Neuraminidase Inhibitors During Pregnancy and Adverse Birth Outcomes: A Meta-Analysis

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Abstract: Neuraminidase inhibitors (NAIs) are commonly used to treat influenza and are also considered the potential treatment for COVID-19. The association of using NAIs during pregnancy with the risk of adverse birth defects has been investigated repeatedly by epidemiological studies; however, results are largely inconsistent. We herein performed this meta-analysis to investigate the true association of NAIs with adverse birth defects, including preterm birth (PTB), low birth weight (LBW), and small for gestational age (SGA). A systematic search was performed through PubMed, Scopus, and Embase to identify all pertinent studies; The ORs with their corresponding 95% CIs were extracted or calculated. Heterogeneity was assessed using the Cochran Q test and the I² statistic. A random-effect model was used for this meta-analysis due to existing heterogeneity. Overall, eight studies were included in our analysis, meta-analysis using a random-effect model showed that NAIs during pregnancy reduced the risk of LBW (OR=0.78, 95% CI=0.66–0.91) and SGA (OR=0.76, 95% CI=0.67–0.86) but is not associated with PTB (OR=1.01, 95% CI=0.87–1.16). Results of the present study suggested that NAIs during pregnancy are safe and may reduce the risk of LBW and SGA. However, further studies from different ethnic populations are warranted to confirm our results.

Keywords: neuraminidase inhibitors; pregnancy; birth defects; birth outcomes; meta-analysis.

1. Introduction

Neuraminidase inhibitors (NAIs), including zanamivir and oseltamivir, are a class of antiviral drugs that have been widely used since March 2009 following the influenza A (H1N1) pandemic as an effective treatment for influenza infection [1,2]. The beneficial effects of NAIs on reducing the risks of hospitalization and mortality in pregnant women have been well established [3,4]. Furthermore, these drugs are now considered as a possible therapy for COVID-19 [5-8]. During the last decade, the concerns about the safety of NAIs, especially on the fetus, has gained a great deal of attention, and several studies have evaluated the correlation between NAIs and the risk of birth defects [9,10]; including preterm (PTB, babies born alive...
<37 weeks of pregnancy), small for gestational age (SGA, babies have birth weight <10th percentile for their gestational age) and low birth weight (LBW, babies born weighing <2,500 grams)), however, results are almost inconsistent, while some studies found an association between use of NAIs during pregnancy and birth defects, others not [11,12]. Therefore, we performed this meta-analysis to summarize the published results and investigate the true association of NAIs use during pregnancy and the risk of LBW, SGA, and PTB.

2. Materials and Methods

2.1. Data source and search strategy.

A comprehensive search was carried out in PubMed, Scopus and Embase to find all pertinent papers up to to December 2020. The following key words were employed: small for gestational age[Title/Abstract] OR SGA[Title/Abstract] OR low birth weight[Title/Abstract] OR preterm [Title/Abstract] OR preterm delivery [Title/Abstract] OR premature [Title/Abstract] OR LBW [Title/Abstract] OR pregnancy outcomes [Title/Abstract] OR birth outcome [Title/Abstract] AND oseltamivir [Title/Abstract] OR Tamiflu [Title/Abstract] OR antivirals [Title/Abstract] OR neuraminidase inhibitors [Title/Abstract] OR Laninamivir [Title/Abstract] OR Rapivab [Title/Abstract] OR Peramivir [Title/Abstract] OR Relenza [Title/Abstract] OR Zanamivir [Title/Abstract]. Moreover, references of all included papers were checked for other relevant papers.

2.2. Study selection.

The following inclusion criteria were used in this study: Case-control, cohort, or cross-sectional studies; Assessed the association of maternal NAIs exposure and risk of PTB, SGA, and LBW; Studies that enrolled women who were ≥16 years old had a singleton gestation and a live birth; ORs with 95% confidence intervals (CI) were indicated or have sufficient information to calculate it; Published in English

2.3. Data extraction and quality assessment.

Two researchers (AHS and MA) independently used a predefined customized form to extract the following information from each included article: the first author, publication date, country, study design, birth outcome, number of cases, the sample size in the exposed group, the age range of participants, and odd ratios with 95% confidence interval. The methodological quality of articles was evaluated using Newcastle–Ottawa Quality Assessment Scale (NOS) [13,14], and studies that achieved ≥7 score out of 9 were considered to be of high quality [15].

2.4. Statistical analysis.

ORs with their 95% CIs were employed as the effect size of each study and were combined to determine total risk. If several ORs based on different times of pregnancy, type of used NAIs, or other parameters were reported in a study, we pooled these ORs using fixed effects and used the combined OR in our primary analysis [16,17]. To evaluate the heterogeneity within the included articles Cochran Q test and the \( I^2 \) statistic were employed. We primarily used a fixed-effect model to determine the association with a forest plot, but if there was a significant heterogeneity (p < 0.1 or \( I^2 > 50\% \)), we used a random-effects model
[18,19]. Furthermore, a subgroup analysis based on the type of birth defects, including PTB, SGA, and LBW was done. Sensitivity analysis was performed to estimate the effect of every single article on the final results [17,20]. Egger’s linear regression test was employed to investigate the publication bias [15,21]. All statistical analysis was conducted using STATA software, RRID: SCR_012763 (version 15.0; Stata Corporation, College Station, TX, USA). Results were considered statistically significant where p-values were less than 0.05 [22,23].

3. Results and Discussion

3.1. Search results and Characteristics of the included studies.

A total of 382 studies were identified from PubMed, Scopus, and Embase, one more study was added from the references of included studies; of these studies, 96 were duplicates, 275 studies were excluded after the title and abstract screening, and 12 studies found to be eligible for full-text reading. Finally, 8 studies were identified as eligible and included in our analysis. The study flow is shown in Figure 1. The main features of the eligible studies are given in Table 1. The NOS scores for included studies ranged from 6 to 8.

![Figure 1. Flow chart of study selection.](https://biointerfaceresearch.com/)

3.2. Association between maternal NAIs exposure and adverse birth outcomes.

To investigate the association of maternal NAIs use during pregnancy and the risk of adverse birth outcomes, Overall OR for each study was employed to estimate the total OR using a random-effect model since there was heterogeneity within included studies ($I^2 = 39.6$, $P = 0.044$). Analyses of 8 included studies showed that maternal NAIs exposure reduced the risk of adverse birth outcomes (OR=0.88, 95% CI=0.78–0.98) as shown in Figure 2. Subgroup analysis based on the type of birth outcome revealed that NAIs exposure reduced the risk of LBW (OR=0.78, 95% CI=0.66–0.91) and SGA (OR=0.76, 95% CI=0.67–0.86), but is not associated with PTB (OR=1.01, 95% CI=0.87–1.16)
Table 1. Characteristics of studies included in the meta-analysis of maternal NAIs exposure and risk of LBW, SGA, and PTB.

| Study      | Year | Country          | Study design     | Outcome | No. of cases* | Sample size* (n) | Age, Median/Range(yrs.) | OR (95%CI) |
|------------|------|------------------|------------------|---------|---------------|------------------|-------------------------|------------|
| Greer      | 2010 | USA              | Retrospective    | PTB     | 13            | 135              | 24.8±5.8                | 1.67(0.94-2.97) |
| Svensson   | 2011 | Sweden           | Cohort           | LBW     | 3             | 86               | 19-30                   | 1.08(0.42-2.81)  |
|            |      |                  |                  | PTB     | 2             | 86               |                         | 0.96(0.40-2.30)  |
| Xie        | 2013 | Canada           | Retrospective    | SGA     | 85            | 1232             | 20-40                   | 0.77(0.60-0.98)  |
|            |      |                  |                  | PTB     | 86            |                  |                         | 1.26(0.99-1.61)  |
| Beau       | 2014 | France           | Cohort           | LBW     | 16            | 337              | 30.2±5.4                | 0.38(0.07-1.39)  |
|            |      |                  |                  | PTB     | 18            |                  |                         | 0.64(0.31-1.27)  |
| Dunstan    | 2014 | UK               | Prospective      | LBW     | 6             | 207              | 16-46                   | 1.73(0.41-7.23)  |
|            |      |                  |                  | PTB     | 16            |                  |                         | 1.08(0.57-2.03)  |
| Graner (A) | 2017 | Denmark, Norway, | Cohort           | LBW     | 157           | 5502             | 19-30                   | 0.77(0.65-0.91)  |
|            |      | Sweden           |                  | SGA     | 111           |                  |                         | 0.72(0.59-0.88)  |
|            |      |                  |                  | PTB     | 268           |                  |                         | 0.97(0.86-1.11)  |
| Graner (B) | 2017 | France           | Cohort           | LBW     | 12            | 322              | 19-30                   | 0.76(0.42-1.41)  |
|            |      |                  |                  | SGA     | 4             |                  |                         | 0.60(0.22-1.62)  |
|            |      |                  |                  | PTB     | 20            |                  |                         | 0.97(0.56-1.68)  |
| Ehrenstein | 2018 | Denmark          | Cohort           | SGA     | 153           | 1855             | -30                     | 0.81(0.64-1.03)  |
|            |      |                  |                  | PTB     | 107           |                  |                         | 0.85(0.65-1.11)  |
| Chambers   | 2019 | USA-Canada       | Prospective      | PTB     | 5             | 97               | -34                     | 0.65(0.26-1.63)  |

*Sample size and number of cases are from exposed groups. Graner A and B are from a single study with two different populations (France and Scandinavian countries).

3.3. Sensitivity analysis and publication bias.

Sensitivity analysis demonstrated that pooled OR and 95% CI were not changed by removing any individual study (Figure 3). Moreover, no evidence of publication bias was observed after performing Egger’s test (Figure 4; P value for Egger’s test, 0.945).
To the best of our knowledge, this is the first study that provided comprehensive insights into the association of NAIs with the birth outcome, including LBW, SGA, and PTB, through meta-analysis. The overall results of this meta-analysis indicated that maternal NAIs use during pregnancy reduced the risk of adverse birth outcome (OR = 0.88; 95% CI: 0.78, 0.98), However subgroup analysis showed that while NAIs reduced the risk of LBW (OR = 0.78; 95% CI: 0.66, 0.91) and SGA (OR = 0.76; 95% CI: 0.67, 0.86), it’s not associated with PTB (OR = 1.01; 95% CI: 0.87, 1.16).

In line with our results, Greer and colleagues in a cohort study with 135 American subjects showed that exposure to oseltamivir was not associated with PTB [24]. Three years later, Xie and colleagues, in a study with 1237 Canadian pregnant women, showed that oseltamivir use during pregnancy reduced the risk of SGA but was not associated with PTB [11]. In contrast to our results, in 2011, Svensson and colleagues, in a study with 81 pregnant

Figure 3. Sensitivity analysis graphs for included studies based on congenital disabilities type; A, PTB; B, SGA; C, LBW.

Figure 4. Funnel plot for publication bias analyses based on the type of birth defect; A, PTB; B, LBW; C, SGA.
women from Sweden, found no association between NAIs use during pregnancy and adverse birth outcomes [25]. In 2014, Beau and colleagues, in a cohort study with 337 pregnant women exposed to oseltamivir, showed no significant association between oseltamivir use and the risk of adverse pregnancy outcomes [26]. Moreover, this year, results of another cohort study with 207 pregnant women from the UK showed that NAIs were not associated with adverse birth defects [27]. More recently, Graner and colleagues in a multinational observational cohort study from Denmark, Norway, Sweden (collectively indicated as the Scandinavian countries), and France, reported that exposure to NAIs during pregnancy did not affect the birth outcomes in the French population, however in Scandinavian population caused a decrease in the incidence of LBW and SGA, which is in line with our results [28]. Furthermore, in another study with 1855 pregnant women that used oseltamivir, no association was observed between oseltamivir use during pregnancy and birth outcomes [29]. The last research on this association is a cohort study that included 112 pregnant women from the United States and Canada that were exposed to oseltamivir; their results also showed no association between the use of oseltamivir during pregnancy and the risk of PTB [12].

The NAIs, including zanamivir and oseltamivir, halt the spread of the influenza virus by blocking the release of progeny influenza virus from infected cells and infecting new cells. Previous studies have indicated the association of influenza infection during pregnancy and the increased risk of adverse birth outcomes [30-33]; therefore, using NAIs during pregnancy reduced the risk of adverse birth outcomes through its protective effects against influenza infection, however, herein results of this meta-analysis showed that NAIs reduced the risk of adverse birth outcomes including LBW and SGA even in healthy women that were not affected by the influenza virus; therefore it also can a potentially safe treatment for Covid-19 during the pregnancy.

The present meta-analysis had two main limitations: first, most of the included studies used oseltamivir as the NAI in their studies; therefore, subgroup analysis based on the type of NAIs was not possible. Second, significant heterogeneity was observed within the included studies, which undermined our results’ reliability.

4. Conclusions

In conclusion, our results suggested that the use of NAIs during pregnancy is safe and may decrease the risk of LBW and SGA. However, further studies are needed to confirm our results and reveal the mechanism underlying the protective effects of NAIs against adverse birth outcomes.

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Conflicts of Interest

The authors declare no conflict of interest.
References

1. Han, N.; Oh, J.M.; Kim, I.-W. Assessment of adverse events related to anti-influenza neuraminidase inhibitors using the FDA adverse event reporting system and online patient reviews. Scientific reports 2020, 10, 1-8. [https://doi.org/10.1038/s41598-020-60068-5]

2. Chen, J.-Y.; Wei, S.-K.; Lai, C.-C.; Weng, T.-S.; Wang, H.-H. A meta-analysis comparing the efficacy and safety of peramivir with other neuraminidase inhibitors for influenza treatment. Medicina 2020, 56, [https://doi.org/10.3390/medicina56020063].

3. Chow, E.J.; Beigi, R.H.; Riley, L.E.; Uyeki, T.M. Clinical Effectiveness and Safety of Antivirals for Influenza in Pregnancy. Open Forum Infectious Diseases 2021, 8, [https://doi.org/10.1093/ofid/ofab138].

4. Tejada, S.; Jansson, M.; Solé-Lleonart, C.; Rello, J. Neuraminidase inhibitors are effective and safe in reducing influenza complications: meta-analysis of randomized controlled trials. European Journal of Internal Medicine 2021, 86, 54-65, [https://doi.org/10.1016/j.ejim.2020.12.010].

5. Frediansyah, A.; Tiwari, R.; Sharun, K.; Dhama, K.; Harapan, H. Antivirals for COVID-19: A critical review. Clinical Epidemiology and global health 2021, 9, 90-98, [https://doi.org/10.1016/j.cegh.2020.07.006].

6. Reche, A.; Kolse, R.; Gupta, S.; Ingle, A.; Chhabra, K.G.; Nimbulkar, G. Therapeutic options for COVID–19: pandemic–a review. International Journal of Research in Pharmaceutical Sciences 2020, 11.

7. Boozari, M.; Hosseinzadeh, H. Natural products for COVID-19 prevention and treatment regarding to previous coronavirus infections and novel studies. Phytotherapy Research 2021, 35, 864-876, [https://doi.org/10.1002/ptr.6873].

8. Yousefi, B.; Valizadeh, S.; Ghaffari, H.; Vahedi, A.; Karbalaei, M.; Esfandi, M. A global treatments for coronaviruses including COVID-19. Journal of cellular physiology 2020, 235, 9133-9142, [https://doi.org/10.1002/jcp.29785].

9. Roosenhoff, R.; Reed, V.; Kenwright, A.; Schutten, M.; Boucher, C.A.; Monto, A.; Clinch, B.; Kumar, D.; Whitley, R.; Nguyen-Van-Tam, J.S. Viral kinetics and resistance development in children treated with neuraminidase inhibitors: the influenza resistance information study (IRIS). Clinical Infectious Diseases 2020, 71, 1186-1194, [https://doi.org/10.1093/cid/ciz939].

10. Polat, I.; Talmac, M.A.; Bahat, P.Y.; Bestel, A.; Akca, A.; Karadeniz, O.; Semerci, S.Y.; Cetinkaya, M. Maternal and Neonatal Outcome of the Pregnant With COVID-19 in Istanbul, Turkey: A Single-Center, Descriptive Study. Authorea Preprints 2020, [https://doi.org/10.22541/au.1591830688.98984176].

11. Xie, H.-y.; Yasseen III, A.S.; Xie, R.-h.; Fell, D.B.; Sprague, A.E.; Liu, N.; Smith, G.N.; Walker, M.C.; Wen, S.W. Infant outcomes among pregnant women who used oseltamivir for treatment of influenza during the H1N1 epidemic. American journal of obstetrics and gynecology 2013, 208, 293. e291-293.e297, [https://doi.org/10.1016/j.ajog.2013.01.015].

12. Chambers, C.D.; Johnson, D.; Xu, R.; Luo, Y.; Jones, K.L.; Group, O.C.R. Oseltamivir use in pregnancy: Risk of birth defects, preterm delivery, and small for gestational age infants. Birth Defects Research 2019, 111, 1487-1493, [https://doi.org/10.1002/bdr2.1566].

13. Abyadeh, M.; Djafarian, K.; Heydarinejad, F.; Alizadeh, S.; Shab-Bidar, S. Association between Apolipoprotein E Gene Polymorphism and Alzheimer’s Disease in an Iranian Population: A Meta-Analysis. Journal of Molecular Neuroscience 2019, 69, 557-562, [https://doi.org/10.1007/s12031-019-01381-1].

14. Wells, G.; Shea, B.; O’connell, D.; Peterson, J.; Welch, V.; Losos, M. The Newcastle-Ottawa scale (NOS) for assessing the quality of nonrandomized studies in meta-analyses. Ottawa: Dept of Epidemiology and Community Medicine, University of Ottawa; 2011. 2016.

15. Habibian Sezavar, A.; Abyareh, M.; Fahimi, R.; Nyasulu, P.S.; Abyadeh, M. The association between maternal cadmium exposure and small for gestational age: a systematic review and meta-analysis. International Journal of Environmental Health Research 2021, 1-9, [https://doi.org/10.1080/09603123.2021.1892035].

16. Wu, M.; Song, J.; Zhu, C.; Wang, Y.; Yin, X.; Huang, G.; Zhao, K.; Zhu, J.; Duan, Z.; Su, L. Association between cadmium exposure and diabetes mellitus risk: a prisma-compliant systematic review and meta-analysis. Oncotarget 2017, 8, [https://doi.org/10.18632/oncotarget.21991].

17. Sezavar, A.H.; Pourhassan, B.; Kakavandi, N.R.; Hooshangi Shayeste, M.R.; Abyadeh, M. Association of maternal blood lead concentration with the risk of small for gestational age: A dose-response meta-analysis. Archives of Environmental & Occupational Health 2021, 1-9, [https://doi.org/10.1080/19338244.2021.1874857].

18. Mantel, N.; Haenszel, W. Statistical aspects of the analysis of data from retrospective studies of disease. Journal of the national cancer institute 1959, 22, 719-748, [https://doi.org/10.1093/jnci/22.4.719].

19. Abyadeh, M.; Heydarinejad, F.; Khakpash, M.; Asefi, Y.; Shab-Bidar, S. Association of Apolipoprotein E gene polymorphism with Preeclampsia: a meta-analysis. Hypertension in Pregnancy 2020, 39, 196-202, [https://doi.org/10.1080/19641955.2020.1753068].

20. Asefi, Y.; Gohari Mahmoudab, A.; Habibian Sezavar, A.; Mirshahvaladi, S.; Abyadeh, M.; Abyareh, M. Association between maternal cadmium exposure and preterm birth: a meta-analysis. International Journal of Environmental Health Research 2020, 1-10, [https://doi.org/10.1080/09603123.2020.1789947].
21. Egger, M.; Smith, G.D.; Schneider, M.; Minder, C. Bias in meta-analysis detected by a simple, graphical test. *Bmj* 1997, 315, 629-634, https://doi.org/10.1136/bmj.315.7109.629.

22. Habibian, A.; Abyadeh, M.; Abyareh, M.; Rahimi Kakavandi, N.; Habibian, A.; Khakpash, M.; Ghazi-Khansari, M. Association of maternal lead exposure with the risk of preterm: a meta-analysis. *The Journal of Maternal-Fetal & Neonatal Medicine* 2021, 1-9, https://doi.org/10.1080/14767058.2021.1946780.

23. Rahimi Kakavandi, N.; Hashemi Moosavi, M.; Asadi, T.; Abyadeh, M.; Yarizadeh, H.; Sezavar, A.H.; Abdollahi, M. Association of maternal intake of nitrate and risk of birth defects and preterm birth: a systematic review and dose-response meta-analysis. *Archives of Environmental & Occupational Health* 2021, 1-10, https://doi.org/10.1080/19338244.2021.1953955.

24. Greer, L.G.; Sheffield, J.S.; Rogers, V.L.; Roberts, S.W.; McIntire, D.D.; Wendel, G.D. Maternal and neonatal outcomes after antepartum treatment of influenza with antiviral medications. *Obstetrics & Gynecology* 2010, 115, 711-716, https://doi.org/10.1097/AOG.0b013e3181d44752.

25. Svensson, T.; Granath, F.; Stephansson, O.; Kieler, H. Birth outcomes among women exposed to neuraminidase inhibitors during pregnancy. *Pharmacoepidemiology and drug safety* 2011, 20, 1030-1034, https://doi.org/10.1002/pds.2194.

26. Beau, A.B.; Hurault-Delarue, C.; Vial, T.; Montastrauc, J.L.; Damase-Michel, C.; Lacroix, I. Safety of oseltamivir during pregnancy: a comparative study using the EFEMERIS database. *BJOG: An International Journal of Obstetrics & Gynaecology* 2014, 121, 895-900, https://doi.org/10.1111/1471-0528.12617.

27. Dunstan, H.; Mill, A.; Stephens, S.; Yates, L.; Thomas, S. Pregnancy outcome following maternal use of zanamivir or oseltamivir during the 2009 influenza A/H1N1 pandemic: a national prospective surveillance study. *BJOG: An International Journal of Obstetrics & Gynaecology* 2014, 121, 901-906, https://doi.org/10.1111/1471-0528.12640.

28. Gruner, S.; Svensson, T.; Beau, A.-B.; Damase-Michel, C.; Engeland, A.; Furu, K.; Hviid, A.; Häberg, S.E.; Melgaard-Nielsen, D.; Pasternak, B. Neuraminidase inhibitors during pregnancy and risk of adverse neonatal outcomes and congenital malformations: population based European register study. *Bmj* 2017, 356, https://doi.org/10.1136/bmj.j629.

29. Ehrenstein, V.; Kristensen, N.R.; Monz, B.U.; Clinch, B.; Kenwright, A.; Sørensen, H.T. Oseltamivir in pregnancy and birth outcomes. *BMC infectious diseases* 2018, 18, 1-10, https://doi.org/10.1186/s12879-018-3423-z.

30. Li, P.; Du, R.; Wang, Y.; Hou, X.; Wang, L.; Zhao, X.; Zhan, P.; Liu, X.; Rong, L.; Cui, Q. Identification of chebulinic acid and chebulagic acid as novel influenza viral neuraminidase inhibitors. *Frontiers in microbiology* 2020, 11, https://doi.org/10.3389/fmicb.2020.00182.

31. Wang, R.; Yan, W.; Du, M.; Tao, L.; Liu, J. The effect of influenza virus infection on pregnancy outcomes: A systematic review and meta-analysis of cohort studies. *International Journal of Infectious Diseases* 2021, 105, 567-578, https://doi.org/10.1016/j.ijid.2021.02.095.

32. Gunnes, N.; Gjessing, H.K.; Bakken, I.J.; Ghaderi, S.; Gran, J.M.; Hungnes, O.; Magnus, P.; Samuelsen, S.O.; Skrondal, A.; Stoltenberg, C.; Trogstad, L.; Wilcox, A.J.; Häberg, S.E. Seasonal and pandemic influenza during pregnancy and risk of fetal death: A Norwegian registry-based cohort study. *European Journal of Epidemiology* 2020, 35, 371-379, https://doi.org/10.1007/s10654-020-00600-z.

33. Vousden, N.; Knight, M. Lessons learned from the A (H1N1) influenza pandemic. *Best Practice & Research Clinical Obstetrics & Gynaecology* 2020, https://doi.org/10.1016/j.bpobgyn.2020.08.006.