

Drinking Patterns and Genetics

The Issue in Brief

Genetic factors affect physiological responses to alcohol and contribute to shaping drinking patterns.

- Variations in alcohol metabolism are, in large part, determined by genetics and modulate individual responses to alcohol.
- Genetic variations also influence the risk of alcohol dependence.

No single gene is responsible for alcohol dependence; instead, multiple genes interact, accounting for variability.

Genetic research may help elucidate helpful markers for individuals at risk for alcohol problems and offer options for early diagnosis and treatment.

Variations in genetic makeup also underlie, in part, different responses to alcohol in individuals.

The level of response to alcohol has been shown to be a good predictor of drinking patterns, including maximum quantity and frequency of drinking.

Some personality traits, also with a genetic component, play a role in drinking patterns and the response to alcohol.

There is evidence that the initiation of drinking behavior and the frequency of drinking among some, but not all, adolescents may also be affected by genetic factors.

While genetic predisposition can play an important role in determining outcomes of drinking, environmental influences also help shape drinking behavior.

ICAP's Health Briefings cover the effects of alcohol consumption on health. They offer an overview of the relationship between drinking patterns and health outcomes, compile the key literature, and provide the reader with an extensive bibliography that refers to original research on each topic. The Briefings attempt to present the balance of the available evidence. They have been peer reviewed by external experts and do not necessarily reflect the views of ICAP or its sponsoring companies.

Relevant ICAP Publications:

International Center for Alcohol Policies (ICAP). (2005-present). Module 8: "At-risk" populations. In *ICAP Blue Book: Practical guides for alcohol policy and prevention approaches*. Available: <http://www.icap.org/>.

International Center for Alcohol Policies (ICAP). (2005-present). Module 17: Alcohol dependence and treatment. In *ICAP Blue Book: Practical guides for alcohol policy and prevention approaches*. Available: <http://www.icap.org/>.

International Center for Alcohol Policies (ICAP). (2005-present). Annex 1. The basics about alcohol. In *ICAP Blue Book: Practical guides for alcohol policy and prevention approaches*. Available: <http://www.icap.org/>.

What Is the Evidence?

Genetic factors play an important role in shaping physiological responses to alcohol and contribute to shaping drinking patterns.

Genetic influences on drinking behavior have been extensively studied.

The evidence shows that genetics are involved in a number of areas, including:

- alcohol metabolism;
- alcohol dependence;
- variation in individuals' sensitivity and responses to drinking.

The genetic substrates of personality traits and psychiatric disorders, involvement in neurological pathways, and responses to alcohol at the molecular and cellular levels also play an indirect but important role in influencing drinking patterns.

Alcohol metabolism

Variations in alcohol metabolism are, in large part, determined by genetics and modulate individual responses to alcohol.

The two primary enzymes involved in the metabolism of alcohol—alcohol dehydrogenase (ADH) and aldehyde dehydrogenase (ALDH)—occur in different forms, encoded by different alleles, or variants of genes (1, 2).

- The presence of a particular allele determines how alcohol will be broken down in the body and underlies an individual's physiological sensitivity to alcohol (3, 4).
- Some genetic variations have been linked to particular ethnic groups. For example, variations in the ALDH2 gene for alcohol dehydrogenase are particularly prevalent among Asian populations (4, 5).

It has been suggested that genetic differences in some metabolic pathways may also affect drinking patterns and likely outcomes at the individual level (2, 6).

- Heightened sensitivity to alcohol's effects may serve as a protective factor against harmful drinking patterns (4, 7-9).

Alcohol dependence

Genetic variations also influence the risk of alcohol dependence.

The heritability of alcohol dependence has been widely studied; a genetic component has been long confirmed (2, 10-15).

- Genetic factors are thought to underlie 50 to 60 % of the variance in the occurrence of alcohol dependence disorders (16).
- More severe disorders may have a particular strong genetic component.

No single gene is responsible for alcohol dependence; instead, multiple genes interact, accounting for variability.

Individual genes on several chromosomes implicated in alcohol dependence have been identified (8, 14, 17).

The involvement of several genes likely accounts for the variable risk for alcohol dependence, the existence of a spectrum of metabolic activity, and varied physiological sensitivity (6).

While earlier findings suggested greater heritability among men of certain traits related to dependence (12), more recent research has shown equal heritability in both genders (18).

- However, genetic influences in men and women may act through different mechanisms (18).
- In at least one study, the protection offered by certain genotypes for alcohol metabolism was observed in men, but not in women (19).

Genetic research may help elucidate helpful markers for individuals at risk for alcohol dependence and offer options for early diagnosis and treatment (8, 20).

Certain phenotypic markers have been identified as indicative of risk for alcohol dependence.

- For example, the P300 brain wave component that responds to particular external stimuli, such as light or sound, has a reduced amplitude in individuals with a genetic predisposition to alcohol dependence (13, 21, 22).
- Major depressive disorder has been linked to alcohol dependence through a common genetic link, with the same gene (or genes) involved in increasing the risk for both (23-25). A similar relationship appears to exist for bipolar disorder (26).
- Anxiety disorders often present together with alcohol use disorders (as well as with depression), providing an additional marker for risk and evidence of a genetic substrate (27).

Responses to alcohol

Variations in genetic makeup also underlie, in part, different responses to alcohol in individuals.

These differences are largely due to variations in the genetics of neurotransmitters (brain chemicals involved

in neuronal communication in the brain), their receptors, and related components.

- Primarily, differences are found in genes involved in the dopamine (DA) (28-30) and gamma-aminobutyric acid (GABA) (13, 31, 32) neurotransmitter systems, as well as in ion channels and transporters (16).

The level of response to alcohol has been shown to be a good predictor of drinking patterns, including maximum quantity and frequency of drinking (33).

- For example, a low level of response to alcohol is thought to be linked to a genetic predisposition for alcohol dependence or harmful drinking patterns (34, 35) in both men and women (36).
- Level of response has been shown to be influenced by drinking habits and family history of alcohol dependence (33).

Some personality traits, also with a genetic component, play a role in drinking patterns and the response to alcohol (37).

- Certain traits, such as lack of behavioral control or high propensity for risk-taking, have been linked to increased risk of alcohol dependence (38).
- Stress relief mechanisms, anxiety, and attention disorders are also linked to problem drinking (1).
- Research suggests a genetic link—and therefore a common susceptibility—between alcohol dependence and some personality disorders, such as antisocial behavior (39).

There is evidence that the initiation of drinking and the frequency of drinking among some, but not all, adolescents may also be affected by genetic factors (40).

Similarly, genetics, along with environmental factors, may play a role in the progression of drinking behavior (40, 41) and the onset of drinking problems (42).

Confounding Influences

While genetic predisposition plays an important part in determining outcomes of drinking, environmental influences also help shape drinking behavior.

These include family environment, parental and peer behavior, attitudes and expectancies, and overall drinking culture.

- Research suggests that alcohol dependence and alcohol problems may be affected by and expressed differently depending on environmental or behavioral factors (43, 44).
- A recent study found that genetic influences on a variety of chemical dependencies (to nicotine, alcohol,

and cannabis) are interrelated, but that different environmental influences are involved for each substance (45).

- Living in a family in which members have problems with alcohol or drugs increases the risk of similar problems (46).

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