**[Diabetes – Medical Marijuana Research Overview](http://www.medicalmarijuanainc.com/diabetes-medical-marijuana-research/)**

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*Diabetes mellitus is a metabolic disease that prevents the body from properly utilizing glucose. Studies have shown marijuana reduces the risk of diabetes, can help treat diabetes once its developed, and assists in the management of pain associated with the disease.*

**Overview of Diabetes**

Diabetes mellitus, also commonly simply referred to as diabetes, is a group of diseases that influences how the body uses glucose. Glucose, or blood sugar, is an important source of fuel for the body’s cells and is the main source of energy for the brain. In diabetes, there is too much glucose in the bloodstream. Glucose builds up because of an issue with insulin, a hormone made by the pancreas that allows your body to process and use glucose.

There are two types of diabetes. Type 1 diabetes, or insulin-dependent diabetes, commonly affects children and teenagers and occurs when the pancreas doesn’t produce enough insulin. Type 2 diabetes, which accounts for 90 to 95% of all diabetes cases, occurs when the pancreas doesn’t produce enough insulin or the body’s cells fail to respond to insulin properly.

Having too much glucose in the blood can lead to serious health problems, including cardiovascular disease, nerve damage, kidney damage, eye damage, foot damage, skin conditions and hearing impairment.

The symptoms associated with diabetes include increased thirst and frequent urination, unexplained weight loss, fatigue, extreme hunger, irritability, blurred vision, presence of ketones in urine, dry and itchy skin, and frequent infections.

The case of type 1 diabetes continues to be unknown. The body’s immune system accidentally attacks and destroys the cells within the pancreas that produce insulin. Type 2 diabetes is linked to being overweight and a lack of exercise.

Treatments for diabetes commonly include the encouragement of healthy eating and regular exercise to lower body weight. In addition, regularly monitoring blood sugar is important for those with type 1 and type 2 diabetes. Insulin injections may be needed to adjust blood glucose levels.

**Findings: Effects of Cannabis on Diabetes**

Cannabis use has been found to have an inverse association with diabetes (Alshaarawy & Anthony, 2015). Those who use cannabis have a lower incidence of the disease. This inverse relationship has been seen both in animal and human studies.

In animal trials, one of the cannabinoids found in cannabis, cannabidiol (CBD), was shown to significantly reduce both pro-inflammatory cytokines in the bloodstream and the incidence of diabetes in non-obese mice (Weiss, et al., 2006). Later, those same researchers followed up with a similar study, but with rodents that were either in a latent diabetes stage or with initial symptoms of diabetes and found that CBD was effective at curtailing the manifestations of the disease. Only 30% of the CBD-treated mice ended up developing diabetes (Weiss, et al., 2008). Research has also found that CBD treatments in rats for one to four weeks received significant protection from diabetic retinopathy (El-Remessy, et al., 2006). Another cannabinoid found in cannabis, tetrahydrocannabinol (THC), produced several beneficial effects reducing the risk of diabetes in obese mice, including reducing glucose intolerance, improving glucose tolerance and increasing insulin sensitivity (Wargent, et al., 2013).

In human studies, cannabis use has been correlated to a lower prevalence of diabetes (Rajavashisth, et al., 2012). An observational trial found that individuals that had used cannabis within the last 30 days experienced both lower fasting insulin levels and insulin resistance (Penner, Buettner & Mittleman, 2013). Other researchers found that those who consumed cannabis in the past year were more likely to possess a lower body mass index, lower fasting insulin and lower insulin resistance compared to non-users (Ngueta, Belanger, Laouan-Sidi & Lucas, 2015). In HIV-HCV infected patients, in which the risk of diabetes is higher, cannabis has been shown to be associated with a lower insulin resistance risk, thus demonstrating its potential as a therapeutic option (Carrieri, et al., 2015). Cannabinoids have also shown they can play a role in the regulation of glucose metabolism, suggesting that they’re beneficial for regulating fat tissue in humans that are obese (Pagano, et al., 2007).

CBD and THC act upon the cannabinoid receptors (CB1 and CB2) of the endocannabinoid system, which stimulates anti-inflammatory and analgesic responses (Bermudez-Silva, et al., 2008) (Di Marzo, 2008) (Horváth, Mukhopadhyay, Haskó & Pacher, 2012). Because of cannabis’ anti-inflammatory effects, researchers have concluded that it can serve as a viable therapeutic option in the treatment of inflammatory diseases, like diabetes (Croxford & Yamamura, 2005). One study found that administering CBD weakened oxidative stress, inflammation, cell death and fibrosis, suggesting that it possesses great therapeutic potential (Rajesh, et al., 2010). An animal study found that action on the CB1 receptor decreased non-fasting plasma glucose, improved glycemic response to glucose and enhanced insulin sensitivity (Irwin, Hunter, Frizzell & Flatt, 2008). When combined with a hypocaloric diet, blocking the CB1 receptor over one year was shown to cause a significant decrease in bodyweight and waist circumference and cause an improvement in cardiovascular risk factors (Van Gaal, et al., 2005). Another study found cannabinoids to be effective at reducing β-cell destruction, which leads to insulin deficiency and cause of type 1 diabetes (Kim, et al., 2016).

Cannabis can also assist in the management of pain associated with diabetes. In numerous studies, administering cannabis in mice reduced diabetic-related tactile allodynia, or pain resulting from a non-injurious stimulus to the skin (Dogrul, et al., 2004) (Ulugol, et al., 2004). One placebo-controlled study found that inhaled cannabis was effective at reducing diabetic peripheral neuropathy pain that had otherwise proven refractory to treatment (Wallace, et al., 2015).

**States That Have Approved Medical Marijuana for Diabetes**

No states have specifically approved medical marijuana for the treatment of diabetes. However, a number of other states will consider allowing medical marijuana to be used for the treatment of diabetes with the recommendation from a physician. These states include: [California](http://www.medicalmarijuanainc.com/california-marijuana-laws/) (any debilitating illness where the medical use of marijuana has been recommended by a physician), [Connecticut](http://www.medicalmarijuanainc.com/connecticut-marijuana-laws/) (other medical conditions may be approved by the Department of Consumer Protection), [Massachusetts](http://www.medicalmarijuanainc.com/massachusetts-marijuana-laws/) (other conditions as determined in writing by a qualifying patient’s physician), [Nevada](http://www.medicalmarijuanainc.com/nevada-marijuana-laws/) (other conditions subject to approval), [Oregon](http://www.medicalmarijuanainc.com/oregon-marijuana-laws/) (other conditions subject to approval), [Rhode Island](http://www.medicalmarijuanainc.com/rhode-island-marijuana-laws/) (other conditions subject to approval), and [Washington](http://www.medicalmarijuanainc.com/washington-marijuana-laws/) (any “terminal or debilitating condition”).

In [Washington D.C.](http://www.medicalmarijuanainc.com/washington-dc-marijuana-law/), any condition can be approved for medical marijuana as long as a DC-licensed physician recommends the treatment.

In addition, [Illinois](http://www.medicalmarijuanainc.com/cannabis-law-in-illlinois/) has approved medical marijuana for the treatment of diabetic neuropathy, which can occur in those with diabetes. Several states have approved medical marijuana specifically to treat “chronic pain.” These states include: [Alaska](http://www.medicalmarijuanainc.com/alaska-marijuana-laws/), [Arizona](http://www.medicalmarijuanainc.com/arizona-marijuana-laws/), [California](http://www.medicalmarijuanainc.com/california-marijuana-laws/), [Colorado](http://www.medicalmarijuanainc.com/colorado-marijuana-laws/), [Delaware](http://www.medicalmarijuanainc.com/delaware-marijuana-laws/), [Hawaii](http://www.medicalmarijuanainc.com/hawaii-marijuana-laws/), [Maine](http://www.medicalmarijuanainc.com/maine-marijuana-laws/), [Maryland](http://www.medicalmarijuanainc.com/maryland-marijuana-laws/), [Michigan](http://www.medicalmarijuanainc.com/michigan-marijuana-laws/), [Montana](http://www.medicalmarijuanainc.com/montana-marijuana-laws/), [New Mexico](http://www.medicalmarijuanainc.com/new-mexico-marijuana-laws/), [Ohio](http://www.medicalmarijuanainc.com/ohio-marijuana-laws/), [Oregon](http://www.medicalmarijuanainc.com/oregon-marijuana-laws/), [Pennsylvania](http://www.medicalmarijuanainc.com/pennsylvania-marijuana-laws/), [Rhode Island](http://www.medicalmarijuanainc.com/rhode-island-marijuana-laws/) and [Vermont](http://www.medicalmarijuanainc.com/vermont-marijuana-laws/). The states of [Nevada](http://www.medicalmarijuanainc.com/nevada-marijuana-laws/), [New Hampshire](http://www.medicalmarijuanainc.com/new-hampshire-marijuana-laws/), [North Dakota](http://www.medicalmarijuanainc.com/north-dakota-marijuana-laws/), [Montana](http://www.medicalmarijuanainc.com/montana-marijuana-laws/), [Ohio](http://www.medicalmarijuanainc.com/ohio-marijuana-laws/) and [Vermont](http://www.medicalmarijuanainc.com/vermont-marijuana-laws/) allow medical marijuana to treat “severe pain.” The states of [Arkansas](http://www.medicalmarijuanainc.com/arkansas-marijuana-laws/), [Minnesota](http://www.medicalmarijuanainc.com/minnesota-marijuana-laws/), [Ohio](http://www.medicalmarijuanainc.com/ohio-marijuana-laws/), [Pennsylvania](http://www.medicalmarijuanainc.com/pennsylvania-marijuana-laws/) and [Washington](http://www.medicalmarijuanainc.com/washington-marijuana-laws/) have approved cannabis for the treatment of “intractable pain.”

**Recent Studies on Cannabis’ Effect on Diabetes**

* **Individuals that used marijuana within the last 30 days experienced lower fasting insulin levels and lower insulin resistance.**
*The impact of marijuana use on glucose, insulin, and insulin resistance among US adults.*
([http://www.amjmed.com/article/S0002-9343(13)00200-3/pdf](http://www.amjmed.com/article/S0002-9343%2813%2900200-3/pdf))
* **Marijuana users found to have a lower prevalence of diabetes compared to non-marijuana users.**
*Decreased prevalence of diabetes in marijuana users: cross-sectional data from the National Health and Nutrition Examination Survey (NHANES) III.*
(<http://bmjopen.bmj.com/content/2/1/e000494.full>)
* **Recently active cannabis smoking is inversely associated with diabetes.**
*Cannabis Smoking and Diabetes Mellitus: Results from Meta-analysis with Eight Independent Replication Samples.*
(<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4801109/>)

**References:**

1. Alshaarawy, O., and Anthony, J.C. (2015, July). Cannabis Smoking and Diabetes Mellitus: Results from Meta-analysis with Eight Independent Replication Samples. *Epidemiology*, 26(4), 597-600. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4801109/>.
2. Bermudez-Silva, F.J., Suarez, J., Baixeras, E., Cobo, N., Bautista, D., Cuesta-Munoz, A.L., Fuentes, E., Juan-Pico, P., Castro, M.J., Milman, G., MEchoulam, R., Nadal, A., and Rodriguez de Fonseca, F. (2008, March). Presence of functional cannabinoid receptors in human endocrine pancreas. Diabetologia, 51(3), 476-87. Retrieved from [http://link.springer.com/article/10.1007%2Fs00125-007-0890-y](http://link.springer.com/article/10.1007/s00125-007-0890-y).
3. Carrieri, M.P., Serfaty, L., Vilotitch, A., Winnock, M., Poizot-Martin, I., Loko, M., Lions, C., Lascoux-Combe, C., Roux, P., Salmon-Ceron, D., Spire, B., and Dabis, F. (2015, March 16). Cannabis use and reduced risk of insulin resistance in HIV-HCV infected patients: a longitudinal analysis (ANRS CO13 HEPAVIH). *Clinical Infectious Diseases*, 61(1), 40-48. Retrieved from <https://academic.oup.com/cid/article-lookup/doi/10.1093/cid/civ217>.
4. Croxford, J.L., and Yamamura, T. (2005, September). Cannabinoids and the immune system: potential for the treatment of inflammatory diseases? *Journal of Neuroimmunology*, 166(1-2), 3-18. Retrieved from [http://www.jni-journal.com/article/S0165-5728(05)00160-8/fulltext](http://www.jni-journal.com/article/S0165-5728%2805%2900160-8/fulltext).
5. Diabetes. (2014, May). *FamilyDoctor.org*. Retrieved from <http://familydoctor.org/familydoctor/en/diseases-conditions/diabetes.printerview.all.html>.
6. Diabetes. (2014, July 31). *Mayo Clinic*. Retrieved from <http://www.mayoclinic.org/diseases-conditions/diabetes/basics/definition/con-20033091>.
7. Di Marzo, V. (2008, August). The endocannabinoid system in obesity and type 2 diabetes. *Diabetologia*, 51(8), 1356-67. Retrieved from [http://link.springer.com/article/10.1007%2Fs00125-008-1048-2](http://link.springer.com/article/10.1007/s00125-008-1048-2).
8. Dogrul, A., Gul, H., Yildiz, O., Bilgin, F., and Guzeldemir, M.E. (2004, September 16). Cannabinoids blocks tactile allodynia in diabetic mice without attentuation of its antinociceptivee effect. *Neuroscience Letters*, 368(1), 82-6. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0304394004007980>.
9. El-Remessy, A.B., Al-Shabrawey, M., Khalifa, Y., Tsai, N.T., Caldwell, R.B., and Liou, G.I. (2006, January). Neuroprotective and blood-retinal barrier-preserving effects of cannabidiol in experimental diabetes. *American Journal of Pathology*, 168(1), 235-44. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1592672/>.
10. Horváth, B., Mukhopadhyay, P., Haskó, G., & Pacher, P. (2012). The Endocannabinoid System and Plant-Derived Cannabinoids in Diabetes and Diabetic Complications. *The American Journal of Pathology*, 180(2), 432–442. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3349875/>.
11. Irwin, N., Hunter, K., Frizzell, N., and Flatt, P.R. (2008, February 26). Antidiabetic effects of sub-chronic administration of the cannabinoid receptor (CB1) antagonist, AM251, in obese diabetic (ob/ob) mice. *European Journal of Pharmacology*, 581(1-2), 226-33. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0014299907013209.>
12. Kim, J., Lee, K.J., Kim, J.S., Rho, J.G., Shin, J.J., Song, W.K., Lee, E.K., Egan, J.M., and Kim, W. (2016). Cannabinoids Regulate Bcl-2 and Cyclin D2 Expression in Pancreatic β Cells. *PLoS ONE*, 11(3), e0150981. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4788443/>.
13. Ngueta, G., Belanger, R.E., Laouan-Sidi, E.A., and Lucas, M. (2015, February). Cannabis use in relation to obesity and insulin resistance in the inuit population. *Obesity*, 23(2), 290-295. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/oby.20973/full>.
14. Pagano, C., Pilon, C., Calcagno, A., Urbanet, R., Rossato, M., Milan, G., Bianchi, K., Rizzuto, R., Bernante, P., Federspil, G., and Vettor, R. (2007, December). The endogenous cannabinoid system stimulates glucose uptake in human fat cells via phosphatidylinositol 3-kinase and calcium-dependent mechanisms. *The Journal of Clinical Endocrinology & Metabolism*, 92(12), 4810-4819. Retrieved from <https://academic.oup.com/jcem/article-lookup/doi/10.1210/jc.2007-0768>.
15. Penner, E.A., Buettner, H., and Mittleman, M.A. (2013, July). The impact of marijuana use on glucose, insulin, and insulin resistance among US adults. *The American Journal of Medicine*, 126(7), 583-9. Retrieved from [http://www.amjmed.com/article/S0002-9343(13)00200-3/pdf](http://www.amjmed.com/article/S0002-9343%2813%2900200-3/pdf).
16. Rajavashisth, T.B., Shaheen, M., Norris, K.C., Pan, D., Sinha, S.K., Oretega, J., Friedman, T.C. (2012). Decreased prevalence of diabetes in marijuana users: cross-sectional data from the National Health and Nutrition Examination Survey (NHANES) III. *BMJ Open*, 2, e000494. Retrieved from <http://bmjopen.bmj.com/content/2/1/e000494.full>.
17. Rajesh, M., Mukhopadhyay, P., Batkai, S., Patel, V., Saito, K., Matsumoto, S., Kashiwaya, Y., Horvath, B., Mukhopadhyay, B., Becker, L., Hasko, G., Liaudet, L., Wink, D.A., Veves, A., Mechoulam, R., and Pacher, P. (2010, December 14). Cannabidiol attentuates cardiac dysfunction, oxidative stress, fibrosis, and inflammatory and cell death signaling pathways in diabetic cardiomyopathy. *Journal of the American College of Cardiology*, 56(25), 2115-25. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3026637/>.
18. Ulugol, A., Karadag, H.C., Ipci, Y., Tamer, M., and Dokmeci, I. (2004, November 23). The effect of WIN 55, 212-2, a cannabinoid agonist, on tactile allodynia in diabetic rats. *Neuroscience Letters*, 371(2-3), 167-70. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1861843/>.
19. Van Gaal, L.F., Rissanen, A.M., Scheen, A.J., Ziegler, O., Rossner, S., and RIO-Europe Study Group. (2005, April). Effects of the cannabinoid-1 receptor blocker rimonabant on weight reduction and cardiovascular risk factors in overweight patients: 1-year experience from the RIO-Europe study. Lancet, (365)9468, 1389-97. Retrieved from [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(05)66374-X/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2805%2966374-X/fulltext).
20. Wallace, M.S., Marcotte, T.D., Umlauf, A., Gouaux, B., and Atkinson, J.H. (2015, July). Efficacy of Inhaled Cannabis on Painful Diabetic Neuropathy. *Journal of Pain*, 17(7), 616-27. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5152762/>.
21. Wargent, E.T., Zaibi, M.S., Silvestri, C., Hislop, D.C., Stocker, C.J., Stott, C.G., Guy, G.W., Duncan, M., Di Marzo, V., and Cawthorne, M.A. (2013, May 27). The cannabinoid 9-tetrahycrocannabivarian (THCV) ameliorates insulin sensitivity in two mouse models of obesity. *Nutrition & Diabetes*, 3, e68. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3671751/>.
22. Weiss, L., Zeira, M., Reich, S., Har-Noy, M., Mechoulam, R., Slavin, S., and Gallily, R. (2006, March). Cannabidiol lowers incidence of diabetes in non-obese diabetic mice. *Autoimmunity*, 39(2), 143-51. Retrieved from <http://www.tandfonline.com/doi/full/10.1080/08916930500356674?needAccess=true>.
23. Weiss, L., Zeira, M., Reich, S., Slavin, S., Raz, I., Mechoulam, R., and Gallily, R. (2008, January). Cannabidiol arrests onset of autoimmune diabetes in NOD mice. *Neuropharmacology*, 54(1), 244-9. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2270485/>.

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