to repeat COVID-19 testing if negative in symptomatic patients		
COVID-19 infection spread can be reduced by education/spreading awareness		
COVID-19 can spread by close person to person contact		

COVID-19 is highly infectious		
COVID -19 can be cured		
Approved treatment for COVID-19 is available		
Vaccination for COVID-19 is available		
Best approach to decrease viral spread is personal hygiene and social distancing		

Days	**7**	**14**	**21**	**28**	**37**
Incubation period/period between infection & onset of symptoms can be up to					
Duration of viral shedding can be up to					

	Yes	**No**
Symptomatic patients with negative COVID-19 testing should self-quarantine for 14 days?		

Part 3: COVID-19 in pregnancy/transmission/neonatal effects/delivery mode/breastfeeding

	Yes	**No**
Pregnant women have similar risk of being infected like non-pregnant women		
Pregnant COVID-19 positive women have increased maternal morbidity		
Coronavirus infected mothers are at higher risk of miscarriage		
Coronavirus infected mothers are at higher risk of preterm delivery		
Pregnant women infected with COVID-19 late in pregnancy have been shown to transmit the virus to the fetus through the placenta		
Pregnant women infected with COVID-19 late in pregnancy have been shown to transmit the virus to the fetus during delivery		
Only delivery mode for COVID-19 ladies is via cesarean delivery		
Virus was shown to transmit through breastmilk		
COVID-19 infection during pregnancy was shown to cause congenital birth defects		
Maternal and neonatal risks of COVID-19 infection during pregnancy are not completely known		

Part 4: Attitudes towards COVID-19 in pregnant ladies

	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
Do you think a pregnant woman with positive COVID-19 infection should undergo cesarean section to prevent fetal intra-uterine infection					
Do you think a pregnant woman with positive COVID-19 infection should undergo cesarean section to decrease exposure of health care workers to the virus					
Do you think you need routine COVID-19 screening during pregnancy					
If you were told the virus does not spread to the infant					

through breast milk of an infected COVID-19 positive mother, would you breastfeed					
If you were told, the virus can spread while breastfeeding through respiratory droplets and contact with COVID-19 infected mother, would you breastfeed					
Telehealth is essential due to the current situation					

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5,6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	7,8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	8
		(*e*) Describe any sensitivity analyses	8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	Shown in tables
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9, tables

		(*b*) Report category boundaries when continuous variables were categorized	Tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	10,11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.