

Biological Aspects of Addiction – Genetic Expression

'My Genes Made Me Do It' or Did They?

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Introduction

Dependence on psychoactive substances, dependence or addiction, has been subject to many theories and models over the centuries- moral weakness, brain disease, self medication, trauma response, sociology, nature, nurture.

Genetics is being explored on many fronts as cause and cure for many aspects of health; addiction is one. This is a brief overview of some evidence regarding genetic influence on the use of, and dependence, on psychoactive substances, and the potential and risk for AOD clients.

Process addiction may also be similarly influenced by genetics, but is not addressed herein.

Aim

To provide a brief overview of some of the evidence in this area, and evaluate a few of the potential benefits and risks to a genetic model of addiction.

- Does addiction have a genetic cause?
- Are genetics the only or major cause?
- If genetics cause addiction what does that mean for clients and for the health professionals working with these clients?

Is there a Biological Link Between Genetics and Addiction?

The answer appears to be a resounding "Yes".

There is now extensive evidence linking genetic features with dependence on use of alcohol, nicotine, opioids, stimulants and sedatives (Li and Burmesiter, 2009). Psychoactive substances react with chemical receptors in the brain in a similar, but heightened, fashion to endogenous chemicals.

It is then unsurprising that some people's chemical & receptor activity is more reactive or sensitive. These different responses may key people to responding more positively or negatively to substance stimulus.

Rodent studies mapping these susceptibility loci and genes is quite advanced, and comparable mapping for humans is progressing. Work with genes potentially related to nicotine dependence appears to reveal strong impact, including variants which may prevent nicotine dependence.

When observing addiction, one can be hard pressed to explain the compulsive nature of addictive behaviours without reference to genetic stimulus. Some experiencing dependence may consistently act against their own best interest, or want to stop, but still struggle to stop.

Some argue repeated and prolonged "drug abuse" can lead to addiction by changing neural pathways (Kelley & Berringer 2002, NIDA 2008). However, this does not explain repeated and prolonged "drug abuse" prior to neural pathway adaptation, or how this pre-adaptation "abuse" is different to 'addiction'.



How are the Biological Link Between Genetics and Addiction Expressed?

Aldehyde dehydrogenase enzyme deficiency illustrates one impact of genetic influences. Aldehyde dehydrogenase processes acetaldehyde, a metabolite of alcohol (*Illustration A*). An excess of acetaldehyde causes symptoms such as flushing, light headedness, palpitations, nausea, and "hangover" type symptoms. This response to alcohol is particularly common in some people of Asian background and young women, due to a genetic predisposition to low aldehyde dehydrogenase production.

The alcohol pharmacotherapy disulfiram replicates this deficiency, to aversive effect. This enzyme deficiency may reverse in women in middle age, suggesting one possible reason alcohol consumption may increase in some female populations as they age (Pasrlesak, Billinger, Bode, Bode 2002; Withnall 2013).

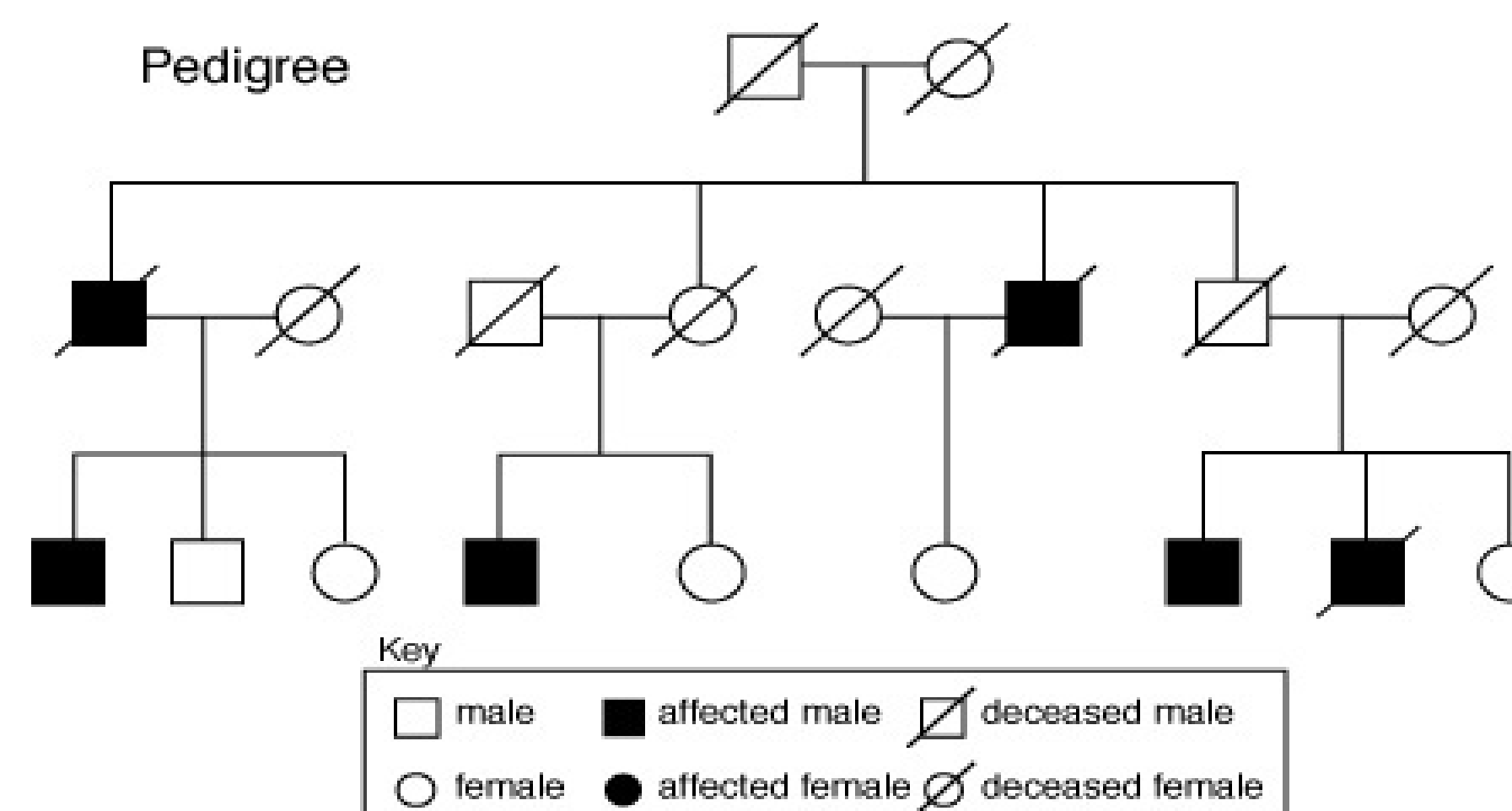
Does the Biological Link Between Genetics and Addiction Sufficiently Explain Addictive Behaviours?

All current literature affirming the existence of genetic links to addiction identify a significant proportion of people with problematic, harmful or dependent psychoactive substance consumption who do not demonstrate genetic predisposition. It is possible to have no genetic predisposition and still experience addiction.

According to Sundram (2014) the probability of addiction heritability is potentially –

Potential	Nicotine	Alcohol	Cannabis
Heritability	33-71%	48-66%	51-59%
'Spontaneous'	29-67%	34-52%	41-49%

Further, per Sundram's genogram, heritability of addiction does not appear obvious or highly predictable (*Illustration B*).



Sufficient Explanation? (cont.)

While genetic predisposition can explain some aspects of addictive behaviour, aspects such as social and behavioural may remain unexplained by these genetic links. Needle or injecting fetishism is well known anecdotally among those who quit or attempt to quit intravenous substance use (Drugs Forum, 2009), (Blue Light, 2011).

Dissociating from substance using peers is often recommended to reduce risks of relapse, supported by evidence that those with extensive non-substance using social connectedness appear to recover from addiction and experience less relapse than others (Granfield and Cloud, 2001).

Finally, there is a significant body of research demonstrating those with problematic substance use, particularly alcohol and nicotine (those best identified as having genetic links), making a spontaneous or 'natural recovery'. The genetic model of addiction does not readily explain this, while behavioural models may.

Conclusion

Are there demonstrable and active genetic links to substance dependence? **Yes.**

Do genetic links cause or explain all or most substance use and substance dependence? **No.**

What does this mean for clients and workers within the AOD sector? **Everything. Nothing. Something.**

Potentially, genetic links can be identified in the individual and tailored treatments/pharmacological aids developed. Some individuals may find a biological explanation alleviates guilt and assists in addressing change.

However, as an intractable biological state, for some this may represent an added health burden, or conversely act as a treatment avoidance aid. It may increase shame in those who do not have a 'genetic excuse', or in those who possess this heritable predisposition.

Like much science, particularly in genetics, impacts will be dependent on its application, and the understanding by those involved, of its individual utility.

Definitive identification of genetic predisposition to substance dependence is likely to present new ethical challenges and opportunities for the AOD sector and its clients.

