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Assessing prevalence of alcohol consumption in early pregnancy: Self-report compared to blood biomarker analysis

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ABSTRACT

Providing appropriate antenatal and postnatal care for women who drink alcohol in pregnancy is only possible if those at risk can be identified. We aimed to compare the prevalence of alcohol consumption in the first trimester of pregnancy using self-report and blood biomarker analysis. Six-hundred routine blood samples from 2014, taken at the antenatal booking appointment, in the first trimester of pregnancy, were anonymously analysed for the presence of Carbohydrate Deficient Transferrin (CDT), a validated marker of chronic alcohol exposure (normalising 2–3 weeks from abstinence) and Gamma-glutamyltransferase (GGT), a liver enzyme elevated for up to 8 weeks after alcohol exposure. In a separate sample of women, from 2015, data taken during the antenatal visit, documenting women's self-reported alcohol consumption, were collected. The percentage of women who reported alcohol intake in the first trimester was 0.8%. This compared to 74.1% of women who reported consuming alcohol before pregnancy. CDT analysis revealed a prevalence rate of 1.4% and GGT a prevalence rate of 3.5% in the first trimester of pregnancy. Although those with elevated CDT generally had high levels of GGT, only one person was positive for CDT and GGT. Results from CDT analysis and self-report may underestimate prevalence for different reasons. GGT appeared to lack specificity, but it may have value in supporting findings from CDT analysis. Further studies using additional blood biomarkers, or a combination of blood biomarkers and self-report, may be beneficial in accurately detecting alcohol drinking history in pregnancy.

1. Introduction

Alcohol is the most widely used toxicant and teratogen worldwide (Smith et al., 2016; World Health Organization, 2014). Throughout Europe and Western societies, alcohol is socially acceptable, readily available and therefore not generally perceived as harmful. Binge drinking, defined as four or more standard drinks on a single occasion in America or in the UK, exceeding six units in one day is common and acceptable, with young women of childbearing age sometimes drinking as much as men (Department of Health, 2016). As an estimated 50% of pregnancies in the UK are unplanned, even informed and compliant women may have unwittingly consumed alcohol in pregnancy (British Medical Association Board of Science, 2007).

Alcohol is both teratogenic and fetotoxic and passes freely across the placenta to the unborn baby at levels at least equal to that of the mother (Hepper et al., 2012). Alcohol is known to have a direct effect on neural development including proliferation, migration, synaptogenesis, and cell death (Smith et al., 2016). It is widely acknowledged that prenatal alcohol exposure can have a negative impact on growth before and after birth, miscarriage, stillbirth and preterm birth (Comasco et al., 2012; Department of Health, 2016).

Although alcohol is teratogenic, the timing, dose and frequency of exposure are known to significantly influence outcomes (British Medical Association Board of Science, 2016). The effects of alcohol consumption on the fetus appear to be confounded by other factors such as diet, smoking, poly-drug use and genetics. Epigenetics may determine some of the harmful effects of prenatal alcohol exposure and contribute to the deficits and abnormalities concomitant to Fetal Alcohol Spectrum Disorder (FASD) (Kobor and Weinberg, 2011). Hereditary and lifestyle factors are known to affect fetal outcomes in response to exposure to alcohol, particularly with moderate drinking (Flak et al., 2014; Kilburn et al., 2015; Nykjaer et al., 2014; Skogerbo et al., 2013). Nevertheless, some reports suggest a link between low/moderate alcohol consumption or binge drinking and poor pregnancy outcomes (Flak et al., 2014; Lewis et al., 2012).

Children with FASD present with damage to the brain and central

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nervous system causing intellectual and developmental disabilities (British Medical Association Board of Science, 2016). Prevailing FASD traits can include attention deficits, poor social skills, hyperactivity, impaired coordination, abnormal muscle tone, slower cognitive processes, alongside difficulties with verbal working memory and receptive language (Savage et al., 2002). Secondary disabilities include educational exclusion, substance abuse, mental illness and even premature mortality and morbidities (Mukherjee et al., 2012). These consequences incur huge costs to health, education, social care and justice sectors (Popova et al., 2017a). The prevalence of FASD globally is thought to be around 1–3%, although reliable data are limited and estimates vary widely depending on the setting (Mukherjee et al., 2012). One recent study using active-case ascertainment found the weighted (to be representative of the background population) FASD prevalence rates of four US communities ranged from 3 to 10% (May et al., 2018). Only after diagnosis can individuals with FASD, and their families, be offered the support needed to help improve outcomes. Although diagnosis guidelines vary, for individuals without the fetal alcohol syndrome (FAS) dysmorphic features, diagnosis of FASD is generally only possible with a maternal alcohol consumption history. In the United Kingdom (UK), this is primarily based on self-report, with more detailed questioning of those who screen positive. This method is commonly regarded as the 'gold standard' (British Medical Association Board of Science, 2007).

Popova et al. (2017a) estimated the prevalence of alcohol use during pregnancy globally via random effects meta-analysis and fractional response modelling. The five countries with the highest rates were Russia (36.5%), the UK (41.3%), Denmark (45.8%), Belarus (46.6%) and Ireland (60.4%). Tsang and Elliott (2017) note that alcohol use data from high risk populations such as indigenous women, adolescents, women with low socioeconomic demographics, women diagnosed with HIV or alcohol use disorders were excluded from analysis as they were not deemed generalisable to their national population. However, the exclusion of these populations from research studies may mean that many prevalence estimates are conservative. Another study by Popova et al. (2017b) illustrated a higher than average prevalence of alcohol use during pregnancy among the Aboriginal populations of Canada and the United States at approximately 36.5% and 42.9% respectively, compared to the general population levels of 10% and 15%.

Although there are no reliable estimates of the prevalence of FASD in the UK, given the data on alcohol use in pregnancy, it is likely to be towards the upper end of the global range (Popova et al., 2017a). Nonetheless, obtaining accurate and reliable data on alcohol use in pregnancy is complicated. Social stigma associated with drinking alcohol, poor recall and difficulty in estimating the alcohol content of some drinks or the volume consumed is thought to result in significant under-reporting (Lange et al., 2014). Self-report can also be influenced by the patient-clinician interaction and the desire of the patient to provide social acceptable responses (Ford et al., 2009; Jones et al., 2011). The situation is compounded by mixed messages to pregnant women in the UK regarding safe levels of alcohol consumption. Although internationally (including the UK Department of Health), guidelines appear to be hardening towards recommendations of total abstinence throughout pregnancy (Department of Health, 2016), informal information sources (such as friends and family and personal experience of a previous pregnancy when alcohol was consumed without adverse effect) can contradict this guidance and influence behaviour (Raymond et al., 2009). All of these factors are likely to contribute to under-diagnosis of FASD, resulting in many mothers and children not getting the support they need.

In an attempt to overcome the potential shortcomings of self-report, objective biomarkers for alcohol consumption have been sought. Analysis techniques using samples of maternal blood, urine, hair and fingernails have been developed (Lange et al., 2014). Of these, blood sampling may be the most promising, given that sampling blood is acceptable to most cultures, sample preparation is relatively straight forward and there are many alcohol metabolites and markers for alcohol consumption which remain within the blood for an extended period (Bakhireva and Savage, 2011). It is important to recognise that the use of biological samples for screening raises wider ethical issues related to consent, stigmatisation, individual rights and the rights of the unborn child (Mizejewski, 2010; Zizzo et al., 2013).

Nonetheless, despite the widespread use of self-report and growing evidence of the technical feasibility of biomarker analysis, there are limited previous data regarding the validity of blood biomarkers to record alcohol consumption in pregnant populations (Bakhireva and Savage, 2011; Howlett et al., 2017; Magnusson et al., 2005; Savage et al., 2002).

We aimed to compare the prevalence of alcohol consumption from self-report with that identified through blood biomarker analysis within a random sample of all women attending routine antenatal clinics during the first trimester of pregnancy in the Northumbria Healthcare National Health Service (NHS) Trust. We hypothesised that the prevalence of alcohol consumption in early pregnancy would be significantly higher from blood biomarker analysis than from self-report. In secondary analysis, we sought to detail the variation in blood biomarker data throughout the year.

2. Methods

2.1. Ethical issues

This study was given a favourable opinion by the Tyne and Wear South Research Ethics Committee (Ref: 15/NE/0216). Individual patient consent was not required. Data on self-reported alcohol consumption were extracted from collated clinical data and patient medical notes. Existing routine clinical blood samples were analysed anonymously, with only the month the blood sample was taken recorded. Blood samples were taken from a different year (and so a different sample of women) to the self-reported data to avoid the possibility of identification of individual blood samples as belonging to a specific individual. Anonymous blood sampling had the advantage of ensuring the blood samples were representative, since we could analyse samples from all patients, without the potential biasing effect of requiring consent.

2.2. Study design

This was a prevalence study of pregnant women, using cross-sectional retrospective data from 2014 to 2015, which compared two methods designed to identify first trimester alcohol intake in pregnancy.

2.3. Participants and setting

Northumbria Healthcare NHS Foundation Trust is one of the largest acute healthcare Trusts in England, covering a population of around 500,000 people living in North Tyneside and Northumberland in North East England. Although much of Northumberland is rural, the South East of the region was formerly an area of intensive coal mining and heavy industry. North Tyneside is largely urban and forms the Eastern border of the city of Newcastle-upon-Tyne. The North East of England has some of the poorest outcomes for alcohol related disease in England, and some of the highest levels of social deprivation (Office for National Statistics, 2016). Rates of drinking over the recommended limits are higher than the average for England (25.7%) at 30.3% and the region also has the highest percentage of binge drinkers at 22.9% (England average 16.5%) (Public Health England, 2017).

2.4. Data collection

In the UK, pregnant women are advised to inform their general