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## Webinar References

### **“Alco-Genes” in the Bottle: Genetically Based SUD Treatment**

[www.naadac.org/genetically-based-treatment-webinar](http://www.naadac.org/genetically-based-treatment-webinar)

July 14, 2021 @ 3:00-4:00pm ET (2CT/1MT/12PT)

#### **References:**

Jellinek E. *The Disease Concept of Alcoholism*. New Haven, CT: College and University Press; (1960).

Cohen G, Collins M. Alkaloids from catecholamines in adrenal tissue: possible role in alcoholism. *Science* (1970) 167:1749–51. 10.1126/science.167.3926.1749 - DOI - PubMed

Davis VE, Walsh MJ. Alcohol addiction and tetrahydropapaveroline. *Science* (1970) 169:1105–6. - PubMed

Blum K, Hamilton MG, Hirst M, Wallace JE. Putative role of isoquinoline alkaloids in alcoholism: a link to opiates. *Alcohol Clin Exp Res.* (1978) 2:113–20. 10.1111/j.1530-0277.1978.tb04710.x - DOI - PubMed

Hamilton MG, Blum K, Hirst M. Identification of an isoquinoline alkaloid after chronic exposure to ethanol. *Alcohol Clin Exp Res.* (1978) 2:133–7. 10.1111/j.1530-0277.1978.tb04713.x - DOI - PubMed

Collins MA, Kahn AJ. Attraction to ethanol solutions in mice: induction by a tetrahydroisoquinoline derivative of L-DOPA. *Subst Alcohol Actions Misuse* (1982) 3:299–302. - PubMed

Blum K, Sheridan PJ, Wood RC, Braverman ER, Chen TJ, Cull JG, et al. . The D2 dopamine receptor gene as a determinant of reward deficiency syndrome. *J R Soc Med.* (1996) 89:396–400. 10.1177/014107689608900711 - DOI - PMC - PubMed

Blum K. Reward deficiency syndrome. In: Wenzel A. editor. *The Sage Encyclopedia of Abnormal Clinical Psychology*. Sage Publications; (2017).

Comings DE, Rosenthal RJ, Lesieur HR, Rugle LJ, Muhleman D, Chiu C, et al. . A study of the dopamine D2 receptor gene in pathological gambling. *Pharmacogenetics* (1996) 6:223–34. 10.1097/00008571-199606000-00004 - DOI - PubMed

Comings DE, Gonzalez N, Wu S, Gade R, Muhleman D, Saucier G, et al. . (1999). Studies of the 48 bp repeat polymorphism of the DRD4 gene in impulsive, compulsive, addictive behaviors: tourette syndrome, ADHD, pathological gambling, and substance abuse. *Am J Med Genet.* 88, 358–368. 10.1002/(SICI)1096-8628(19990820)88:4<358::AID-AJMG13>3.0.CO;2-G - DOI - PubMed

Joutsa J, Hirvonen MM, Arponen E, Hietala J, Kaasinen V. DRD2-related TaqIA genotype is associated with dopamine release during a gambling task. *J Addict Med.* (2014) 8:294–5. 10.1097/ADM.0000000000000037 - DOI - PubMed

Comings DE. Clinical and molecular genetics of ADHD and Tourette syndrome. Two related polygenic disorders. *Ann N Y Acad Sci.* (2001) 931:50–83. 10.1111/j.1749-6632.2001.tb05773.x - DOI - PubMed

Nespoli E, Rizzo F, Boeckers T, Schulze U, Hengerer B. Altered dopaminergic regulation of the dorsal striatum is able to induce tic-like movements in juvenile rats. *PLoS ONE* (2018) 13:e0196515. 10.1371/journal.pone.0196515 - DOI - PMC - PubMed

Yuan A, Su L, Yu S, Li C, Yu T, Sun J. Association between DRD2/ANKK1 TaqIA polymorphism and susceptibility with tourette syndrome: a meta-analysis. *PLoS ONE* (2015) 10:e0131060. 10.1371/journal.pone.0131060 - DOI - PMC - PubMed

Spencer TJ, Biederman J, Madras BK, Dougherty DD, Bonab AA, Livni E, et al. . Further evidence of dopamine transporter dysregulation in ADHD: a controlled PET imaging study using altropane. *Biol Psychiatry* (2007) 62:1059–61. 10.1016/j.biopsych.2006.12.008 - DOI - PMC - PubMed

Ghosh P, Sarkar K, Bhaduri N, Ray A, Sarkar K, Sinha S, et al. . Catecholaminergic gene variants: contribution in ADHD and associated comorbid attributes in the eastern Indian probands. *Biomed Res Int.* (2013) 2013:918410. 10.1155/2013/918410 - DOI - PMC – PubMed.

Spencer TJ, Biederman J, Faraone SV, Madras BK, Bonab AA, Dougherty DD, et al. . Functional genomics of attention-deficit/hyperactivity disorder (ADHD) risk alleles on dopamine transporter binding in ADHD and healthy control subjects. *Biol Psychiatry* (2013) 74:84–9. 10.1016/j.biopsych.2012.11.010 - DOI - PMC – PubMed.

Dackis CA, Gold MS. New concepts in cocaine addiction: the dopamine depletion hypothesis. *Neurosci Biobehav Rev.* (1985) 9:469–77. 10.1016/0149-7634(85)90022-3 - DOI - PubMed

Noble EP, Blum K, Khalsa ME, Ritchie T, Montgomery A, Wood RC, et al. . Allelic association of the D2 dopamine receptor gene with cocaine dependence. *Drug Alcohol Depend* (1993) 33:271–85. 10.1016/0376-8716(93)90113-5 - DOI - PubMed

Dackis CA, Gold MS, Sweeney DR, Byron JP Jr, Climko R. Single-dose bromocriptine reverses cocaine craving. *Psychiatry Res.* (1987) 20:261–4. 10.1016/0165-1781(87)90086-2 - DOI - PubMed

Lawford BR, Young RM, Rowell JA, Qualichefski J, Fletcher BH, Syndulko K, et al. . Bromocriptine in the treatment of alcoholics with the D2 dopamine receptor A1 allele. *Nat Med.* (1995) 1:337–41. 10.1038/nm0495-337 - DOI - PubMed

Rouillard C, Bedard PJ, Falardeau P, Dipaolo T. Behavioral and biochemical evidence for a different effect of repeated administration of L-dopa and bromocriptine on denervated versus non-denervated striatal dopamine receptors. *Neuropharmacology* (1987) 26:1601–6. 10.1016/0028-3908(87)90008-6 - DOI - PubMed

Bogomolova EV, Rauschenbach IY, Adonyeva NV, Alekseev AA, Faddeeva NV, Gruntenko NE. Dopamine down-regulates activity of alkaline phosphatase in *Drosophila*: the role of D2-like receptors. *J Insect Physiol.* (2010) 56:1155–9. 10.1016/j.jinsphys.2010.03.014 - DOI - PubMed

Morales M, Root DH. Glutamate neurons within the midbrain dopamine regions. *Neuroscience* (2014) 282c:60–8. 10.1016/j.neuroscience.2014.05.032 - DOI - PMC - PubMed

Rothman RB, Blough BE, Baumann MH. Dual dopamine/serotonin releasers: potential treatment agents for stimulant addiction. *Exp Clin Psychopharmacol.* (2008) 16:458–74. 10.1037/a0014103 - DOI - PMC - PubMed

Blum K, Braverman ER, Holder JM, Lubar JF, Monastra VJ, Miller D, et al. . Reward deficiency syndrome: a biogenetic model for the diagnosis and treatment of impulsive, addictive, and compulsive behaviors. *J Psychoactive Drugs* (2000) 32(Suppl. i-iv):1–112. 10.1080/02791072.2000.10736099 - DOI - PubMed

Heiden P, Heinz A, Romanczuk-Seiferth N. Pathological gambling in Parkinson's disease: what are the risk factors and what is the role of impulsivity? *Eur J Neurosci.* (2017) 45:67–72. 10.1111/ejn.13396 - DOI - PMC - PubMed

Volkow ND, Morales M. The brain on drugs: from reward to addiction. *Cell* (2015) 162:712–25. 10.1016/j.cell.2015.07.046 - DOI - PubMed

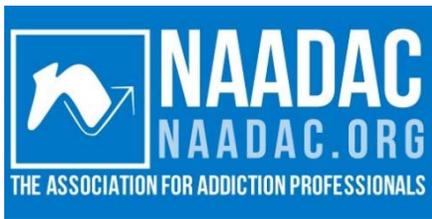
Blum K, Chen AL, Chen TJ, Braverman ER, Reinking J, Blum SH, et al. . Activation instead of blocking mesolimbic dopaminergic reward circuitry is a preferred modality in the long term treatment of reward deficiency syndrome (RDS): a commentary. *Theor Biol Med Model.* (2008) 5:24. 10.1186/1742-4682-5-24 - DOI - PMC - PubMed

Blum K, Oscar-Berman M, Stuller E, Miller D, Giordano J, Morse S, et al. . Neurogenetics and nutrigenomics of neuro-nutrient therapy for reward deficiency syndrome (RDS): clinical ramifications as a function of molecular neurobiological mechanisms. *J Addict Res Ther.* (2012) 3:139. 10.4172/2155-6105.1000139 - DOI - PMC - PubMed

Thanos PK, Rivera SN, Weaver K, Grandy DK, Rubinstein M, Umegaki H, et al. . Dopamine D2R DNA transfer in dopamine D2 receptor-deficient mice: effects on ethanol drinking. *Life Sci.* (2005) 77:130–9. 10.1016/j.lfs.2004.10.061 - DOI - PubMed

Thanos PK, Michaelides M, Umegaki H, Volkow ND. D2R DNA transfer into the nucleus accumbens attenuates cocaine self-administration in rats. *Synapse* (2008) 62:481–6. 10.1002/syn.20523 - DOI - PMC - PubMed

Mandel RJ, Hartgraves SL, Severson JA, Woodward JJ, Wilcox RE, Randall PK. A quantitative estimate of the role of striatal D-2 receptor proliferation in dopaminergic behavioral supersensitivity: the contribution of



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## Webinar References

mesolimbic dopamine to the magnitude of 6-OHDA lesion-induced agonist sensitivity in the rat. *Behav Brain Res.* (1993) 59:53–64. 10.1016/0166-4328(93)90151-F - DOI - PubMed

Blum K, Chen TJ, Downs BW, Bowirrat A, Waite RL, Braverman ER, et al. . Neurogenetics of dopaminergic receptor supersensitivity in activation of brain reward circuitry and relapse: proposing “deprivation-amplification relapse therapy” (DART). *Postgrad Med.* (2009) 121:176–96. 10.3810/pgm.2009.11.2087 - DOI - PMC - PubMed

Blum K, Febo M, Badgaiyan RD. Fifty Years in the development of a glutaminergic-dopaminergic optimization complex (KB220) to balance brain reward circuitry in reward deficiency syndrome: a pictorial. *Austin Addict Sci* (2016) 1:1006. - PMC - PubMed

Blum K, Downs B.w, Baron D, Steinberg B, Siwicki D, Giordano J, et al. . “Dopamine homeostasis” requires balanced polypharmacy: Issue with destructive, powerful dopamine agents to combat America's drug epidemic. *J Syst Integr Neurosci.* (2017) 3:6. 10.15761/JSIN.1000183 - DOI - PMC - PubMed

Blum K, Liu Y, Wang W, Wang Y, Zhang Y, Oscar-Berman M, et al. . rsfMRI effects of KB220Z on neural pathways in reward circuitry of abstinent genotyped heroin addicts. *Postgrad Med.* (2015) 127:232–41. 10.1080/00325481.2015.994879 - DOI - PMC - PubMed

Febo M, Blum K, Badgaiyan RD, Baron D, Thanos PK, Colon-Perez LM, et al. . Dopamine homeostasis: brain functional connectivity in reward deficiency syndrome. *Front Biosci. (Landmark Ed.)* (2017) 22:669–91. 10.2741/4509 - DOI - PubMed

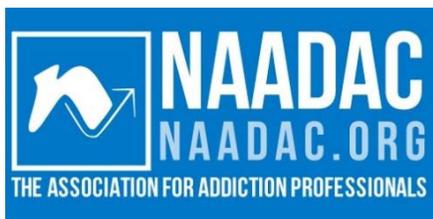
Huang Y, Liu X, Li T, Guo L, Ma X, Yuan G, et al. . Transmission disequilibrium test of DRD4 exon III 48bp variant number tandem repeat polymorphism and tic disorder. *Zhonghua Yi Xue Yi Chuan Xue Za Zhi* (2002) 19:100–3. - PubMed

Dragan WL, Oniszczenko W. The association between dopamine D4 receptor exon III polymorphism and intensity of PTSD symptoms among flood survivors. *Anxiety Stress Coping* (2009) 22:483–95. 10.1080/10615800802419407 - DOI - PubMed

Gervasini G, Gonzalez LM, Gamero-Villarrol C, Mota-Zamorano S, Carrillo JA, Flores I, et al. . Effect of dopamine receptor D4 (DRD4) haplotypes on general psychopathology in patients with eating disorders. *Gene* (2018). 10.1016/j.gene.2018.02.035 - DOI - PubMed

Comings DE, Blum K. Reward deficiency syndrome: genetic aspects of behavioral disorders. *Prog Brain Res.* (2000) 126:325–41. 10.1016/S0079-6123(00)26022-6 - DOI - PubMed

Ren K, Guo B, Dai C, Yao H, Sun T, Liu X, et al. . Striatal distribution and cytoarchitecture of dopamine receptor subtype 1 and 2: evidence from double-labeling transgenic mice. *Front Neural Circuits* (2017) 11:57. 10.3389/fncir.2017.00057 - DOI - PMC - PubMed



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## Webinar References

Liu JH, Zhong HJ, Dang J, Peng L, Zhu YS. Single-nucleotide polymorphisms in dopamine receptor D1 are associated with heroin dependence but not impulsive behavior. *Genet Mol Res.* (2015a) 14:4041–50. 10.4238/2015 - DOI - PubMed

Huang W, Ma JZ, Payne TJ, Beuten J, Dupont RT, Li MD. Significant association of DRD1 with nicotine dependence. *Hum Genet.* (2008a) 123:133–40. 10.1007/s00439-007-0453-9 - DOI - PubMed

Huang W, Li MD. Differential allelic expression of dopamine D1 receptor gene (DRD1) is modulated by microRNA miR-504. *Biol Psychiatry* (2009) 65:702–5. 10.1016/j.biopsych.2008.11.024 - DOI - PMC - PubMed

Kim DJ, Park BL, Yoon S, Lee HK, Joe KH, Cheon YH, et al. . 5' UTR polymorphism of dopamine receptor D1 (DRD1) associated with severity and temperament of alcoholism. *Biochem Biophys Res Commun.* (2007) 357:1135–41. 10.1016/j.bbrc.2007.04.074 - DOI - PubMed

Batel P, Houchi H, Daoust M, Ramoz N, Naassila M, Gorwood P. A haplotype of the DRD1 gene is associated with alcohol dependence. *Alcohol Clin Exp Res.* (2008) 32:567–72. 10.1111/j.1530-0277.2008.00618.x - DOI - PubMed

Jacobs MM, Okvist A, Horvath M, Keller E, Bannon MJ, Morgello S, et al. . Dopamine receptor D1 and postsynaptic density gene variants associate with opiate abuse and striatal expression levels. *Mol Psychiatry* (2013) 18:1205–10. 10.1038/mp.2012.140 - DOI - PMC - PubMed

Peng S, Du J, Jiang H, Fu Y, Chen H, Sun H, et al. . The dopamine receptor D1 gene is associated with the length of interval between first heroin use and onset of dependence in Chinese Han heroin addicts. *J Neural Transm (Vienna)* (2013) 120:1591–8. 10.1007/s00702-013-1029-6 - DOI - PubMed

Grandy DK, Litt M, Allen L, Bunzow JR, Marchionni M, Makam H, et al. . The human dopamine D2 receptor gene is located on chromosome 11 at q22-q23 and identifies a TaqI RFLP. *Am J Hum Genet.* (1989) 45:778–85. - PMC - PubMed

Neville MJ, Johnstone EC, Walton RT. Identification and characterization of ANKK1: a novel kinase gene closely linked to DRD2 on chromosome band 11q23.1. *Hum Mutat* (2004) 23:540–5. 10.1002/humu.20039 - DOI - PubMed

Noble EP, Blum K, Ritchie T, Montgomery A, Sheridan PJ. Allelic association of the D2 dopamine receptor gene with receptor-binding characteristics in alcoholism. *Arch Gen Psychiatry* (1991) 48:648–54. 10.1001/archpsyc.1991.01810310066012 - DOI - PubMed

Blum K, Noble EP, Sheridan PJ, Montgomery A, Ritchie T, Jagadeeswaran P, et al. . Allelic association of human dopamine D2 receptor gene in alcoholism. *JAMA* (1990) 263:2055–60. 10.1001/jama.1990.03440150063027 - DOI - PubMed

Suraj Singh H, Ghosh PK, Saraswathy KN. DRD2 and ANKK1 gene polymorphisms and alcohol dependence: a case-control study among a Mendelian population of East Asian ancestry. *Alcohol Alcohol* (2013) 48:409–14. 10.1093/alcalc/agt014 - DOI - PubMed

Panduro A, Ramos-Lopez O, Campollo O, Zepeda-Carrillo EA, Gonzalez-Aldaco K, Torres-Valadez R, et al. . High frequency of the DRD2/ANKK1 A1 allele in Mexican Native Amerindians and Mestizos and its association with alcohol consumption. *Drug Alcohol Depend* (2017) 172:66–72. 10.1016/j.drugalcdep.2016.12.006 - DOI - PubMed

Wang TY, Lee SY, Chen SL, Huang SY, Chang YH, Tzeng NS, et al. . Association between DRD2, 5-HTTLPR, and ALDH2 genes and specific personality traits in alcohol- and opiate-dependent patients. *Behav Brain Res*. (2013) 250:285–92. 10.1016/j.bbr.2013.05.015 - DOI - PubMed

Merritt KE, Bachtell RK. Initial d2 dopamine receptor sensitivity predicts cocaine sensitivity and reward in rats. *PLoS ONE* (2013) 8:e78258. 10.1371/journal.pone.0078258 - DOI - PMC - PubMed

Persico AM, Bird G, Gabbay FH, Uhl GR. D2 dopamine receptor gene TaqI A1 and B1 restriction fragment length polymorphisms: enhanced frequencies in psychostimulant-preferring polysubstance abusers. *Biol Psychiatry* (1996) 40:776–84. 10.1016/0006-3223(95)00483-1 - DOI - PubMed

Wang N, Zhang JB, Zhao J, Cai XT, Zhu YS, Li SB. Association between dopamine D2 receptor gene polymorphisms and the risk of heroin dependence. *Genet Mol Res*. (2016) 15:4. 10.4238/gmr15048772 - DOI - PubMed

Zhang J, Yan P, Li Y, Cai X, Yang Z, Miao X, et al. . A 35.8 kilobases haplotype spanning ANKK1 and DRD2 is associated with heroin dependence in Han Chinese males. *Brain Res* (2018) 1688:54–64. 10.1016/j.brainres.2018.03.017 - DOI - PubMed

Vengeliene V, Leonardi-Essmann F, Perreau-Lenz S, Gebicke-Haerter P, Drescher K, Gross G, et al. . The dopamine D3 receptor plays an essential role in alcohol-seeking and relapse. *Faseb J*. (2006) 20:2223–33. 10.1096/fj.06-6110com - DOI - PubMed

Thome J, Weijers HG, Wiesbeck GA, Sian J, Nara K, Boning J, et al. . Dopamine D3 receptor gene polymorphism and alcohol dependence: relation to personality rating. *Psychiatr Genet*. (1999) 9:17–21. 10.1097/00041444-199903000-00004 - DOI - PubMed

Huang W, Payne TJ, Ma JZ, Li MD. A functional polymorphism, rs6280, in DRD3 is significantly associated with nicotine dependence in European-American smokers. *Am J Med Genet B Neuropsychiatr Genet* (2008b) 147b:1109–15. 10.1002/ajmg.b.30731 - DOI - PubMed

Joyce PR, Rogers GR, Miller AL, Mulder RT, Luty SE, Kennedy MA. Polymorphisms of DRD4 and DRD3 and risk of avoidant and obsessive personality traits and disorders. *Psychiatry Res*. (2003) 119:1–10. 10.1016/S0165-1781(03)00124-0 - DOI - PubMed

Retz W, Rosler M, Supprian T, Retz-Junginger P, Thome J. Dopamine D3 receptor gene polymorphism and violent behavior: relation to impulsiveness and ADHD-related psychopathology. *J Neural Transm (Vienna)* (2003) 110:561–72. 10.1007/s00702-002-0805-5 - DOI - PubMed

Spangler R, Goddard NL, Avena NM, Hoebel BG, Leibowitz SF. Elevated D3 dopamine receptor mRNA in dopaminergic and dopaminoceptive regions of the rat brain in response to morphine. *Brain Res Mol Brain Res.* (2003) 111:74–83. 10.1016/S0169-328X(02)00671-X - DOI - PubMed

Chen C, Burton M, Greenberger E, Dmitrieva J. Population migration and the variation of dopamine D4 receptor (DRD4) allele frequencies around the globe. *Evol Hum Behav.* (1999) 20:309–24. 10.1016/S1090-5138(99)00015-X - DOI

Wang E, Ding YC, Flodman P, Kidd JR, Kidd KK, Grady DL, et al. . The genetic architecture of selection at the human dopamine receptor D4 (DRD4) gene locus. *Am J Hum Genet.* (2004) 74:931–44. 10.1086/420854 - DOI - PMC - PubMed

Ji H, Xu X, Liu G, Liu H, Wang Q, Shen W, et al. . Dopamine receptor D4 promoter hypermethylation increases the risk of drug addiction. *Exp Ther Med.* (2018) 15:2128–33. 10.3892/etm.2017.5615 - DOI - PMC - PubMed

Kawarai T, Kawakami H, Yamamura Y, Nakamura S. Structure and organization of the gene encoding human dopamine transporter. *Gene* (1997) 195:11–8. 10.1016/S0378-1119(97)00131-5 - DOI - PubMed

Moron JA, Brockington A, Wise RA, Rocha BA, Hope BT. Dopamine uptake through the norepinephrine transporter in brain regions with low levels of the dopamine transporter: evidence from knock-out mouse lines. *J Neurosci.* (2002) 22:389–95. 10.1523/JNEUROSCI.22-02-00389.2002 - DOI - PMC - PubMed

Faraone SV, Spencer TJ, Madras BK, Zhang-James Y, Biederman J. Functional effects of dopamine transporter gene genotypes on in vivo dopamine transporter functioning: a meta-analysis. *Mol Psychiatry* (2014) 19:880–9. 10.1038/mp.2013.126 - DOI - PubMed

Wheeler DD, Edwards AM, Chapman BM, Ondo JG. Effects of cocaine on sodium dependent dopamine uptake in rat striatal synaptosomes. *Neurochem Res.* (1994) 19:49–56. 10.1007/BF00966728 - DOI - PubMed

Ciliax BJ, Drash GW, Staley JK, Haber S, Mobley CJ, Miller GW, et al. . Immunocytochemical localization of the dopamine transporter in human brain. *J Comp Neurol.* (1999) 409:38–56. 10.1002/(SICI)1096-9861(19990621)409:1<38::AID-CNE4>3.0.CO;2-1 - DOI - PubMed

Liu Z, Yan SF, Walker JR, Zwingman TA, Jiang T, Li J, et al. . Study of gene function based on spatial co-expression in a high-resolution mouse brain atlas. *BMC Syst Biol.* (2007) 1:19. 10.1186/1752-0509-1-19 - DOI - PMC - PubMed

Sullivan D, Pinsonneault JK, Papp AC, Zhu H, Lemeshow S, Mash DC, et al. . Dopamine transporter DAT and receptor DRD2 variants affect risk of lethal cocaine abuse: a gene-gene-environment interaction. *Transl Psychiatry* (2013) 3:e222. 10.1038/tp.2012.146 - DOI - PMC - PubMed

Cinque S, Zoratto F, Poleggi A, Leo D, Cerniglia L, Cimino S, et al. . Behavioral phenotyping of dopamine transporter knockout rats: compulsive traits, motor stereotypies, and anhedonia. *Front Psychiatry* (2018) 9:43. 10.3389/fpsy.2018.00043 - DOI - PMC - PubMed

Shih JC. Molecular basis of human MAO A and B. *Neuropsychopharmacology* (1991) 4:1–7. - PubMed

Zhu Q, Shih JC. An extensive repeat structure down-regulates human monoamine oxidase A promoter activity independent of an initiator-like sequence. *J Neurochem.* (1997) 69:1368–73. 10.1046/j.1471-4159.1997.69041368.x - DOI - PubMed

Shih JC, Chen K, Ridd MJ. Role of MAO A and B in neurotransmitter metabolism and behavior. *Pol J Pharmacol.* (1999) 51:25–9. - PubMed

Brummett BH, Krystal AD, Siegler IC, Kuhn C, Surwit RS, Zuchner S, et al. . Associations of a regulatory polymorphism of monoamine oxidase-A gene promoter (MAOA-uVNTR) with symptoms of depression and sleep quality. *Psychosom Med.* (2007) 69:396–401. 10.1097/PSY.0b013e31806d040b - DOI - PMC - PubMed

Wang KS, Liu X, Aragam N, Jian X, Mullersman JE, Liu Y, et al. . Family-based association analysis of alcohol dependence in the COGA sample and replication in the Australian twin-family study. *J Neural Transm (Vienna)* (2011) 118:1293–9. 10.1007/s00702-011-0628-3 - DOI - PubMed

Ducci F, Enoch MA, Hodgkinson C, Xu K, Catena M, Robin RW, et al. . Interaction between a functional MAOA locus and childhood sexual abuse predicts alcoholism and antisocial personality disorder in adult women. *Mol Psychiatry* (2008) 13:334–47. 10.1038/sj.mp.4002034 - DOI - PubMed

Tikkanen R, Auvinen-Lintunen L, Ducci F, Sjoberg RL, Goldman D, Tiihonen J, et al. . Psychopathy, PCL-R, and MAOA genotype as predictors of violent reconvictions. *Psychiatry Res.* (2011) 185:382–6. 10.1016/j.psychres.2010.08.026 - DOI - PMC - PubMed

Gorodetsky E, Bevilacqua L, Carli V, Sarchiapone M, Roy A, Goldman D, et al. . The interactive effect of MAOA-LPR genotype and childhood physical neglect on aggressive behaviors in Italian male prisoners. *Genes Brain Behav.* (2014) 13:543–9. 10.1111/gbb.12140 - DOI - PMC - PubMed

Vanyukov MM, Moss HB, Yu LM, Tarter RE, Deka R. Preliminary evidence for an association of a dinucleotide repeat polymorphism at the MAOA gene with early onset alcoholism/substance abuse. *Am J Med Genet.* (1995) 60:122–6. 10.1002/ajmg.1320600207 - DOI - PubMed

Tikkanen R, Ducci F, Goldman D, Holli M, Lindberg N, Tiihonen J, et al. . MAOA alters the effects of heavy drinking and childhood physical abuse on risk for severe impulsive acts of violence among alcoholic violent

offenders. *Alcohol Clin Exp Res.* (2010) 34:853–60. 10.1111/j.1530-0277.2010.01157.x - DOI - PMC - PubMed

Huang CL, Ou WC, Chen PL, Liu CN, Chen MC, Lu CC, et al. . Effects of interaction between dopamine D2 receptor and monoamine oxidase a genes on smoking status in young men. *Biol Res Nurs.* (2015) 17:422–8. 10.1177/1099800415589366 - DOI - PubMed

Labrosse EH, Axelrod J, Kety SS. O-Methylation, the principal route of metabolism of epinephrine in man. *Science* (1958) 128:593–4. 10.1126/science.128.3324.593 - DOI - PubMed

Wilson AF, Elston RC, Siervogel RM, Weinshilboum R, Ward LJ. Linkage relationships between a major gene for catechol-o-methyltransferase activity and 25 polymorphic marker systems. *Am J Med Genet.* (1984) 19:525–32. 10.1002/ajmg.1320190314 - DOI - PubMed

Vandenbergh DJ, Rodriguez LA, Hivert E, Schiller JH, Villareal G, Pugh EW, et al. . Long forms of the dopamine receptor (DRD4) gene VNTR are more prevalent in substance abusers: no interaction with functional alleles of the catechol-o-methyltransferase (COMT) gene. *Am J Med Genet.* (2000) 96:678–83. 10.1002/1096-8628(20001009)96:5<678::AID-AJMG15>3.0.CO;2-8 - DOI - PubMed

Hill SY, Lichenstein S, Wang S, Carter H, Mcdermott M. Caudate volume in offspring at ultra high risk for alcohol dependence: COMT Val158Met, DRD2, externalizing disorders, and working memory. *Adv J Mol Imaging* (2013) 3:43–54. 10.4236/ami.2013.34007 - DOI - PMC - PubMed

Sery O, Didden W, Mikes V, Pitelova R, Znojil V, Zvolsky P. The association between high-activity COMT allele and alcoholism. *Neuro Endocrinol Lett.* (2006) 27:231–5. - PubMed

Guillot CR, Fanning JR, Liang T, Berman ME. COMT Associations with disordered gambling and drinking measures. *J Gambl Stud.* (2015) 31:513–24. 10.1007/s10899-013-9434-1 - DOI - PMC - PubMed

Enoch MA, Waheed JF, Harris CR, Albaugh B, Goldman D. Sex differences in the influence of COMT Val158Met on alcoholism and smoking in plains American Indians. *Alcohol Clin Exp Res.* (2006) 30:399–406. 10.1111/j.1530-0277.2006.00045.x - DOI - PubMed

Blum K, Chen ALC, Thanos PK, Febo M, Demetrovics Z, Dushaj K, et al. . Genetic addiction risk score (GARS), a predictor of vulnerability to opioid dependence. *Front Biosci. (Elite Ed.)* (2018) 10:175–96. 10.2741/e816 - DOI - PubMed

Haerian BS, Haerian MS. OPRM1 rs1799971 polymorphism and opioid dependence: evidence from a meta-analysis. *Pharmacogenomics* (2013) 14:813–24. 10.2217/pgs.13.57 - DOI - PubMed

Marini V, Fucile C, Zuccoli ML, Testino G, Sumberaz A, Robbiano L, et al. . Involvement of the mu-opioid receptor gene polymorphism A118G in the efficacy of detoxification of alcohol dependent patients. *Addict Behav.* (2013) 38:1669–71. 10.1016/j.addbeh.2012.09.015 - DOI - PubMed

Wang SC, Tsou HH, Chen CH, Chen YT, Ho IK, Hsiao CF, et al. . Genetic polymorphisms in the opioid receptor mu1 gene are associated with changes in libido and insomnia in methadone maintenance patients. *Eur Neuropsychopharmacol.* (2012) 22:695–703. 10.1016/j.euroneuro.2012.02.002 - DOI - PubMed

Bond C, Laforge KS, Tian M, Melia D, Zhang S, Borg L, et al. . Single-nucleotide polymorphism in the human mu opioid receptor gene alters beta-endorphin binding and activity: possible implications for opiate addiction. *Proc Natl Acad Sci USA.* (1998) 95:9608–13. 10.1073/pnas.95.16.9608 - DOI - PMC - PubMed

Pinto E, Reggers J, Gorwood P, Boni C, Scantamburlo G, Pitchot W, et al. . The short allele of the serotonin transporter promoter polymorphism influences relapse in alcohol dependence. *Alcohol Alcohol* (2008) 43:398–400. 10.1093/alcalc/agn015 - DOI - PubMed

Kosek E, Jensen KB, Lonsdorf TB, Schalling M, Ingvar M. Genetic variation in the serotonin transporter gene (5-HTTLPR, rs25531) influences the analgesic response to the short acting opioid Remifentanyl in humans. *Mol Pain* (2009) 5:37. 10.1186/1744-8069-5-37 - DOI - PMC - PubMed

Treister R, Pud D, Ebstein RP, Laiba E, Raz Y, Gershon E, et al. . Association between polymorphisms in serotonin and dopamine-related genes and endogenous pain modulation. *J Pain* (2011) 12:875–83. 10.1016/j.jpain.2011.02.348 - DOI - PubMed

Otten R, Engels RC. Testing bidirectional effects between cannabis use and depressive symptoms: moderation by the serotonin transporter gene. *Addict Biol.* (2013) 18:826–35. 10.1111/j.1369-1600.2011.00380.x - DOI - PubMed

Herman AI, Conner TS, Anton RF, Gelernter J, Kranzler HR, Covault J. Variation in the gene encoding the serotonin transporter is associated with a measure of sociopathy in alcoholics. *Addict Biol.* (2011) 16:124–32. 10.1111/j.1369-1600.2009.00197.x - DOI - PMC - PubMed

Herman AI, Balogh KN. Polymorphisms of the serotonin transporter and receptor genes: susceptibility to substance abuse. *Subst Abuse Rehabil.* (2012) 3:49–57. 10.2147/SAR.S25864 - DOI - PMC - PubMed

Polsinelli GN, Levitan RN, De Luca V. 5-HTTLPR polymorphism in bulimia nervosa: a multiple-model meta-analysis. *Psychiatr Genet.* (2012) 22:219–25. 10.1097/YPG.0b013e32835669b3 - DOI - PubMed

Harkness KL, Bagby RM, Stewart JG, Larocque CL, Mazurka R, Strauss JS, et al. . Childhood emotional and sexual maltreatment moderate the relation of the serotonin transporter gene to stress generation. *J Abnorm Psychol.* (2015) 124:275–87. 10.1037/abn0000034 - DOI - PubMed

Liu S, Maili L, Lane SD, Schmitz JM, Spellicy CJ, Cunningham KA, et al. . Serotonin transporter gene promoter polymorphism predicts relationship between years of cocaine use and impulsivity. *Psychiatr Genet.* (2015b) 25:213–4. 10.1097/YPG.0000000000000094 - DOI - PMC - PubMed

Garbarino VR, Gilman TL, Daws LC, Gould GG. Extreme enhancement or depletion of serotonin transporter function and serotonin availability in autism spectrum disorder. *Pharmacol Res.* (2018).

10.1016/j.phrs.2018.07.010 - DOI - PMC - PubMed

Noble EP, Zhang X, Ritchie T, Lawford BR, Grosser SC, Young RM, et al. . D2 dopamine receptor and GABA(A) receptor beta3 subunit genes and alcoholism. *Psychiatry Res.* (1998) 81:133–47. 10.1016/S0165-1781(98)00084-5 - DOI - PubMed

Edenberg HJ, Dick DM, Xuei X, Tian H, Almasy L, Bauer LO, et al. . Variations in GABRA2, encoding the alpha 2 subunit of the GABA(A) receptor, are associated with alcohol dependence and with brain oscillations. *Am J Hum Genet.* (2004) 74:705–14. 10.1086/383283 - DOI - PMC - PubMed

Konishi T, Calvillo M, Leng AS, Lin KM, Wan YJ. Polymorphisms of the dopamine D2 receptor, serotonin transporter, and GABA(A) receptor beta(3) subunit genes and alcoholism in Mexican-Americans. *Alcohol* (2004) 32:45–52. 10.1016/j.alcohol.2003.11.002 - DOI - PubMed

Han DH, Bolo N, Daniels MA, Lyoo IK, Min KJ, Kim CH, et al. . Craving for alcohol and food during treatment for alcohol dependence: modulation by T allele of 1519T>C GABAAalpha6. *Alcohol Clin Exp Res.* (2008) 32:1593–9. 10.1111/j.1530-0277.2008.00734.x - DOI - PubMed

Namkoong K, Cheon KA, Kim JW, Jun JY, Lee JY. Association study of dopamine D2, D4 receptor gene, GABAA receptor beta subunit gene, serotonin transporter gene polymorphism with children of alcoholics in Korea: a preliminary study. *Alcohol* (2008) 42:77–81. 10.1016/j.alcohol.2008.01.004 - DOI - PubMed

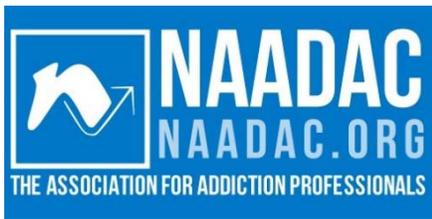
Enoch MA, Baghal B, Yuan Q, Goldman D. A factor analysis of global GABAergic gene expression in human brain identifies specificity in response to chronic alcohol and cocaine exposure. *PLoS ONE* (2013) 8:e64014. 10.1371/journal.pone.0064014 - DOI - PMC - PubMed

Enoch MA, Hodgkinson CA, Yuan Q, Albaugh B, Virkkunen M, Goldman D. GABRG1 and GABRA2 as independent predictors for alcoholism in two populations. *Neuropsychopharmacology* (2009) 34:1245–54. 10.1038/npp.2008.171 - DOI - PMC - PubMed

Terranova C, Tucci M, Sartore D, Cavarzeran F, Di Pietra L, Barzon L, et al. . GABA receptors, alcohol dependence and criminal behavior. *J Forensic Sci.* (2013) 58:1227–32. 10.1111/1556-4029.12201 - DOI - PubMed

Massat I, Souery D, Del-Favero J, Oruc L, Noethen MM, Blackwood D, et al. . Excess of allele1 for alpha3 subunit GABA receptor gene (GABRA3) in bipolar patients: a multicentric association study. *Mol Psychiatry* (2002) 7:201–7. 10.1038/sj.mp.4000953 - DOI - PubMed  
121.

Cui WY, Seneviratne C, Gu J, Li MD. Genetics of GABAergic signaling in nicotine and alcohol dependence. *Hum Genet.* (2012) 131:843–55. 10.1007/s00439-011-1108-4 - DOI - PMC - PubMed



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## Webinar References

Szutorisz H, Dinieri JA, Sweet E, Egervari G, Michaelides M, Carter JM, et al. . Parental THC exposure leads to compulsive heroin-seeking and altered striatal synaptic plasticity in the subsequent generation. *Neuropsychopharmacology* (2014) 39:1315–23. 10.1038/npp.2013.352 - DOI - PMC - PubMed

Mclaughlin T, Blum K, Oscar-Berman M, Febo M, Agan G, Fratantonio JL, et al. . Putative dopamine agonist (KB220Z) attenuates lucid nightmares in PTSD patients: role of enhanced brain reward functional connectivity and homeostasis redeeming joy. *J Behav Addict.* (2015) 4:106–15. 10.1556/2006.4.2015.008 - DOI - PMC - PubMed

Arida RM, Gomes Da Silva S, De Almeida AA, Cavalheiro EA, Zavala-Tecuapetla C, Brand S, et al. . Differential effects of exercise on brain opioid receptor binding and activation in rats. *J Neurochem.* (2015) 132:206–17. 10.1111/jnc.12976 - DOI - PubMed

Newquist G, Gardner RA. Reconsidering food reward, brain stimulation, and dopamine: incentives act forward. *Am J Psychol.* (2015) 128:431–44. 10.5406/amerjpsyc.128.4.0431 - DOI - PubMed

Kjaer TW, Bertelsen C, Piccini P, Brooks D, Alving J, Lou HC. Increased dopamine tone during meditation-induced change of consciousness. *Brain Res Cogn Brain Res.* (2002) 13:255–9. 10.1016/S0926-6410(01)00106-9 - DOI - PubMed

Blum K, Chen TJ, Morse S, Giordano J, Chen AL, Thompson J, et al. . Overcoming qEEG abnormalities and reward gene deficits during protracted abstinence in male psychostimulant and polydrug abusers utilizing putative dopamine D(2) agonist therapy: part 2. *Postgrad Med.* (2010) 122:214–26. 10.3810/pgm.2010.11.2237 - DOI - PubMed

Starkman BG, Sakharkar AJ, Pandey SC. Epigenetics—beyond the genome in alcoholism. *Alcohol Res.* (2012) 34:293–305. - PMC - PubMed

Sheppard CW, Smith DE, Gay GR. The changing face of heroin addiction in the Haight-Ashbury. *Int J Addict.* (1972) 7:109–22. 10.3109/10826087209026765 - DOI - PubMed