

Obstetric and neonatal outcomes with exclusive vaping in pregnancy

Abstract

Objective: To compare obstetric and neonatal outcomes in women who exclusively vaped with non-smokers in pregnancy.

Methods: This is a retrospective observational cohort study. In 2017, a question on vaping behavior in pregnancy was included in the women's initial antenatal visit (booking visit) at our hospital. This study compared delivery outcomes in those women who at booking acknowledged exclusive vape usage with non-smokers and smokers. This was obtained by using information from the hospital electronic health records database. In total, data from 32,174 births were examined.

Results: A total of 765 women reported vaping exclusively. There were 351 women who concurrently smoked and vaped (dual users) and 2470 women who exclusively smoked. There were 28,588 women who were non-smokers and non-vapers who acted as a control group.

There were no significant differences in pregnancy or neonatal outcome when exclusive vapers were compared to the control group.

When the whole cohort was analyzed there were significant reductions in birth weight, gestational age and prematurity rates and increases in the need for neonatal care in the exclusive smoking and dual users.

Conclusion: Exclusive vaping in pregnancy was not associated with reduced birth weight, gestational age, prematurity rates, stillbirth, or fetal abnormality. Low birth weights and pre-term birth rates were only associated with women who smoked. Dual use of cigarettes and vapes were associated with the negative outcomes of smoking exclusively in pregnancy.

Keywords: neonatal outcomes, pregnancy, vaping, fetal abnormality, cigarette smoking

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Introduction

Cigarette smoking significantly increases the risk of babies being born small for gestational age (SGA) and other negative health outcomes.¹ However, cessation of smoking in early pregnancy reduces the risks of spontaneous preterm birth and of SGA babies.² In recent times, vaping products have gained popularity as alternatives to traditional smoking and aids to smoking cessation. Beyond their role in smoking cessation, these products have emerged as primary choices in their own right. In theory, during pregnancy, they could potentially diminish smoking behaviors and alleviate associated complications. Nevertheless, substantial gaps remain in our understanding of vaping products, ranging from their ingredients to the potential long-term health repercussions. The prevalence of vaping has increased in the general population and is becoming more accessible in recent years but data regarding their risk in pregnancy remains limited.^{3,4} Vaping is most commonly used for nicotine-based products allowing the user to obtain the stimulant effects of nicotine while foregoing the effects of tobacco smoke associated with conventional cigarette usage. Nicotine is a recognized teratogen that adversely affects fetal physiology with neurological sequelae that may lead to subsequent adverse health outcomes long-term.⁵ To assist smoking cessation in pregnancy, nicotine replacement therapy (NRT) is used as an adjunct. While some studies have suggested that NRT does not significantly increase risk to the fetus, but long-term effects have not been extensively investigated.⁶

Before vaping can be recommended as a smoking cessation aid during pregnancy, or to be discouraged entirely, it is imperative to

gather more robust data outlining the risks and potential benefits associated with switching from smoking to vaping. Longitudinal data on birth and neonatal outcomes have shown conflicting results and long-term data is not yet available.

This study compared 765 women who, during their booking visit, acknowledged exclusively vaping with non-smokers and looked at their delivery outcomes. In addition, 351 women who both smoked and vaped (dual users) and 2,470 women who smoked exclusively were analyzed.

Methods

The Coombe Hospital (CH) maintains a contemporaneous database of electronic health records where every patient who books for antenatal care has a history taken and recorded during their first official clinical encounter known as their 'booking history'. This database is updated at the time of delivery.

Questions related to smoking cigarettes currently and in the past are recorded as well as the current use of vaping products in the index pregnancy are included in their electronic health records.

The database was interrogated and the details of all deliveries where the vaping question was answered since 2017 were analyzed using Excel and SPSS (IBM, Armonk, NY USA). Additional calculations were performed with icalcU.com.

The age, BMI, birthweight and gestation at delivery were tested and found to be not normally distributed (Kolmogorov-Smirnov test

statistic 0.08, 0.097, 0.061 and 0.2 respectively, P<0.001 in all cases) so non-parametric analyses were used.

The study was approved by the local audit committee (Aqua approval 2022 09 01).

Results

Between 1st July.2017 and 30th April 2022 36,549 women with single pregnancies were delivered at the Coombe hospital. There were 32,174 women who had answered the question about the use of vaping and E -cigarette products with a gestational age at delivery between 22 weeks and 45 weeks inclusively. The missing numbers were because the question was introduced during this period and not all women were asked about the use of vaping products.

Small numbers of individual results were excluded due to obvious input errors and missing data. These errors amounted to less than 1% of all entries.

Overall 2,470 women only smoked cigarettes and 28,588 women gave a history of not smoking or vaping in the current pregnancy ('non-

smoker' control group). There were 765 women who exclusively vaped and 351 women who concurrently smoked and vaped (Figure 1).

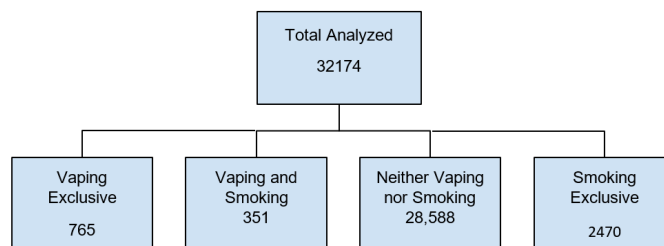


Figure 1 The answers given by 32,174 women at the booking interview to questions relating to use of cigarettes or vaping in the index pregnancy.

Analysis of the whole cohort

Non-smokers were significantly older and had a lower BMI than the exclusive smokers, exclusive vapers or dual users and were significantly less likely to be of Irish nationality (Table 1).

Table 1 The background data on 28,588 women who did not smoke cigarettes or vape in pregnancy compared to 765 women who exclusively vaped in pregnancy 351 who smoked and vaped and 2470 women who exclusively smoked in pregnancy

	Vaping exclusively (n=765)	Vaping and smoking (n=351)	Neither vaping or smoking (control group) (n=28588)	Smoking exclusively (n=2,470)	Comparison of all groups Significance Chi-sq analysis unless stated	Comparison of vaping exclusive and control groups Significance Chi-sq analysis unless stated
Median (range) age (years)	32 (16-47)	29 (17-44)	33 (15-53)	29 (15-45)	Kruskal-Wallis 1173 (p<0.001)	Mann Whitney U 6.6 (p<0.001)
Median (range) BMI	26.1 (15.6-57.1)	25.4 (16.4-54.4)	25.1 (14.5-61.1)	25.5 (14.8-61.3)	Kruskal Wallis 18.8 (p<0.001)	Mann Whitney U -3.8 (p<0.001)
Irish nationality n (%)	613 (80.1%)	281 80.1%)	19690 [a] (68.9%)	2040 (82.6%)	258 (p<0.001)	44.3 (p<0.001)
Has ever smoked in the past n (%)	652 (85.2%)	351 (100%)	9735 (34.1%)	2470 (100%)		853 (p<0.001)
Primiparous n (%)	354 (46.3%)	127 (36.2%)	11855 (41.6%)	758 (30.7%)	122 (p<0.001)	7.1 (p<0.01)
Past history of mental health problems n (%)	288 (37.6%)	154 (43.9%)	6451 (22.6%)	1088 (44%)	703 (p<0.001)	95.8 (p<0.001)
Past or present hypertensive disease n (%)	29 (3.8%)	12 (3.4%)	1477 (5.2%)	88 (3.6%)	16.6 (p<0.001)	2.9 (p=0.09, NS)
Any post-natal problems n (%)	122 (15.9%)	46 (13.1%)	4376 (15.3%)	343 (13.9%)	5.1 (p=0.17, NS)	0.24 (P=0.63, NS)

[a] 21 women did not have nationality recorded.

Exclusive vapers were significantly more likely to be former smokers and to have had a previous history of mental health problems than the control group (Table 1).

The non-smoker group demonstrated a higher mean gestational age, birthweight and term delivery rate and Caesarean section rate than the 2 groups that included smokers. The non-smoker group delivered babies that were less likely to go to the neonatal unit for care and also less likely to be admitted to the neonatal intensive care unit (NICU) (Table 2).

Analysis of the non-smoking groups (765 exclusive vapers and 28,588 in the control group)

There was no difference in any of the delivery or neonatal outcomes when exclusive vapers were compared to non-smokers (Table 2).

Exclusive vapers were significantly younger and had greater BMIs than the control group (Table 1).

Exclusive vapers were more likely to be Irish, Caucasian and former smokers than the control group.

Table 2 The pregnancy and neonatal outcome data on 28,588 women who did not smoke cigarettes or vape in pregnancy compared to 765 women who exclusively vaped in pregnancy, 351 who smoked and vaped and 2,470 women who exclusively smoked in pregnancy

	Vaping exclusively (n=765)	Vaping and smoking (n=351)	Neither vaping or smoking (control group) (n=28588)	Smoking exclusively (n=2,470)	Comparison of all groups Significance Chi-sq analysis unless stated	Comparison of vaping exclusive and control groups Significance Chi-sq analysis unless stated
Median (range) gestation at delivery (weeks)	39 (23-42)	39 (24-42)	39 (22-45)	39 (23-44)	Kruskal-Wallis 134 (p<0.001)	Mann Whitney U 0.02 (p=0.99, NS)
Median (range) birthweight (grams)	3,480 (525-4830)	3230 (248-4390)	3,480 (20-5800)	3210 (420-5350)	Kruskal-Wallis 734 (p<0.001)	Mann Whitney U 0.13 (p=0.69, NS)
Female baby n (%)	364 (47.6%)	185 (52.7%)	13834 (48.4%)	1200 (48.6%)	2.8 (p=0.42, NS)	0.2 (p=0.66, NS)
Any pregnancy problems recorded n (%)	226 (29.5%)	111 (31.6%)	8173 (28.6%)	773 (31.3%)	9.6 (p<0.05)	0.33 (p=0.57, NS)
Fetal abnormalities diagnosed/suspected at birth n (%)	23 (3.0%)	6 (1.7%)	932 (3.3%)	75 (3.1%)	3 (p=0.39, NS)	0.16 (p=0.69, NS)
Premature delivery by gestation categories					196 (p<0.001)	1.34 (p=0.51, NS)
Premature 23-32 weeks gestation n (%)	14 (1.8%)	13 (3.7%)	420 (1.5%)	65 (2.6%)		
Premature 33-37 weeks gestation n (%)	87 (11.4%)	65 (18.5%)	3546 (12.4%)	520 (21.1%)		
Term gestation > 38 weeks	664 (86.8%)	273 (77.8%)	24609 (86.1%)	1,885 (76.3%)		
Total premature n (%)	101 (13.2%)	78 (22.2%)	3966 (13.9%)	585 (23.7%)	190 (p<0.001)	0.29 (p=0.59, NS)
Spontaneous vaginal delivery n (%)	382 (49.9%)	211 (60.1%)	14957 (52.3%)	1578 (63.9%)	132 (p<0.001)	1.7 (p=0.19, NS)
Post-partum haemorrhage >500ml n (%)	166 (21.7%)	53 (15.1%)	6264 (21.9%)	348 (14.1%)	91.3 (p<0.001)	0.02 (p=0.88, NS)
Apgar score <7 at 1min n (%)	41 (5.4%)	24 (7%)	1204 (4.2%)	126 (5.2%)	12.3 (p<0.01)	2.4 (p=0.12, NS)
Apgar score <7 at 5 min n (%)	7 (0.9%)	3 (0.9%)	211 (0.7%)	21 (0.9%)	0.76 (p=0.86, NS)	0.32 (p=0.57, NS)
Admission to baby unit n (%)	92 (12%)	61 (17.4%)	3,193 (11.2%)	440 (15.3%)	61.4 (p<0.001)	0.55 (p=0.46, NS)
Admission to NICU n (%)	49 (6.4%)	34 (9.7%)	1682 (5.9%)	220 (8.9%)	43.6 (p<0.001)	0.37 (p=0.55, NS)
Stillbirth n (%)	2 (0.3%)	3 (0.9%)	95 (0.3%)	15 (0.6%)	7.5 (p=0.06, NS)	0.11 (p=0.74, NS)

Exclusive vapers were more likely to have a past history of mental health problems and less likely to have hypertensive disease in the past.

In summary there were no significant differences in pregnancy outcomes in exclusive vapers and women who neither vaped nor

smoked in pregnancy. When women who smoked were included in the analysis there were differences in gestation, prematurity rates, birth weight and need for neonatal care that were mostly due to the differences in the smoking groups.

Discussion

Comparison of all groups including smokers

Smoking and its negative effects on the user are well-known. Its impact on pregnancy and neonatal outcomes has become well established over time. A recent study looking at vaping in pregnancy suggested that it was associated with unfavorable birth outcomes.⁷ However, they did not define whether vaping was exclusive or dual use combined with cigarettes. This is important to acknowledge as previous studies have shown that dual use results in similar obstetric outcomes and SGA babies similar to that of exclusively smoking.⁸ The data from our study is consistent with these findings.

Term delivery and normal birthweight are often used as predicting factors of a baby's neonatal health. The two groups that included smokers had significantly lower mean birth weights and term delivery rates. The higher rates of prematurity and complications associated with the same were likely contributing factors for the higher NICU and Special care admission rates seen within the smoker groups.

A recent systematic review of the literature suggests that vaping has a less detrimental effect on birth weight than smoking.⁴ This is in keeping with results from a recent study in our hospital in 2020 where mean birth weight of exclusive vapers was similar to that of non-smokers ($3470\text{g} \pm 555\text{g}$ and $3471\text{g} \pm 504\text{g}$ $P = 0.97$) and significantly greater than that of smokers ($3166\text{g} \pm 502\text{g}$, $P < 0.001$). It also showed dual users to have a mean birthweight of 3140g ($\pm 628\text{g}$).⁸ Our results again were similar with median birthweight of exclusive vapers and non-smokers (3480g and 3480g , $p = 0.69$) both being greater than that of dual users and smokers (3230g and 3210g , $p < 0.001$ for the whole cohort).

As many as 1 in 5 women have mental health problems in pregnancy or postnatally. Exclusive vapers, exclusive smokers and dual users were significantly more likely to have had a past history of mental health problems reported at their booking appointment than the control group. Smoking cessation has been shown to be associated with an improvement in mental health in the general population in comparison with those who continue to smoke, in particular with anxiety, depression and stress.⁹

Exclusive smokers, exclusive vapers and dual users were significantly younger than the control group. Since 2015, there has been an overall increase in the use of vaping products and decrease of smoking in the general population in Ireland.³ Vape sales and marketing are poorly regulated and have been accessible to those under 18 years of age, the legal age to buy cigarettes. Legislation for tighter control on the sale of nicotine products to underage buyers has recently been passed in Ireland but the long-term use of the products that had been so readily available is yet to be seen indicating it will be an ongoing subject of discussion in future pregnant populations.

Within the cohort, 14.2% of smokers also vaped. This is higher than the nationally reported frequency of 6% of smokers also vaping.³ Given the established risk associated with smoking in pregnancy, it may be an indicator of a higher rate of using vapes to aid smoking cessation. The vaping and smoking combined use group of ($n = 351$) was the smallest group and had outcomes such as prematurity rate, median birthweight and admission to NICU that were similar to the smoking group and not similar to the vaping and control groups. Smoking is associated with negative effects on birthweight and prematurity that are not offset by the use of vaping products. Therefore combined smoking and vaping should not be encouraged and either conversion from exclusive smoking to vaping only or complete abstinence are better strategies.

Comparison of vaping exclusive group and control group when smokers are excluded

When smokers were excluded, the risks of negative obstetric and neonatal outcomes appeared to be mitigated. Exclusive vapers were significantly more likely to be former smokers than the control group (85.2% vs 34.1%). This may indicate that they had converted to using vapes as a form of smoking cessation. Given that vapers were more likely to be younger in age, it is possible they would have been smoking for a shorter period of time and may find it easier to move exclusively to vaping.

From the data, although the majority of those who exclusively vape had smoked previously, there were 30% of those who exclusively vaped that had not. This may indicate a new trend in behavior that begins with exclusively vaping rather than the dual use of cigarette smoking or use as an aid for smoking cessation.

The outcome of smoking cessation using vaping products is another area that requires further work before efficacy can be shown. The use of vaping products is provisionally not associated with improved smoking cessation outcomes post-partum with one study showing that although the majority use of vapes in pregnancy was to help quit smoking (80.6%), there was no evidence that their use was associated with improved smoking cessation outcomes in the short-term.¹⁰ They may provide improved neonatal outcomes as seen in a study by Shittu et al where those who exclusively smoked, quitting or switching to a vape normalized SGA risk.¹¹ However, they also found that in those who exclusively used vapes, quitting during pregnancy normalized the risk of SGA babies. In dual users quitting smoking had a greater effect on birthweight but it is likely that quitting both would have the greatest desired effect.

Limitations of this study include the lack of data on frequency of smoking or vaping and of the nicotine or chemical content of the vaping products used. Given the variety of products on the market and lack of regulation it is difficult to measure the amount of exposure of nicotine and other chemicals to the user and therefore difficult to measure a dose related effect. It would also have been useful to survey if there were any changes in behaviors during the pregnancy such as smoking cessation and switching to vaping. In a multicenter study by Regan et al, daily vape use was associated with low birth weight.¹² They also found more than half of respondents who acknowledged use of vapes in the 3 months before pregnancy (2.7%) had stopped using during the last 3 months of pregnancy (1.1%).

Multivariate analysis of the vaping v control outcomes was not performed as there were no differences in outcome between these 2 groups.

Conclusion

In conclusion, exclusively vaping in pregnancy was not shown to be associated with any difference in obstetric or neonatal outcomes when compared with a non-smoking cohort. Smoking in pregnancy is associated with lower term delivery rates as well as lower birth weights with babies having a higher rate of NICU and special care admissions. Dual users had similar negative outcomes as smoking exclusively. Further research is needed to ascertain if there is a dose related effect or other negative outcomes, especially long-term, associated with the use of vaping in pregnancy. A nested case control study allowing us to capture more details on the vaping behaviors and types of products used would greatly strengthen this study.

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Conflicts of interest

Authors has no conflicts of interest to declare.

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