

*Null Results in Brief*Alcohol Dehydrogenase 3 Genotype Is Not Predictive for Risk of Colorectal Cancer<sup>1</sup>

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**Introduction**

Excess alcohol consumption is associated with higher risk of colorectal cancer (1). A common functional polymorphism in ADH<sub>3</sub>,<sup>3</sup> encoding the rate-limiting enzyme converting alcohol to acetaldehyde, has been identified in Caucasian population (2). The ADH<sub>3</sub><sup>1-1</sup> genotype has more than twice the activity than the ADH<sub>3</sub><sup>2-2</sup> genotype *in vitro* (2). In epidemiological studies, the fast-metabolizing ADH<sub>3</sub><sup>1-1</sup> genotype has been associated with increased risk of breast cancer (3), oral cavity, and pharyngeal cancers (4). We hypothesized that this functional polymorphism in ADH<sub>3</sub> would increase the risk of colorectal cancer associated with alcohol consumption.

**Materials and Methods**

We conducted a nested case control study within the Physicians' Health Study, a double-blind trial of aspirin and β-carotene among 22,071 United States male physicians, of which 93% are Caucasians. Alcohol consumption was derived from baseline questionnaire. Participants were followed through biannual mailed questionnaires. From 1982 to 1995, 211 incident cases of colorectal cancer were identified and confirmed from medical records by the End Point Committee. Men (343) free from diagnosed cancer at the time of case ascertainment were selected as controls who were matched on age (±1 year) and smoking status (never, past, and current). To increase the statistical power, we included additional 770 control subjects from a separate case control study on myocardial infarction. Together, 211 cases and 1113 controls are included in the study.

Genotyping for ADH<sub>3</sub> was carried out using a PCR-RFLP-based method modified from that of Freudenheim *et al.* (3).

Methods for measurement of plasma folate (5) and total homocysteine levels (6) were described previously. Laboratory personnel were blind to case control status.

Analyses yielded nearly identical estimates on case control and combined populations but with greater precision with the latter. Thus, only results from the combined population are reported. Using the most common genotype, ADH<sub>3</sub><sup>1-1</sup>, as a reference, we calculated RRs and 95% CIs for the association of the ADH<sub>3</sub> genotype with risk of colorectal cancer using unconditional logistic regression adjusting for age, smoking status (never, past, and current), multivitamin use, and aspirin assignment group in the trial. Interaction of alcohol consumption and the ADH<sub>3</sub> genotype was tested by likelihood ratio test. Alcohol consumption was categorized into tertiles based on the distribution of controls with cutoff points: less than or equal to one drink per week, two to four drinks per week, and more than or equal to five drinks per week. Statistical analyses were done using SAS 6.0 statistical package (SAS Institute).

**Results**

In this population of male physicians, we found no significant differences between cases and controls. In both groups, the distribution of ADH<sub>3</sub> genotype was in agreement with the expected value of Hardy-Weinberg Equilibrium ( $P > 0.80$ ). Compared with the ADH<sub>3</sub><sup>1-1</sup> genotype, the multivariate-adjusted RR was 0.92 (95% CI: 0.67–1.27) for the ADH<sub>3</sub><sup>1-2</sup> genotype and 0.83 (95% CI: 0.53–1.31) for the ADH<sub>3</sub><sup>2-2</sup> genotype (Table 1).

In this population of light drinkers, we observed only a small increase in colorectal cancer risk associated with alcohol consumption (Table 1). Compared with individuals who consumed one drink per week or less, those who consumed two to four drinks per week had a 52% (95% CI: 1.05–2.17) increase in risk, whereas those with five drinks per week or more had a nonsignificant 25% (95% CI: 0.85–1.84) increase in risk. The overall trend for risk associated with alcohol consumption was not significant ( $P = 0.23$ ). The association of cancer risk and alcohol consumption was stronger among individuals with the ADH<sub>3</sub><sup>2-2</sup> ( $P = 0.04$ ) genotype compared with other genotypes. Using low drinkers with the ADH<sub>3</sub><sup>1-1</sup> genotype as a reference, low drinkers with the ADH<sub>3</sub><sup>2-2</sup> genotype had a decreased risk of colorectal cancer (RR: 0.44, 95% CI: 0.16–1.20) while high drinkers with the ADH<sub>3</sub><sup>2-2</sup> genotype had an increased risk (RR: 1.63, 95% CI: 0.77–3.45). However, neither modification in risk was significant. The likelihood ratio test for interaction was borderline significant ( $P = 0.06$ ).

**Discussion**

To the best of our knowledge, this is the first study on the association of ADH<sub>3</sub> polymorphism and risk of colorectal cancer. This prospective study, although moderate in size, has sufficient power (>80%) to detect RR of 1.5 for ADH<sub>3</sub><sup>2</sup> allele (assuming 40% allele frequency) or RR of 1.8 for ADH<sub>3</sub><sup>2-2</sup>

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<sup>3</sup> The abbreviations used are: ADH<sub>3</sub>, alcohol dehydrogenase 3; RR, relative risk; CI, confidence interval.

Table 1 Relationship of alcohol intake and risk of colorectal cancer according to ADH<sub>3</sub> genotype

	Overall RR <sup>a</sup> (95% CI) [No. case, No. control]	ADH <sub>3</sub> Genotype			P, trend
		ADH <sub>3</sub> <sup>1-1</sup>	ADH <sub>3</sub> <sup>1-2</sup>	ADH <sub>3</sub> <sup>2-2</sup>	
		RR (95% CI) [No. case, No. control]	RR (95% CI) [No. case, No. control]	RR (95% CI) [No. case, No. control]	
Overall		1.0 (referent) [86, 426]	0.92 (0.67–1.27) [96, 513]	0.83 (0.53–1.31) [29, 174]	0.40
Alcohol consumption (drinks/week)					
≤1	1.0 (referent) [61, 397]	1.0 (referent) [28, 167]	1.09 (0.62–1.91) [28, 162]	0.44 (0.16–1.20) [5, 68]	0.20
2–4	1.51 (1.05–2.17) [84, 369]	1.54 (0.88–2.71) [31, 128]	1.42 (0.84–2.40) [41, 184]	1.38 (0.66–2.90) [12, 57]	0.68
≥5	1.25 (0.85–1.84) [66, 338]	1.31 (0.73–2.35) [27, 127]	1.00 (0.56–1.78) [27, 163]	1.63 (0.77–3.45) [12, 48]	0.94
P, trend	0.25	0.59	0.81	0.04	

<sup>a</sup> RR adjusted for age, smoking status, use of aspirin, and multivitamins.

genotype (assuming 15% genotype frequency). Besides true lack of association, the absence of independent risk associated with the ADH<sub>3</sub> polymorphism may be explained by the limited effect of alcohol, thus, its metabolizing gene on colorectal carcinogenesis. This may also reflect the fact that physicians in this study population only consume moderate alcohol (36% less than or equal to one drink per week), and they are generally well nourished, which may counteract the adverse effects imposed by alcohol on colorectal carcinogenesis.

Despite the absence of independent risk associated the ADH<sub>3</sub> polymorphism, there was an indication of interaction between the ADH<sub>3</sub> genotype and alcohol consumption on risk of colorectal cancer. A dose-response relationship of cancer risk and alcohol consumption was significant only among individuals with the slow ADH<sub>3</sub><sup>2-2</sup> genotype. However, the reduced risk of colorectal cancer in low drinkers with the ADH<sub>3</sub><sup>2-2</sup> genotype compared with low drinkers with the ADH<sub>3</sub><sup>1-1</sup> genotype cannot be easily explained. It may reflect the small sample size of the ADH<sub>3</sub><sup>2-2</sup> subgroup (29 cases and 173 controls).

In summary, the ADH<sub>3</sub> polymorphism did not confer significant risk of colorectal cancer independently; however, it may modify the association between alcohol consumption and risk of colorectal cancer.

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