

Article

Travel during Pregnancy: A Web-Based Survey of People Who Have Been Pregnant within the Past 10 Years

Lada H. Nechval^{1,2} and Kathleen M. Antony^{2,*} 

¹ Department of Spanish and Portuguese, University of Wisconsin-Madison, 1220 Linden Drive, Madison, WI 53706, USA

² Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, University of Wisconsin-Madison, 1010 Mound Street, Madison, WI 53715, USA

* Correspondence: kantony@wisc.edu

Abstract: Travel is frequent among many populations, including pregnant people. The focus of this online survey was to better understand the travel practices of people who have been pregnant within the last ten years. An online survey was conducted for three months through social media posts on Facebook and Twitter. Previously pregnant people were asked questions about where they traveled, if they cancelled any travel plans, and travel-related discussions with their obstetric provider. During the three months the survey was open, 469 participants completed the survey. A total of 390 (83.2%) participants traveled domestically, while 114 (24.3%) traveled internationally or between non-contiguous states within the United States of America (USA). Of these respondents, 170 (44.2%) of the domestic travelers and 69 (61.1%) of the international travelers reported discussing travel plans with their OB provider. Additionally, 49 (10.5%) participants cancelled at least one domestic trip and 30 (6.41%) cancelled at least one international trip. Regarding travel discussions, 6 (3.6%) participants who traveled domestically and 2 (2.9%) who traveled internationally reported that their OB provider initiated the conversation. Many pregnant people choose to travel domestically and internationally. However, it is also clear that not all travelers discuss plans with their OB provider, and in few cases does the provider initiate the conversation. Given the frequency with which people travel, pregnant people and their OB providers should have conversations regarding travel to minimize potential risks.

Keywords: pregnancy; travel; international travel; domestic travel; obstetrics



Citation: Nechval, L.H.; Antony, K.M.

Travel during Pregnancy: A Web-Based Survey of People Who Have Been Pregnant within the Past 10 Years. *Reprod. Med.* **2023**, *4*, 166–179. <https://doi.org/10.3390/reprodmed4030016>

Academic Editor: Berthold Huppertz

Received: 30 May 2023

Revised: 2 July 2023

Accepted: 20 July 2023

Published: 28 July 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Travel is frequent among many populations, including pregnant people [1–3]. There are several travel-related risks that pregnant people should be aware of when planning a trip. Air transportation risks include turbulence, radiation exposure, decreased oxygen, risk of thromboembolism, and delivery en route [4]. At the travel destination, infectious diseases, such as malaria, Zika, and SARS-CoV-2, pose risks to pregnant people and their fetuses [2–7]. Pregnant people are more likely to attract mosquitoes that can cause malaria and Zika than their non-pregnant counterparts [8,9], and pregnant people have more severe malaria infections, as well as increased risk for developing pregnancy-specific complications, including preterm birth, low birth weight, congenital infection, miscarriage, stillbirth, and death [10–17]. Zika can cause fetal anomalies, including severe fetal brain injury, fetal growth restriction, miscarriages, and stillbirths, as well as ocular changes and hearing loss [7,18–22]. Moreover, SARS-CoV-2 and its evolving variants exist worldwide [23–25]; notably, pregnant people infected with SARS-CoV-2 are more likely to experience intensive care unit admission, invasive ventilation, extracorporeal membrane oxygenation, and death [23–25].

The focus of this research was to better understand the travel practices of people who have been pregnant within the past ten years. We previously queried travel practices

among a limited population of people delivering in Madison, Wisconsin, USA during the Zika epidemic [2,3]. One study queried travel during the first half of pregnancy, and we found that around 5% of respondents had traveled internationally and around 40% had traveled domestically [3]. A second study queried postpartum people about travel through their whole pregnancy and we found that about 11% had traveled internationally and around 75% had traveled domestically [2]. Based upon our previous investigations, we hypothesized that both domestic and international travel would be common [2,3]. We also hypothesized that there would be many cancelled travel plans due to Zika, SARS-CoV-2, or pregnancy-related travel restrictions.

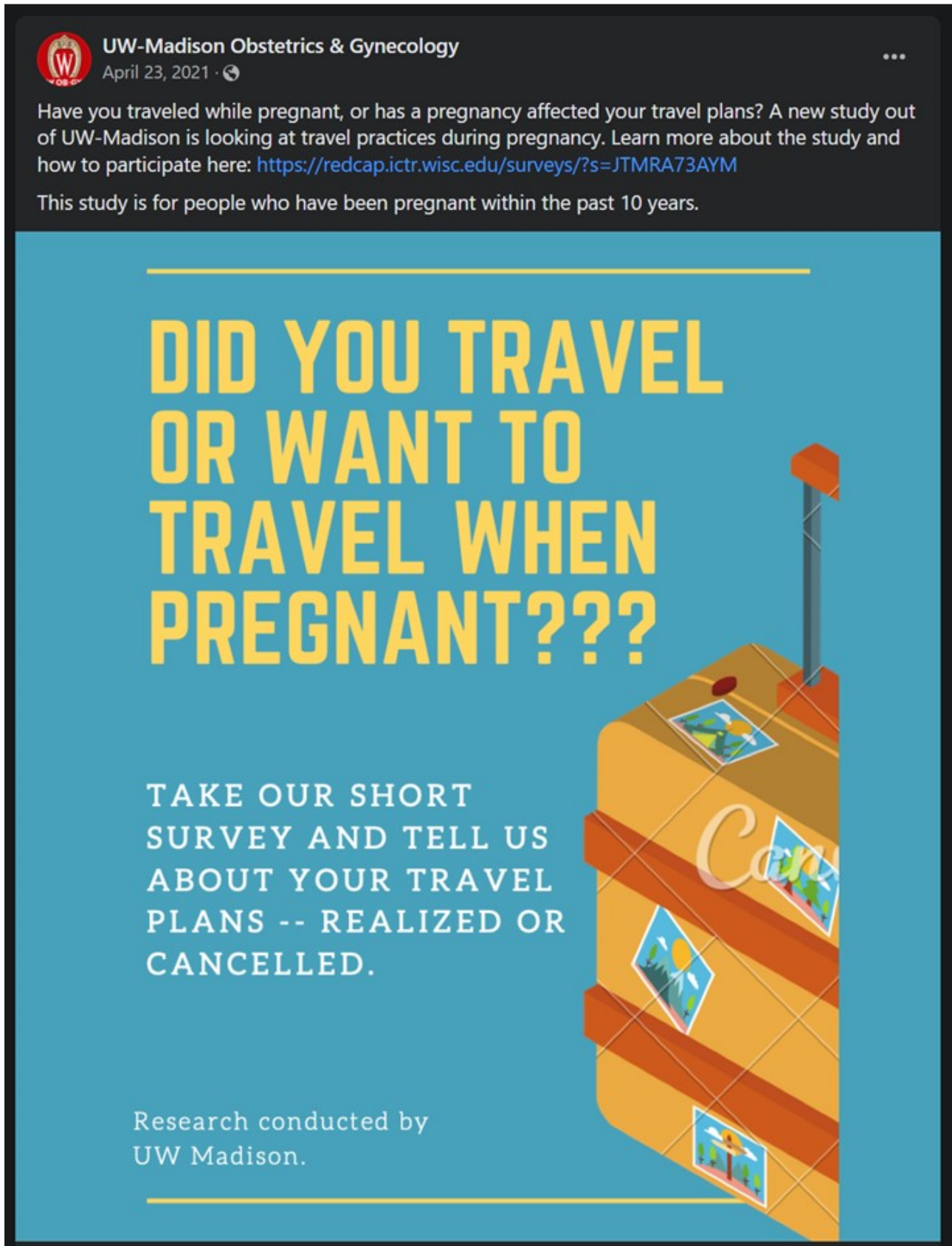
2. Materials and Methods


This project was approved by the University of Wisconsin-Madison Minimal Risk Institutional Review Board (ID 2021-0295, approved 15 March 2021). A pre-existing survey regarding travel during pregnancy was converted to an online format (REDCap) and tested for technical functionality and usability before it was fielded [2,26,27]. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies and it aids in the electronic distribution of online surveys. This open survey was available by clicking on a direct online link. The survey was open to the public through posts on Facebook and Twitter for three months between 23 April 2021 and 1 August 2021. The link was posted to the University of Wisconsin Department of Obstetrics and Gynecology's Facebook page, the senior author's Facebook page (KMA), and to Facebook "parenting" groups with the goal of targeting individuals who had been pregnant within the past ten years. The Department of Obstetrics and Gynecology also cross-posted the link to Twitter (Figure 1).

Before potential participants could proceed with the survey about travel, a screening survey was administered that discussed the goals of the survey and queried inclusion criteria. The informed consent form was posted on the screening survey and attached as a separate PDF. Both the screening survey and the consent form discussed that completion of the survey was voluntary and that no identifying information would be collected. The survey introduction warned that the survey included a limited number of questions about pregnancy outcomes, such as miscarriage, which could cause distress. No incentives were offered for participation.

The inclusion criteria included having had a pregnancy within the last 10 years, being older than 18, and agreeing to complete the survey. The timeframe of the past ten years was chosen so that the results would reflect recent travel patterns. This timeframe also encompassed both the Zika and SARS-CoV-2 pandemic, both of which would be expected to impact the travel patterns of pregnant people. The survey itself asked participants whether they traveled domestically or internationally during pregnancy, where they traveled, and whether any travel plans were cancelled. It also queried about discussions with their obstetric provider regarding travel. At the end of the survey, general information about demographics and pregnancy outcomes were queried.

The survey was designed to take 5–15 min to complete, and participants were not required to answer all questions. Branching logic was built into the survey to capture travel details, depending upon the number of trips and type of travel. Thus, the total number of questions answered depended upon the number of trips taken during the pregnancy. Once consent was obtained, the whole survey was within one webpage and had a minimum of 39 questions, many of which were "Yes/No" or radio button responses. For the trips themselves, many response fields allowed for open-ended answers, such as questions about travel destinations. Where appropriate, some questions allowed a respondent to choose more than one response. No identifying data were collected from the participants nor was any attempt made to verify the responses with medical records. All responses by the participants were self-reported. Respondents were able to edit any or all responses until the whole survey was submitted. No cookies were used to assign a unique identifier to each computer, nor were IP checks or log file analyses performed to assess for multiple entries.



 **UW-Madison Obstetrics & Gynecology**
April 23, 2021 · 🌐

Have you traveled while pregnant, or has a pregnancy affected your travel plans? A new study out of UW-Madison is looking at travel practices during pregnancy. Learn more about the study and how to participate here: <https://redcap.ictr.wisc.edu/surveys/?s=JTMRA73AYM>

This study is for people who have been pregnant within the past 10 years.

DID YOU TRAVEL OR WANT TO TRAVEL WHEN PREGNANT???

TAKE OUR SHORT
SURVEY AND TELL US
ABOUT YOUR TRAVEL
PLANS -- REALIZED OR
CANCELLED.

Research conducted by
UW Madison.




Figure 1. Image of a social media post inviting people who have been pregnant within the past 10 years to complete an online survey.

For this study, domestic travel was considered to be travel of at least 60 miles (97 km) within the continental or contiguous United States of America (USA), within continental Canada, or within the country the participant lived in at the time of their pregnancy. International or long-distance travel was defined as travel outside of the continental or contiguous USA, outside of continental Canada, or outside of the country the participant lived in at the time, including travel to and from Hawaii or Alaska and the contiguous USA, and travel to US Territories, such as Puerto Rico.

For the statistical analysis, a Pearson's Chi-Square, Fisher's Exact, Student's *t*-test, and Mann-Whitney U test were performed where appropriate. All statistical analyses were performed using Stata (16.1, StataCorp LLC, College Station, TX, USA). The map demonstrating the international travel destinations of participants in this survey was created using Mapbox (Mapbox, 2022, OpenStreetMap, accessed 16 March 2022). In this analysis, incomplete questionnaires were excluded.

3. Results

Between 23 April 2021 and 1 August 2021, 711 people clicked on the link to the survey. A total of 242 were not eligible for inclusion based upon timing of pregnancy being greater than 10 years prior (7), not consenting to participation in the survey (232), or not completing the survey once started (3) (Figure 2). The participation rate was 472/711 (66.4%) and the completion rate was 469/472 (99.4%). Incomplete surveys were excluded because only a few questions were answered for each of the three surveys that were not completed.

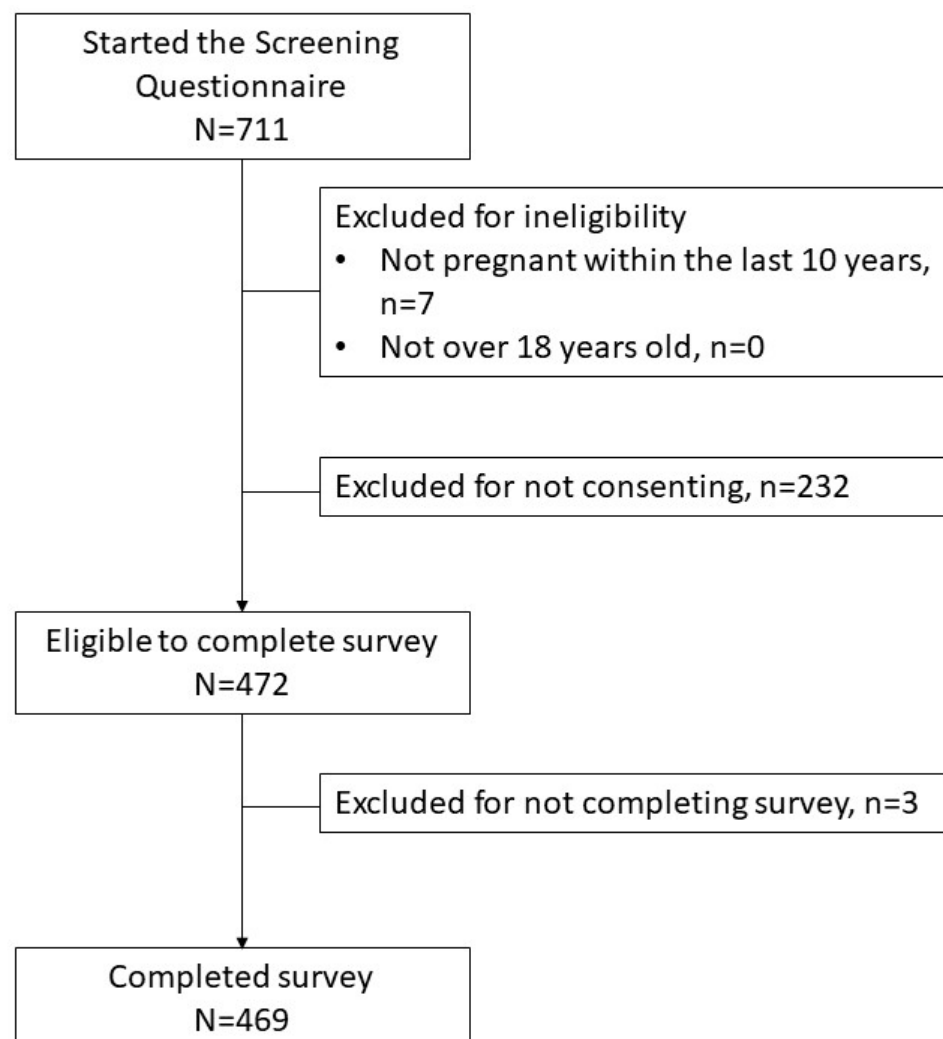


Figure 2. Flow diagram of survey initiation, eligibility criteria, and completion.

Of the 469 completed surveys, 425 (90.6%) responses were for people who lived in the USA during their most recent pregnancy and 44 (9.4%) were for people who lived outside the USA. Of the respondents who resided outside the USA during their most recent pregnancy, 63.6% reported domestic travel compared to 85.2% of respondents who lived within the USA ($p < 0.001$). While the majority of respondents were themselves born in the USA, a total of 43 different birth countries were represented. Of respondents who resided outside the USA, 56.8% reported international travel compared to 21.0% of respondents who resided within the USA ($p < 0.001$). International travel destinations are shown in Figure 3. The USA was the most common international destination (for pregnant people residing outside the USA) at 37%. England was the second most common at 31.4%. Every continent except Antarctica was visited by pregnant people who completed this survey.

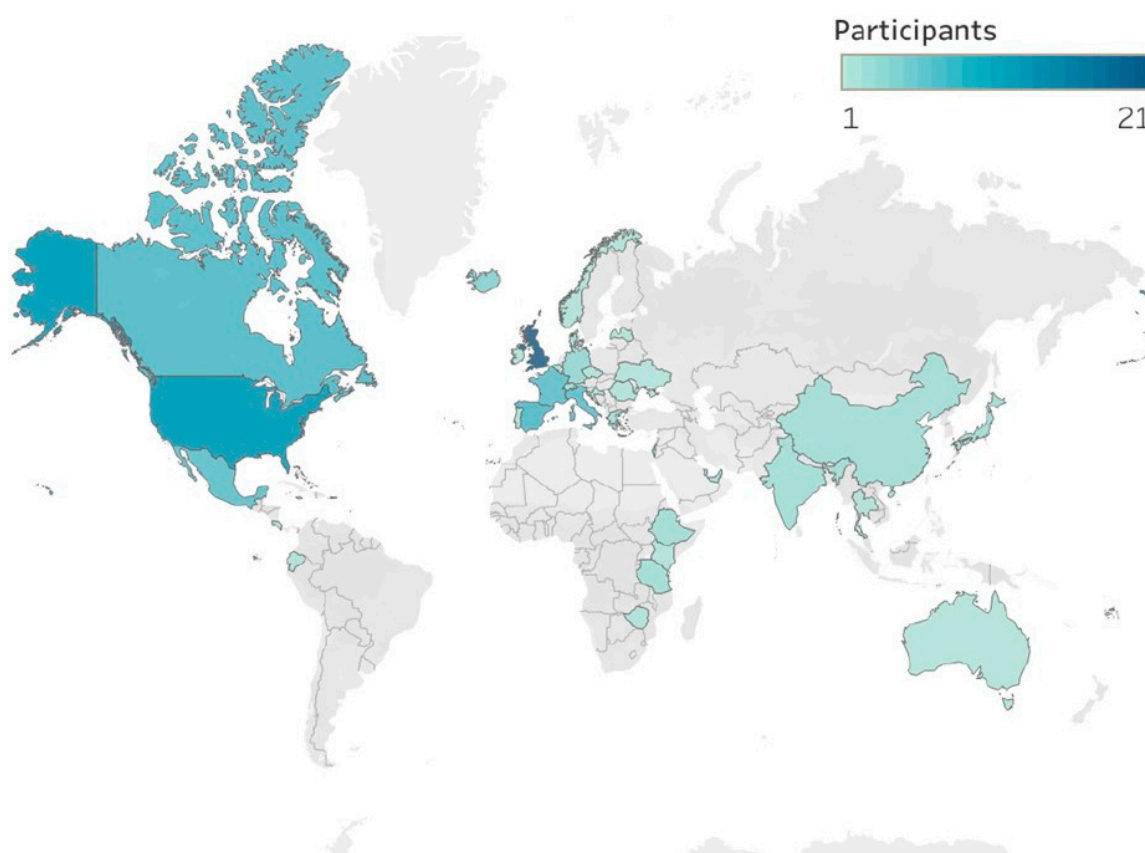


Figure 3. International travel destinations of participants who completed this survey.

The characteristics of respondents who did or did not travel domestically are shown in Table 1. The average age of the participants who domestically traveled was similar to those who did not travel domestically, as was the prevalence of advanced maternal age. There were racial differences between domestic travelers and non-travelers ($p = 0.005$). The annual income of domestic travelers differed from non-travelers with higher incomes associated with domestic travel ($p = 0.010$). There were also rural–urban differences ($p = 0.032$). Medical and obstetric comorbidities were similar between domestic travelers and non-travelers. The most common trimester for travel was the second trimester, with 281 travelers taking at least one trip during the second trimester. The second most common trimester for travel was the first trimester, with 239 travelers taking at least one domestic trip during this time. A total of 203 respondents traveled domestically during the third trimester. Overall, 83.2% of participants took at least one domestic trip during their most recent pregnancy; 63.8% took two domestic trips, 44.6% took three domestic trips, 23.9% took four domestic trips, and 15.8% took five or more domestic trips.

Table 1. Characteristics of those who traveled domestically while pregnant compared to those who did not travel domestically.

Characteristic	No Domestic Travel N = 79	Domestic Travel N = 390	<i>p</i> *
Age (mean, SD)	34.8 (3.9)	34.3 (3.7)	0.290
Advanced maternal age (n, %)	32 (40.5)	144 (36.9)	0.549
Race (n, %)			
White/Caucasian	59 (74.7)	319 (82.6)	0.005
African American	3 (3.8)	12 (3.1)	
American Indian or Alaskan Native	0 (0)	2 (0.5)	
Asian	7 (8.9)	41 (10.6)	
Native Hawaiian or other Pacific Islander	1 (1.3)	0 (0)	
From multiple races	4 (5.1)	6 (1.6)	
Other or prefer not to answer	5 (6.3)	6 (1.6)	
Hispanic or Latina (n, %)	7 (9.0)	28 (7.2)	0.600
Marital status (n, %)			
Currently married or living with partner	79 (100.0)	380 (97.4)	0.150
Currently widowed, divorced, separated, or never married/not living with partner	0 (0)	10 (2.6)	
Highest educational level (n, %)			
High school or less than high school	0 (0)	3 (0.8)	0.078
Some or completed college	19 (24.1)	56 (14.4)	
Graduate degree	60 (76.0)	331 (84.9)	
Annual Income (n, %)			
<\$50,000	10 (12.7)	43 (11.0)	0.010
\$50,000–149,999	29 (36.7)	84 (21.5)	
\$150,000 or more	40 (50.6)	263 (67.4)	
Residence † (n, %)			
Urban	35 (44.3)	121 (31.3)	0.032
Suburban	41 (51.9)	214 (55.3)	
Rural	3 (3.8)	45 (11.6)	
Other	0 (0)	7 (1.8)	
Born in the United States † (n, %)	62 (78.5)	328 (84.8)	0.169
Parents born in the United States (n, %)	50 (64.1)	279 (72.3)	0.147
Primary household language English (n, %)	67 (84.8)	353 (91.7)	0.057
Medical comorbidities (n, %)			
Tobacco use	0 (0)	1 (0.26)	0.651
Diabetes	5 (6.3)	34 (8.8)	0.469
Hypertension	11 (13.9)	52 (13.4)	0.908
Thyroid disease	6 (7.6)	29 (7.5)	0.975
Asthma	3 (3.8)	32 (8.3)	0.165
Seizures	0 (0)	1 (0.3)	0.652
Body mass index \geq 30 kg/m ²	10 (12.7)	75 (19.2)	0.167

Table 1. Cont.

Characteristic	No Domestic Travel N = 79	Domestic Travel N = 390	<i>p</i> *
Obstetric characteristics (n, %)			
Gravidity (median, IQR)	3 (2–3)	2 (2–3)	0.151
Gravida 1 ‡	12 (15.2)	75 (19.5)	0.382
Gravida 2	26 (32.9)	142 (36.9)	
Gravida 3 or greater	41 (51.9)	168 (43.6)	
First pregnancy (n, %)	24 (30.4)	129 (33.1)	0.641
Prior miscarriage	34 (43.0)	144 (36.9)	0.307
Twin pregnancy	1 (1.3)	8 (2.1)	0.635

* Pearson’s Chi-Square, Fisher’s Exact (where appropriate), Student’s *t*-test, or Mann-Whitney U test, where appropriate. † Foreign born participants were born in Bolivia (1), Brazil (5), Canada (6), China (2), Columbia (2), Costa Rica (1), Czech Republic (1), Dominican Republic (1), Ecuador (1), El Salvador (1), “Europe” (1), Finland (1), France (2), Germany (2), Ghana (1), Hong Kong (1), Iceland (1), India (7), Iran (1), Israel (1), Lebanon (1), Malaysia (2), Mexico (1), Netherlands (1), New Zealand (1), Nigeria (2), North Macedonia (1), “Other” (1), Peru (2), Philippines (4), Puerto Rico (1), Romania (3), Russia/USSR (2), Singapore (1), South Korea (2), Sri Lanka (1), Sweden (1), Taiwan (1), UK (2), Ukraine (4), Venezuela (1), and Zimbabwe (1). ‡ 5 did not respond to the gravidity question.

The characteristics of respondents who did or did not travel internationally are shown in Table 2. Advanced maternal age was more common among those who traveled internationally than those who did not travel internationally (*p* = 0.006). There were also racial differences between international travelers and non-travelers (*p* = 0.020). Annual income was not associated with international travel (*p* = 0.431). Medical and obstetric comorbidities did differ between international travelers and non-travelers. Among international travelers, BMI ≥ 30 kg/m² was less common, primiparity was more common, and gravidity was lower (*p* = 0.030, *p* = 0.014, and *p* = 0.018, respectively). The most common trimester for international travel was the second trimester with 61 travelers taking at least one trip during the second trimester. Fifty-four travelers took at least one international trip in the first trimester and 25 took at least one international trip during the third trimester. Overall, 24.3% of participants took at least one international trip during their most recent pregnancy; 4.9% took two international trips, 2.1% took three international trips, 1.1% took four international trips, and 0.4% took five or more international trips.

Table 2. Characteristics of those who traveled internationally (or outside the contiguous United States for USA residents) while pregnant compared to those who did not travel internationally (or outside the contiguous United States for USA residents).

Characteristic	No International or Non-Contiguous Travel N = 353	International or Non-Contiguous Travel N = 114 *	<i>p</i> †
Age (mean, SD)	34.2 (3.6)	34.8 (3.8)	0.201
Advanced maternal age (n, %)	120 (33.9)	55 (48.2)	0.006
Race (n, %)			
White/Caucasian	298 (85.1)	79 (69.3)	0.020
African American	9 (2.6)	6 (5.3)	
American Indian or Alaskan Native	1 (0.3)	1 (0.9)	
Asian	28 (8.0)	20 (17.5)	
Native Hawaiian or other Pacific Islander	1 (0.3)	0 (0)	
From multiple races	6 (1.7)	4 (3.5)	
Other or prefer not to answer	7 (2.1)	4 (3.5)	

Table 2. Cont.

Characteristic	No International or Non-Contiguous Travel	International or Non-Contiguous Travel	<i>p</i> †
Hispanic or Latina (n, %)	25 (7.1)	10 (8.8)	0.551
Marital status (n, %)			
Currently married or living with partner	346 (98.0)	112 (98.2)	0.877
Currently widowed, divorced, separated, or never married/not living with partner	7 (2.0)	2 (1.8)	
Highest educational level (n, %)			
High school or less than high school	2 (0.6)	0 (0)	0.665
Some or completed college	58 (16.4)	17 (14.9)	
Graduate degree	293 (83.0)	97 (85.1)	
Annual Income (n, %)			
<\$50,000	36 (10.2)	16 (14.0)	0.431
\$50,000–149,999	84 (23.8)	29 (25.4)	
\$150,000 or more	233 (66.0)	69 (60.5)	
Residence (n, %)			
Urban	109 (31.1)	47 (41.2)	0.024
Suburban	199 (56.7)	55 (48.2)	
Rural	40 (11.4)	8 (7.0)	
Other	3 (0.8)	4 (3.5)	
Born in the United States ‡ (n, %)	302 (86.0)	87 (76.3)	0.015
Parents born in the United States (n, %)	265 (75.7)	63 (55.8)	<0.001
Primary household language English (n, %)	322 (92.3)	97 (85.1)	0.023
Medical comorbidities (n, %)			
Tobacco use	1 (0.3)	0 (0)	0.568
Diabetes	31 (8.8)	8 (7.1)	0.559
Hypertension	52 (14.8)	11 (9.6)	0.161
Thyroid disease	26 (7.4)	9 (7.9)	0.864
Asthma	31 (8.9)	4 (3.5)	0.059
Seizures	1 (0.3)	0 (0)	0.566
Body mass index ≥ 30 kg/m ²	72 (20.4)	13 (11.4)	0.030
Obstetric characteristics (n, %)			
Gravidity (median, IQR)	2 (2–3)	2 (1–3)	0.018
Gravida 1	56 (16.0)	31 (27.4)	0.026
Gravida 2	130 (37.1)	37 (32.7)	
Gravida 3 or greater	164 (46.9)	45 (39.8)	
First pregnancy (n, %)	105 (29.8)	48 (42.1)	0.014
Prior miscarriage	140 (39.7)	38 (33.3)	0.227
Twin pregnancy	5 (1.4)	4 (3.5)	0.162

* Two who completed the survey did not respond to the question about international travel. † Pearson's Chi-Square, Fisher's Exact (where appropriate), Student's *t*-test, or Mann-Whitney U test, where appropriate. ‡ Foreign born participants were born in Bolivia (1), Brazil (5), Canada (6), China (2), Columbia (2), Costa Rica (1), Czech Republic (1), Dominican Republic (1), Ecuador (1), El Salvador (1), "Europe" (1), Finland (1), France (2), Germany (2), Ghana (1), Hong Kong (1), Iceland (1), India (7), Iran (1), Israel (1), Lebanon (1), Malaysia (2), Mexico (1), Netherlands (1), New Zealand (1), Nigeria (2), North Macedonia (1), "Other" (1), Peru (2), Philippines (4), Puerto Rico (1), Romania (3), Russia/USSR (2), Singapore (1), South Korea (2), Sri Lanka (1), Sweden (1), Taiwan (1), UK (2), Ukraine (4), Venezuela (1), and Zimbabwe (1).

Regarding pregnancy outcomes, no statistically significant difference was found in preterm birth between pregnant people who travelled domestically (7.6%) and who did not (11.4%) ($p = 0.257$). Miscarriage was reported by 1.8% of domestic travelers compared to 10.4% by those who did not travel domestically ($p < 0.001$). There was no statistically significant difference in preterm birth between pregnant people who travelled internationally (7.1%) compared to those who did not (8.6%) ($p = 0.610$). Similarly, there was no statistically significant difference in miscarriage. Miscarriage was reported by 2.7% of international travelers compared to 3.4% who did not travel internationally ($p = 0.697$). There were no differences in the prevalence of fetal anomalies (Table 3).

Table 3. Pregnancy complications.

Complication	No Domestic Travel N = 79	Domestic Travel N = 390	<i>p</i>	No International Travel N = 353	International Travel N = 114	<i>p</i>
Preterm birth *	9 (11.4)	29 (7.6)	0.257	30 (8.6)	8 (7.1)	0.610
Miscarriage †	8 (10.3)	7 (1.8)	<0.001	12 (3.4)	3 (2.7)	0.697
Fetal anomalies ‡	3 (3.8)	13 (3.4)	0.833	13 (3.7)	3 (2.6)	0.579
Venous thromboembolism §	0 (0)	1 (0.3)	0.652	0 (0)	1 (0.9)	0.077

* 6 domestic travelers, 4 non-international travelers, and 1 international traveler did not respond to the question about preterm birth. † 1 non-domestic traveler, 5 domestic travelers, 3 non-international travelers, and 2 international travelers did not respond to the question about miscarriage. ‡ 1 non-domestic traveler, 4 domestic travelers, and 4 non-international travelers did not respond to the question about fetal anomalies. § 1 non-domestic traveler, 6 domestic travelers, 4 non-international travelers, and 2 international travelers did not respond to the question about venous thromboembolism.

Regarding travel complications, there were no reports of participants with venous thromboembolism who did not travel domestically or internationally, while one participant who traveled domestically (0.3%) and another who travelled internationally (0.9%) did report a venous thromboembolism.

Regarding the reasons for travel, most respondents traveled domestically for vacation (91.3%), followed by familial reasons (77.1%) (Table 4). Similarly, most respondents traveled internationally for vacation (94.6%), followed by familial reasons (78.5%).

Table 4. Cited reasons for domestic and international travel (or travel outside the contiguous United States).

Reason	Domestic Travel, n (%)	International Travel, n (%)
	N = 390 *	N = 114
Work	118 (30.4)	32 (34.8)
Leisure/vacation	355 (91.3)	88 (94.6)
Family	300 (77.1)	73 (78.5)
Pregnancy or medical	10 (2.6)	2 (2.2)
Family emergency or unplanned travel	28 (7.2)	2 (2.2)

* 2 domestic travelers did not respond to these questions.

The median for the longest duration of transportation domestically by car was 5 h, compared to 4 h by plane. The median for the longest duration of transportation internationally by car was 3.5 h, compared to 7 h by plane (Table 5).

Table 5. Characteristics of travel.

Characteristics	Domestic Travel,	International Travel,
	n (IQR)	n (IQR)
	N = 390	N = 114
Duration by car travel, (hours) median (IQR)	5 (3–8)	3.5 (2–7)
Duration by air travel, (hours) median (IQR)	4 (3–5)	7 (5–12)
Number of trips, median (IQR, min-max)	3 (2–4, 1–5)	1 (1–1, 1–5)

A total of 44.2% of domestic and 61.1% of international travelers reported discussing travel plans with their OB provider. Regarding these conversations, 3.6% of domestic and 2.9% of international travelers reported that their OB provider initiated the discussion. Furthermore, 20.6% of domestic and 15.5% of international travelers reported that their OB provider discussed the risks and benefits of travel, with the decision of whether to travel left to the participant. Of the risks discussed, blood clots related to immobility were most often mentioned to both domestic (78.2%) and international (86.4%) travelers. The OB provider recommended frequent ambulation and hydrating to both domestic (74.7%, 76.5%) and international (66.7%, 69.6%) travelers (Table 6).

Table 6. Details of discussions with obstetric provider for people who traveled internationally or domestically.

Discussion Items	Domestic Travelers n = 390	International Travelers n = 114
Participant discussed travel plans with OB provider	170 (44.2)	69 (61.1)
Obstetric provider initiated the conversation and asked about travel *	6 (3.6)	2 (2.9)
Obstetric provider’s recommendations about travel *		
Generally supportive of travel plans *	126 (74.1)	55 (79.7)
Discouraged travel *	9 (5.3)	3 (4.4)
Discussed risks and benefits, left decision to pregnant person *	35 (20.6)	11 (15.9)
Obstetric provider discussed risks and benefits of travel?		
Risks of blood clots related to immobility	97 (78.2)	38 (86.4)
Risk of food or water borne illness	20 (16.1)	14 (31.8)
Risk of other illnesses	35 (28.2)	17 (38.6)
Obstetric provider recommended the following		
Frequent ambulation *	127 (74.7)	46 (66.7)
Hydrating *	130 (76.5)	48 (69.6)
Steps to avoid food and water borne illnesses *, ‡	26 (15.3)	14 (20.3)
Steps to avoid mosquito borne illnesses *, ‡	42 (25.0)	22 (31.9)
Obstetric provider reviewed the following		
Signs of blood clots *	83 (48.8)	30 (43.5)
Symptoms of travel related illnesses *	28 (16.5)	15 (21.7)
Whether Zika was a concern *, ‡	40 (23.6)	21 (30.4)

* n (%) for participants who discussed travel plans with their provider. ‡ Food, waterborne, and mosquito-borne illnesses were not concerns for most destinations.

A total of 49 participants (10.4%) canceled at least one domestic trip and 35 (7.5%) canceled at least one international trip, including any trips between the contiguous USA and Alaska or Hawaii. Most of the cancelled domestic trips were to California (22.4%), followed by Wisconsin (16.3%) and Florida (12.2%). Most of the cancelled international trips were to Mexico (20%), followed by Hawaii (14.3%). Infection concerns during transportation were the most commonly cited reason for cancelled domestic trips (78.9%), followed by infection concerns at the destination (63.2%) and pregnancy complications (28.9%). Infection concerns at the destination were the most commonly cited reason for cancelled international trips (54.3%), with two respondents (5.7%) specifically adding comments

about Zika virus, followed by general concerns about transportation (22.8%) and venous thromboembolism (8.6%). In total, 16.3% of cancelled domestic trips were to destinations that had local transmission of Zika virus and 42.9% of cancelled international trips were to destinations that had local transmission of Zika virus at some point. A total of 8.2% of domestic trips that were cancelled during this 10-year period occurred during 2016–2017, and 57.1% occurred during 2020–2021 ($p < 0.005$). Of the international trips that were cancelled during this 10-year period, 28.6% were cancelled during 2016–2017 and 31.4% were cancelled during 2020–2021 ($p = 0.289$).

4. Discussion

The results of this online survey confirm that many people choose to travel domestically and internationally during pregnancy. Of the participants, 83.2% traveled domestically and 24.3% traveled internationally or non-contiguously. These data show an even greater participation in travel than our earlier studies that surveyed local pregnant or postpartum people, wherein 39.6–75.4% traveled domestically and 5.1–11.4% traveled internationally [2,3]. However, those particular studies were conducted during the Zika epidemic, which notably impacted travel. This present study queried a 10-year time period [2,3,28–31].

Travel patterns differed based upon the country of residence during pregnancy, with domestic travel being more common among those residing in the USA and international travel being more common among those residing outside the USA. These findings are consistent with other investigators who report frequent travel during pregnancy [5,32,33]. One reason for these differences may be that travel distances that would be domestic within the USA (or a similarly large country) would be international if one resides in country with less geographic area than the USA.

Regarding the impact of infectious disease on travel, this study found that over 40% of cancelled international trips were to destinations that had active transmission of Zika virus reported at some point. Infection concerns either during transportation or at the destination were the most commonly cited reasons for cancelled trips. The majority of cancelled domestic and international trips identified in this survey occurred during either the Zika or SARS-CoV-2 pandemic. This is consistent with guidance for pregnant people to avoid travel to areas with active transmission of Zika virus and for all people to avoid or minimize travel during the SARS-CoV-2 pandemic [34,35].

Travel during pregnancy is generally safe. However, there are some risks of travel and transportation in some obstetric scenarios [4]. OB providers should counsel pregnant people about travel to ensure that travel is as safe as possible at every stage. Of those who participated in the survey, a minority of domestic travelers and a majority of international travelers reported discussing travel plans with their OB provider. However, less than 5% of these conversations were initiated by the OB provider. An important step in increasing the number of conversations regarding travel is encouraging OB providers to inquire about travel interests or plans. For those people who did not speak with their OB provider about travel, whether other sources of information were sought is not known. Many people look to the internet for answering their medical questions, but the reliability varies from high reliability (for websites run by the World Health Organization or the Centers for Disease Control and Prevention, or national obstetrics societies or healthcare-based organizations) to low reliability (individual social media accounts, blogs, or similar). Even when using reliable sources, the internet cannot customize the counseling to any given pregnant person's situation and cannot take individual pregnancy risk factors, such as the presence of placenta previa, into account. As a result, while people may not feel the need to inform their OB provider of any upcoming travel, other sources of guidance may not be sufficiently detailed for an individual case.

Pregnant people may not feel comfortable telling their OB provider about any travel plans because they may think that travel is not recommended during pregnancy. Indeed, older publications suggest that travel by car can cause miscarriages [36]. However, more

recent publications have not substantiated these concerns [4]. Recent studies have found no evidence that air travel is detrimental to pregnancy outcomes, and one even demonstrated slightly higher birthweights and gestational ages at delivery among those who travel [1,37,38]. Here, we similarly found that pregnancy outcomes were overall favorable with outcomes, such as preterm birth [39] and miscarriage [40], about the same [39] as and slightly lower [40] than in the general population, respectively, which was likely related to the population sampled and this being a retrospective study. It is imperative that OB providers initiate these conversations to help pregnant people make informed decisions before traveling, en route, and while at their destinations, and also so that referral to a travel or infectious disease clinic can be made, when appropriate [4,41]. Of note, this survey did not ask participants why they did not discuss travel with their OB provider, and future research would be needed to best evaluate these patterns. We did not specifically find that pregnant people cancelling their travel plans was related to advanced gestational age, although many did cancel their travel plans due to pregnancy complications. We speculate that this may have been because people were already not making specific travel plans that would occur near term, so there would not have been a need to cancel such plans.

This study demonstrated that pregnant people continue travelling domestically and internationally. However, we previously reported that the frequency with which OB providers asked about travel and initiated conversations exceeded 90% and providers here initiated these discussions less than 5% of the time [2]. Our prior investigations occurred during the Zika epidemic, when providers were encouraged to inquire with pregnant people about past or future travel during pregnancy, which likely partly explains these different findings. Similar to some, [32,38] but not all prior investigators—we found that pregnancy complications were not more common among those who traveled.

The strengths of this study include the online setting, which allowed this survey to reach a larger and more geographically diverse target population. The convenience of an online survey provided interested participants ample time as well as privacy to complete their responses compared to face-to-face interviews. This study has limitations. These results have limited generalizability. Most participants were highly educated White people with high income from Wisconsin. This is consistent with the author's home institution being within Wisconsin and the department assisting with promoting the survey. The demographic composition of this sample may overestimate the frequency with which people travel. As with any survey, responses here are by self-reporting, which may also impact reliability; people may not recall every domestic trip they took that exceeded 60 miles during a pregnancy up to ten years prior, for example. Lastly, as this survey was advertised on the UW Health OBGYN social media page and spread by "sharing" or word-of-mouth, participants were limited to those who use and have access to online social networks.

5. Conclusions

Pregnant people should be aware of travel-related risks, including thromboembolism and diseases such as Zika, malaria, and SARS-CoV-2. Here, we found that travel during pregnancy is common, but discussions about travel are uncommon. Referral to travel clinics would have been appropriate given that travel destinations included every continent of our planet, except Antarctica. We also found that epidemics and pandemics impact travel during pregnancy. It remains important that pregnant people and their OB provider engage in discussions regarding travel, particularly in an era of global pandemics or multinational epidemics.

Author Contributions: L.H.N.: Conceptualization, Methodology, Software, Investigation, Resources, Data Curation, Writing-Original Draft, Writing-Review & Editing, Visualization, Project Administration. K.M.A.: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing-Review & Editing, Supervision, Funding acquisition. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the Clinical and Translational Science Award (CTSA) program, through the NIH National Center for Advancing Translational Sciences (NCATS), grant UL1TR002373.

The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH. Further support was provided by the University of Wisconsin School of Medicine and Public Health Department of Obstetrics and Gynecology.

Institutional Review Board Statement: This project was reviewed by the University of Wisconsin-Madison Institutional Review Board (2021-0295).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data underlying this article will be shared upon reasonable request to the corresponding author.

Acknowledgments: We thank Jacquelyn Askins and Rob Garza for creating the social media posts advertising this study (employed by UW Madison Department of Obstetrics and Gynecology). The project described was supported by the Clinical and Translational Science Award (CTSA) program, through the NIH National Center for Advancing Translational Sciences (NCATS), grant UL1TR002373. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Jones, C.A.; Chan, C. Bon Voyage: An Update on Safe Travel in Pregnancy. *J. Obstet. Gynaecol. Can.* **2014**, *36*, 1101–1106. [[CrossRef](#)]
2. Melidosian, L.; Evans, E.; Stewart, K.; Antony, K.M. Travel during pregnancy: A study of postpartum women in Madison, Wisconsin. *WMJ* **2019**, *118*, 114–119. [[PubMed](#)]
3. Antony, K.M.; Gupta, V.K.; Hoppe, K.K.; Quamme, T.; Feldman, N.; Stewart, K. Travel during Pregnancy: Results from an Ultrasound Unit-Based Questionnaire. *WMJ* **2017**, *116*, 49–54.
4. Antony, K.M.; Ehrental, D.; Evensen, A.; Iruretagoyena, J.I. Travel during Pregnancy: Considerations for the Obstetric Provider. *Obstet. Gynecol. Surv.* **2017**, *72*, 97–115. [[CrossRef](#)]
5. VJaeger, V.K.; Tschudi, N.; Rüegg, R.; Hatz, C.; Bühler, S. The elderly, the young and the pregnant traveler—A retrospective data analysis from a large Swiss Travel Center with a special focus on malaria prophylaxis and yellow fever vaccination. *Travel Med. Infect. Dis.* **2015**, *13*, 475–484. [[CrossRef](#)]
6. Lagerberg, R.E. Malaria in Pregnancy: A Literature Review. *J. Midwifery Women's Health* **2008**, *53*, 209–215. [[CrossRef](#)]
7. Rice, M.E.; Galang, R.R.; Roth, N.M.; Ellington, S.R.; Moore, C.A.; Valencia-Prado, M.; Ellis, E.M.; Tufa, A.J.; Taulung, L.A.; Alfred, J.M.; et al. Vital signs: Zika-associated birth defects and neurodevelopmental abnormalities possibly associated with congenital zika virus infection—U.S. Territories and freely associated states, 2018. *Morb. Mortal. Wkly. Rep.* **2018**, *67*, 858–867. [[CrossRef](#)]
8. Lindsay, S.; Ansell, J.; Selman, C.; Cox, V.; Hamilton, K.; Walraven, G. Effect of pregnancy on exposure to malaria mosquitoes. *Lancet* **2000**, *355*, 1972. [[CrossRef](#)]
9. Ansell, J.; Hamilton, K.; Pinder, M.; Walraven, G.; Lindsay, S. Short-range attractiveness of pregnant women to *Anopheles gambiae* mosquitoes. *Trans. R. Soc. Trop. Med. Hyg.* **2002**, *96*, 113–116. [[CrossRef](#)]
10. Sholapurkar, S.L.; Gupta, A.N.; Mahajan, R.C. Clinical course of malaria in pregnancy—A prospective controlled study from India. *Trans. R. Soc. Trop. Med. Hyg.* **1988**, *82*, 376–379. [[CrossRef](#)]
11. World Health Organization Division of Control of Tropical Diseases. Severe and Complicated Malaria. *Trans. R. Soc. Trop. Med. Hyg.* **1990**, *84* (Suppl. S2), 1–65. [[CrossRef](#)]
12. McGregor, I.A. Epidemiology, malaria, and pregnancy. *Am. J. Trop. Med. Hyg.* **1984**, *33*, 517–525. [[CrossRef](#)] [[PubMed](#)]
13. Smereck, J. Malaria in pregnancy: Update on emergency management. *J. Emerg. Med.* **2011**, *40*, 393–396. [[CrossRef](#)] [[PubMed](#)]
14. Espinoza, E.; Hidalgo, L.; Chedraui, P. The effect of malarial infection on maternal-fetal outcome in Ecuador. *J. Matern. Fetal. Neonatal Med.* **2005**, *18*, 101–105. [[CrossRef](#)]
15. Ducarme, G.; Thuillier, C.; Wernet, A.; Bellier, C.; Luton, D. Malaria in pregnant woman masquerading as HELLP syndrome. *Am. J. Perinatol.* **2009**, *27*, 171–172. [[CrossRef](#)]
16. Newman, R.D.; Hailemariam, A.; Jimma, D.; Degifie, A.; Kebede, D.; Rietveld, A.E.C.; Nahlen, B.L.; Barnwell, J.W.; Steketee, R.W.; Parise, M.E. Burden of malaria during pregnancy in areas of stable and unstable transmission in Ethiopia during a non-epidemic year. *J. Infect. Dis.* **2003**, *187*, 1765–1772. [[CrossRef](#)]
17. Singh, N.; Saxena, A.; Chand, S.K.; Valecha, N.; Sharma, V.P. Studies on malaria during pregnancy in a tribal area of central India (Madhya Pradesh). *Southeast Asian J. Trop. Med. Public Health* **1998**, *29*, 10–17.
18. de Barros Miranda-Filho, D.; Martelli, C.M.T.; de Alencar Ximenes, R.A.; Araújo, T.V.B.; Rocha, M.A.W.; Ramos, R.C.F.; Dhalia, R.; de Oliveira França, R.F.; de Azevedo Marques Júnior, E.T.; Rodrigues, L.C. Initial description of the presumed congenital Zika syndrome. *Am. J. Public Health* **2016**, *106*, 598–600. [[CrossRef](#)]
19. Costello, A.; Dua, T.; Duran, P.; Gülmezoglu, M.; Oladapo, O.T.; Perea, W.; Pires, J.; Ramon-Pardo, P.; Rollins, N.; Saxena, S. Defining the syndrome associated with congenital Zika virus infection. *Bull. World Health Organ.* **2016**, *94*, 406. [[CrossRef](#)]

20. Pomar, L.; Musso, D.; Malinger, G.; Vouga, M.; Panchaud, A.; Baud, D. Zika virus during pregnancy: From maternal exposure to congenital Zika virus syndrome. *Prenat. Diagn.* **2019**, *39*, 420–430. [[CrossRef](#)]
21. Freitas, D.A.; Souza-Santos, R.; Carvalho, L.M.A.; Barros, W.B.; Neves, L.M.; Brasil, P.; Wakimoto, M.D. Congenital Zika syndrome: A systematic review. *PLoS ONE* **2020**, *15*, e0242367. [[CrossRef](#)] [[PubMed](#)]
22. Puntasecca, C.J.; King, C.H.; LaBeaud, A.D. Measuring the global burden of Chikungunya and Zika viruses: A systematic review. *PLoS Negl. Trop. Dis.* **2021**, *15*, e0009055. [[CrossRef](#)] [[PubMed](#)]
23. DeSisto, C.L.; Wallace, B.; Simeone, R.M.; Polen, K.; Ko, J.Y.; Meaney-Delman, D.; Ellington, S.R. Risk for Stillbirth among Women with and without COVID-19 at Delivery Hospitalization—United States, March 2020–September 2021. *MMWR Morb. Mortal. Wkly. Rep.* **2021**, *70*, 1640–1645. [[CrossRef](#)]
24. Kasehagen, L.; Byers, P.; Taylor, K.; Kittle, T.; Roberts, C.; Collier, C.; Rust, B.; Ricaldi, J.N.; Green, J.; Zapata, L.B.; et al. COVID-19—Associated Deaths after SARS-CoV-2 Infection during Pregnancy—Mississippi, 1 March 2020–6 October 2021. *MMWR Morb. Mortal. Wkly. Rep.* **2021**, *70*, 1646–1648. [[CrossRef](#)] [[PubMed](#)]
25. Zambrano, L.D.; Ellington, S.; Strid, P.; Galang, R.R.; Oduyebo, T.; Tong, V.T.; Woodworth, K.R.; Nahabedian, J.F.; Azziz-Baumgartner, E.; Gilboa, S.M.; et al. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status—United States, 22 January–3 October 2020. *MMWR Morb. Mortal. Wkly. Rep.* **2020**, *69*, 1641–1647. [[CrossRef](#)]
26. Harris, P.A.; Taylor, R.; Minor, B.L.; Elliott, V.; Fernandez, M.; O’Neal, L.; McLeod, L.; Delacqua, G.; Delacqua, F.; Kirby, J.; et al. The REDCap consortium: Building an international community of software platform partners. *J. Biomed. Inform.* **2019**, *95*, 103208. [[CrossRef](#)]
27. Harris, P.A.; Taylor, R.; Thielke, R.; Payne, J.; Gonzalez, N.; Conde, J.G. Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *J. Biomed. Inform.* **2009**, *42*, 377–381. [[CrossRef](#)]
28. Squiers, L.; Lynch, M.; Dolina, S.; Ray, S.; Kelly, B.; Herrington, J.; Turner, M.; Chawla, D.; Becker-Dreps, S.; Stamm, L.; et al. Zika and travel in the news: A content analysis of US news stories during the outbreak in 2016–2017. *Public Health* **2019**, *168*, 164–167. [[CrossRef](#)]
29. Chandrasekaran, N.; Marotta, M.; Taldone, S.; Curry, C. Perceptions of Community Risk and Travel during Pregnancy in an Area of Zika Transmission. *Cureus* **2017**, *9*, 7–10. [[CrossRef](#)]
30. Gallivan, M.; Oppenheim, B.; Madhav, N.K. Using social media to estimate Zika’s impact on tourism: #babymoon, 2014–2017. *PLoS ONE* **2019**, *14*, e0212507. [[CrossRef](#)]
31. United Nations Development Programme. A Socio-Economic Impact Assessment of the Zika Virus in Latin America and the Caribbean with a Focus on Brazil, Colombia and Suriname. 2017. Available online: https://www.undp.org/publications/socio-economic-impact-assessment-zika-virus-latin-america-and-caribbean?utm_source=EN&utm_medium=GSR&utm_content=US_UNDP_PaidSearch_Brand_English&utm_campaign=CENTRAL&c_src=CENTRAL&c_src2=GSR&gclid=Cj0KCQjwK0qZBhDNARIsAAC (accessed on 9 March 2022).
32. Chibber, R.; Al-Sibai, M.H.; Qahtani, N. Adverse outcome of pregnancy following air travel: A myth or a concern? *Aust. N. Z. J. Obstet. Gynaecol.* **2006**, *46*, 24–28. [[CrossRef](#)] [[PubMed](#)]
33. Bühler, S.; Rüegg, R.; Steffen, R.; Hatz, C.; Jaeger, V.K. A profile of travelers—An analysis from a large Swiss travel clinic. *J. Travel Med.* **2014**, *21*, 324–331. [[CrossRef](#)] [[PubMed](#)]
34. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention: Zika Virus: Zika Travel Information. Available online: <https://wwwnc.cdc.gov/travel/page/zika-travel-information> (accessed on 4 May 2019).
35. Centers for Disease Control and Prevention. COVID-19 Travel Recommendations by Destination. COVID-19 Travel Recommendations by Destination. Available online: <https://www.cdc.gov/coronavirus/2019-ncov/travelers/map-and-travel-notice.html> (accessed on 24 February 2022).
36. Better Homes & Gardens (Ed.) *Better Homes and Gardens Baby Book: A Handbook for Parents by the Better Homes & Gardens Child Care and Training Department*, 5th ed.; Meredith Publishing Company: Des Moines, IA, USA, 1951.
37. Ram, H.S.; Ram, S.; Miller, N.; Rosental, Y.S.; Chodick, G. Air travel during pregnancy and the risk of adverse pregnancy outcomes as gestational age and weight at birth: A retrospective study among 284,069 women in Israel between the years 2000 to 2016. *PLoS ONE* **2020**, *15*, e0228639. [[CrossRef](#)]
38. Freeman, M.; Ghidini, A.; Spong, C.Y.; Tchabo, N.; Bannon, P.Z.; Pezzullo, J.C. Does air travel affect pregnancy outcome? *Arch. Gynecol. Obstet.* **2003**, *269*, 274–277. [[CrossRef](#)] [[PubMed](#)]
39. American College of Obstetricians and Gynecologists. Prediction and prevention of spontaneous preterm birth. ACOG Practice Bulletin No. 234. *Obstet. Gynecol.* **2021**, *138*, e65–e90. [[CrossRef](#)] [[PubMed](#)]
40. American College of Obstetricians and Gynecologists. ACOG practice bulletin no. 200: Early pregnancy loss. *Obstet. Gynecol.* **2018**, *132*, e197–e207. [[CrossRef](#)]
41. Aw, B.; Boraston, S.; Botten, D.; Cherniwchan, D.; Fazal, H.; Kelton, T.; Libman, M.; Saldanha, C.; Saldanha, C.; Stowe, B. Travel Medicine: What’s Involved? When to Refer? *Can. Fam. Physician* **2014**, *60*, 1091–1103. Available online: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4264804/> (accessed on 10 August 2016).

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.