Michael Frowen Memorial Essay Prize 2011 Competition

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Is drinking alcohol during pregnancy a form of child abuse?

The issue of alcohol consumption during pregnancy has been a huge area of focus and attention over the last few decades, ever since the recognition of preventable alcohol-induced effects on the developing fetus along with the rising number of women of child-bearing age consuming alcohol. Both national and independent organisations are actively attempting to educate the public on the potential devastating effects alcohol exposure can have on the developing fetus. According to the Office of National Statistics (ONS) report on birth defects from 1995-2002, birth defects make up 1.1% of total births. Moreover, fetal alcohol spectrum disorder (FASD) is prevalent in one in a hundred children, according to the National Organisation on Fetal Alcohol Syndrome-UK (NOFAS-UK). Although these figures may seem small or insignificant, it is no doubt that prenatal alcohol exposure is the leading preventable cause of birth defects and developmental disabilities in newborn children.

However with regards to whether a voluntary action such drinking alcohol during pregnancy should be considered a form of child abuse is challenging as it requires the clear distinction between the morality underlying such an action and the legal liability and implications of enforcing law such an act. Nevertheless for most people, conceiving a child is definitely a joy-filled defining moment, and the last thing any parent would wish to happen to their child, is to be born with any form of congenital birth defects or disability.

In this article, firstly I would introduce some of disorders associated with alcohol exposure on a developing fetus. It would then be followed by a further understanding of the main effects of alcohol and some pathogenic mechanisms involved in these alcohol-associated developmental disorders. The principles of teratology would also be used to understand how teratogen can cause variable effects on fetus in general. Lastly, some moral and legal issues regarding alcohol consumption during pregnancy will be touched upon, with the consideration of whether there is a need for the legalisation of such an act in society.

Alcohol as a teratogen and Fetal Alcohol Spectrum Disorders

A teratogen is any agent that causes birth defects or malformation in a developing fetus, and alcohol is an example of a potent behavioural teratogen. When alcohol is consumed by a pregnant mother, it is passed very quickly through the placenta into the fetal bloodstream. Since the developing fetus cannot break down alcohol as efficiently due to the late development of the liver, the alcohol levels within the fetal's blood remain high, leading to severe consequences on its development.

Fetal alcohol spectrum disorders (FASD) refers to a broad range of disabilities and defects associated with pre-natal exposure of alcohol on the fetus. These disabilities include that of physical, mental, behavioural or learning difficulties associated with possible life-long implications. The most severe manifestation of such disorders is the fetal alcohol syndrome (FAS), commonly associated with intellectual and behavioural deficits *(BMA Board of Science, 2007)*. FASD is not in itself a clinical diagnosis but rather, includes many other partial expressions of FAS such as alcohol-related neurodevelopmental disorder (ARND) and fetal alcohol effect (FAE).

The diagnosis of FAS is usually made upon clinical indicators such as characteristics facial dysmorphology, pre and post-natal growth deficiency, neuro-developmental disorders, behavioural or emotional problems and a history of maternal alcohol consumption during pregnancy. Central nervous system dysfunction in FAS can also be associated with many other secondary disorders such as learning disabilities, verbal language, visuo-spatial processing, attention deficits and problems with executive functioning and IQ. *(Jones, 2011)* The diagram below shows the full clinical phenotypic characteristics of FAS, however these facial features are rarely used alone as a form of diagnosis, due to their partial expression many other alcohol-related disorders.

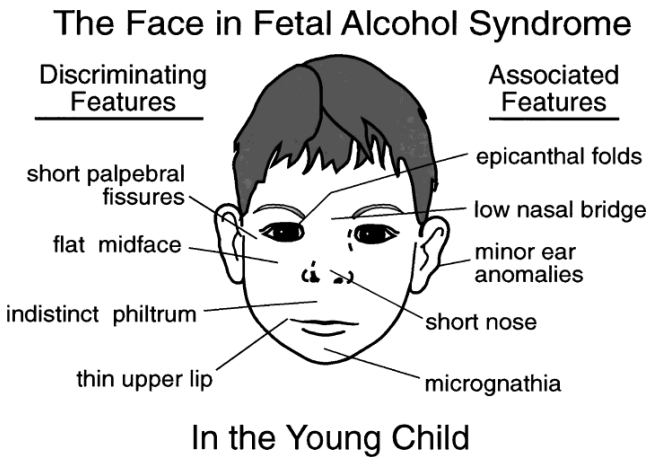

Fig1. Typical dysmorphologic face of a child with fetal alchol syndrome (Sampson et al., 1997)

Alcohol-induced effects and associated pathogenesis on developing fetus

Although alcohol is associated with a wide range of possible disorders in the fetus, the most important and primary effect of alcohol is on the central nervous system. It is revealed that heavy consumption of alcohol during the period of brain growth spurt, which spans from the last trimester of pregnancy to first several years after birth, is extremely detrimental to the developing brain of the fetus. It has been shown that alcohol is responsible for initiating

apoptotic actions on the neurons in the brain via its NMDA antagonist and GABA mimetic properties. Hence, this gives us a possible explanation to the reduced brain and neuro-behavioural disturbances commonly associated in FAS. (Olney et al., 2000)

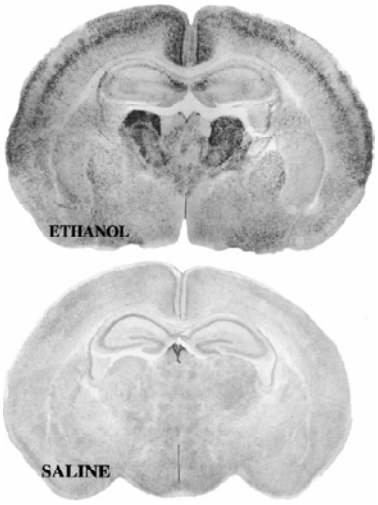

Fig2. Alcohol-induced neurodegeneration observed in the brain of a 8 day old mouse after 24hours of subcutaneous treatment with ethanol, especially in the forebrain as compared to a control mouse with saline. A degenerating neuron will show up as a black speck in the section. (Olney et al., 2000)

Reactive oxygen species (ROS) are found to play a critical role in ethanol-induced oxidative stress and pathogenesis. Using the figure shown below, ethanol is capable of inducing oxidative stress directly and indirectly. In the direct pathway, the presence of ROS and free radicals such as hydroxyl is responsible for the peroxidation of lipids, nucleic acids and especially protein which can affect the activity of transporters and enzymes. Cytochrome P-4502E1 can induce the formation of ROS especially in the brain and liver. In the indirect pathway, a reduction of glutathione peroxidise, an anti-oxidant activity is observed. This may be related to impaired entry of cytosolic glutathione into the mitochondria, hence decreasing the available pool of glutathione for oxidation and the associated simultaneous reduction of hydrogen peroxide to water. *(Cohen-Kerem and Koren, 2003)*

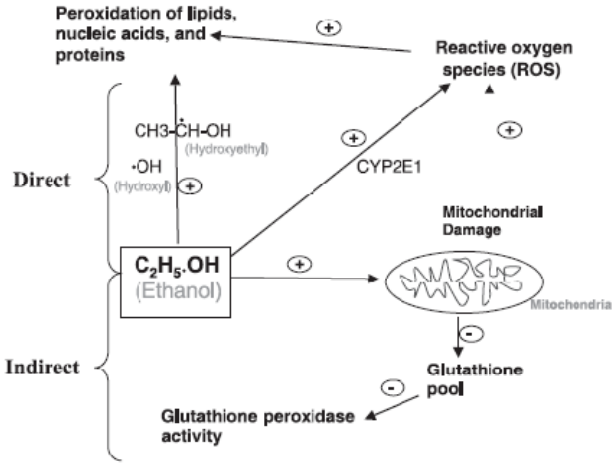

Fig3. A diagram illustrating ethanol-induced oxidative mechanisms; Key: Hydroxyethyl and hydroxyl group: oxygen free radicals, CYP2E1: cytochrome P-450 2E1. (Cohen-Kerem and Koren, 2003)

It has also been recently identified that NADPH oxidase (NOX) is the critical source of ROS in fetus exposed to alcohol, with co-treatment of NOX inhibitor, diphenyleneiodonium (DPI) significantly reducing ethanol-associated oxidative generation and hence damage. *(Dong et al., 2010)*

Factors affecting variability in alcohol-induced effects on the fetus

The principles of teratology proposed by James Wilson in 1959 serve as a basis to understanding the degree of the susceptibility of the developing fetus to alcohol exposure, and hence the severity of conditions or malformations associated. Factors affecting the susceptibility of the fetus include genotype of conceptus, developmental stage of exposure to the conceptus, the dose and duration of alcohol exposure and possibly the pattern of alcohol consumption by the mother.

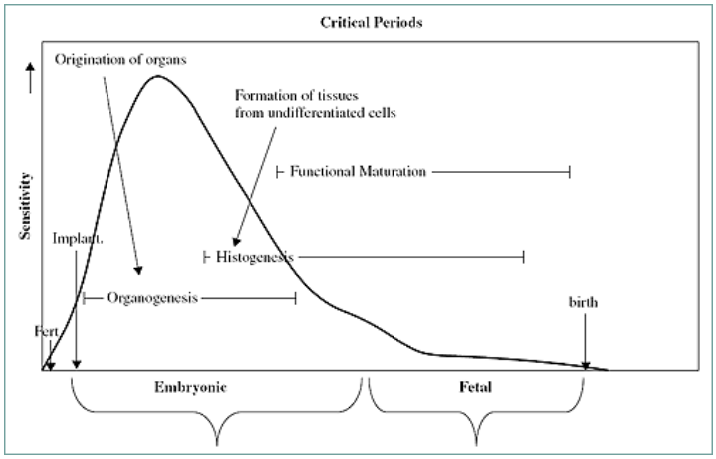

Fig4. Graph showing the sensitivity of fetus to induction of birth defects by teratogens against different periods in gestation. (Branch S, 2004)

The timing of alcohol exposure is critical in determining the severity of alcohol-induced effects on the fetus. During early embryonic development from fertilisation to early post-implantation, exposure to teratogens generally result in embryonic lethality. A growing fetus is most susceptible to the induction of adverse morphological birth defects during the period of organogenesis around the third to eighth week of gestation. This is the period where the major organs are formed. Any exposure during the fetal to birth period results in functional disorders and possibly growth retardation of the fetus.

Another key factor in determining the effect of alcohol exposure on a fetus is related to the amount of alcohol consumed over the period of pregnancy and the maternal pattern of consumption.

A recent study using data from the Millennium Cohort Study, a national-wide study of infants born in UK revealed that light drinking-one or two drinks per week during pregnancy was not found to be associated with any form of clinically significant behavioural and cognitive difficulties when compared to control groups of children born to mother who did not drink at all during pregnancy. *(Kelly et al., 2010)*

According to the Office for National Statistics (ONS), heavy drinking is defined as six or more units for women on at least one day in the week. In the UK, each unit of alcoholic drink corresponds to about 7.9 grams (g) or 10 millilitres (ml) of ethanol. Binge drinking which is the heavy consumption of alcohol over a short period of time is defined by the Prime Minister's Strategy Unit (PMSU) as drinking over twice the recommended guidelines for daily drinking-two to three units for women daily. *(BMA Board of Science, 2007)*

It is highlighted that factors that alter the peak blood alcohol concentration (BAC) experienced by the fetus is most likely to affect the severity of alcohol-induced developmental injury on the developing brain of the fetus. Hence, the type of maternal drinking pattern such as that of binge-drinking by pregnant women is likely to put the fetus at higher risk of brain injury as compared to mothers who drink consistently over a period of longer time due to the higher BACs experienced over a shorter period of time. (Maier & West, 2001)

Alcohol guidelines for pregnant women

UK Department of Health advises "women who are pregnant or trying to conceive to avoid drinking alcohol; and if they do decide to drink, they are advised not to drink more one to two units of alcohol once or twice a week and should not get drunk". Due to the increased risk of miscarriage associated with alcohol exposure, National Institute for Health and Clinical Excellence (NICE) also advises women to avoid alcohol particularly in the first three months of pregnancy.

However, as no one knows exactly the dose of alcohol at which it can be stated unequivocally that the fetus will not be harmed, it is therefore only prudent that pregnant women avoid all drinking during these periods of their life. Abstinence from alcohol during pregnancy is also advocated in other countries such as United States and Australia.

Law on alcohol consumption during pregnancy

When considering alcohol consumption during pregnancy as a form of child abuse, one would naturally associate with the legal implications of such an act, as it is clear that child abuse is against the law; hence also suggesting that drinking alcohol during pregnancy is illegal or not allowed under the law.

In the UK, law governing the children protection system is based on the Children Act 1989, which states in section 31, defines "harm" as ill-treatment (including sexual abuse and non-physical forms of ill-treatment) or the impairment of health (physical or mental) or development (physical, intellectual, emotional, social or behavioural)"

Indeed, as discussed earlier, FASD are associated with a range of possible disorders that are related to causing potential mental and developmental "harm" in the fetus as the child will find it hard to have normal cognitive and social skills to interact with others in the future. However, just like the ethical dilemma on whether and when it is right to abort a fetus, it is unclear when exactly a fetus can be considered to be a human and if it can fall under the category of "child" abuse.

The main purpose of the legislating the act of alcohol consumption on pregnancy is unarguably to serve the primary aim of improving health outcomes of pregnancy relating to eliminating alcohol-associated birth defects. In my opinion, the argument is neither about the morality of doing the 'right' act with regards to drinking or not during pregnancy or the range of developmental disorders alcohol can have on a fetus, be it mild or severe.

The true concern here lies in the fact whether we can truly bring about changes in health outcomes by enforcing such law. Can we promote parental responsibility towards the fetus by criminalising such an act in order to warn them of the seriousness of this situation? In addition, we have to be able to define the limits of what is considered suitable amount of alcohol consumption, but the fact lies all well that we still do not have enough evidence to support the exact level of alcohol consumption that is safe for the developing fetus. The complexity of the ethical and practicality difficulty in conducting such a dose-response evaluation on human, along with the numerous factors that have to be taken into consideration before we can translate the results of current animal studies to human just make it tougher to be able draw a safe limit.

Moreover, in a recent committee opinion by the American College of Obstetricians and Gynaecologists, it was emphasised that pregnant women with alcohol and drug abuse problems should be given appropriate care and treatment with regards to the addiction

problem instead on focusing on the incarceration of such acts. It was mentioned that the effects of incarceration and threats of incarceration can be counter-productive to the primary aim of improving health outcomes as mothers might try to avoid pre-natal care to escape identification by the legal system, hence bringing about negative repercussions to the importance of pre-natal care during pregnancy. Though this opinion commentary was focussed slightly more on the law criminalising the act of drug abuse during pregnancy; a similar link can be drawn upon that to alcohol consumption during pregnancy. Do we want to provide a safe and comfortable environment for pregnant women with health problems to come and treat their addiction or do we want to insist on criminalising or attempting to threaten them with the legal system just so that they will perhaps come to a realisation that what they are doing are afterall harmful to their own fetus? *(American College of Obstetricians and Gynaecologists, 2011)*

Possible Treatments

A new publication this year revealed the potential of using repressor element-1 silencing transcription factor (REST), especially REST4 in protecting the fetus from ethanol-associated brain injury. REST is found to play a key role in central nervous system development. The expression of REST4 was significantly elevated in the brains of wild-type mice as compared to REST-conditional knockout mice. Hence this provides first line evidence in the possibility of REST acting as a therapeutic target in FAS. *(Cai et al., 2011)*

Conclusion

In conclusion, prenatal exposure to alcohol is undeniably an issue to tackle on to improve health outcomes associated with preventable birth defects, especially with the increasing rate of alcohol consumption in women of child-bearing age. However, I believe that the use of the legal system to address such an issue can be a little tricky and if not carefully evaluated, can possibly lead to many unforeseen counter-productive effects.

Hence approaches to managing this issue should still be focussed on promoting healthy behaviours in pregnant women through education and provision of knowledge on the consequences of alcohol exposure to the fetus during gestation, together with proper screening or identification methods to pick out potential women facing alcohol problems and referring them to the right professionals specialised in giving advice and guidance with regards to addiction treatments. Hopefully, all these approaches can aid in promoting the sense of personal responsibility that a mother-to-be should have towards their fetus, since ultimately the choice of whether to conduct such an act of drinking alcohol when pregnant,

be it mild or excessively, still lies in the hands of these mothers-to-be. As more extensive research are carried out in this field of alcohol-induced disorders, we are hopeful that new potential treatments will be introduced as another method to improving health outcomes if the legalisation of drinking alcohol during pregnancy is not viable for any reason. Lastly, I would like to end with a simple but inspiring quote by Michel Eyquem Montaigne, "The births of all things are weak and tender, and therefore, our eyes should be intent on beginnings."

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