



RESEARCH MODELS

Zucker Diabetic Sprague Dawley (ZSDS) Rat

A Translatable Rat Model for Obesity, Metabolic Syndrome, Diabetes, and Diabetic Complications

The ZSDS polygenic rat model does not rely on monogenetic leptin or leptin receptor mutations for development of obesity and Type 2 diabetes, more closely mimicking human conditions.

Evaluate your therapeutic agents in a translatable rat model, which more closely mirrors human disease development and progression.

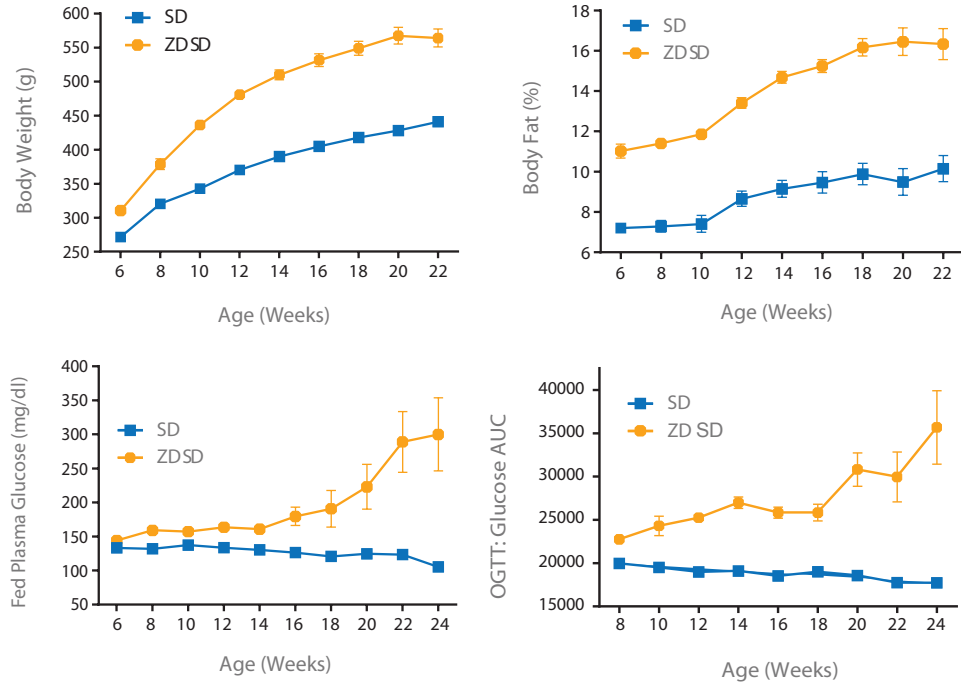
- ZSDS rat features:
 - Polygenic obesity model, without leptin or leptin receptor mutations.
 - Developed by crossing ZDF rat (Lean +/+) with CD(SD) rat and selectively bred to select for obesity and diabetes traits.
 - Inbred for 35+ generations.
- Type 2 diabetes progresses similarly to the human disease – pre-diabetes (8-16 weeks), through overt diabetes (> 16 weeks), to diabetic complications (24+ weeks).
- Diabetic complications include nephropathy, neuropathy, fatty liver, etc.
- Metabolic syndrome characteristics including insulin resistance, dyslipidemia, and hypertension.
- Move your agents for obesity, metabolic syndrome, diabetes, and diabetic complications into the clinic with confidence.

ZSDS Rat Model vs. Conventional Models

	Human	ZSDS Rat	ZDF	Zucker	DIO Rat
Polygenic Disease	•	•			•
Intact Leptin Pathway	•	•			•
Pre-Diabetic State	•	•			•
Glucose Intolerance on Normal Diet	•	•	•	•	
Weight Gain on Normal Diet	•	•	•	•	
Hyperglycemia	•	•	•		
Comorbidities	•	•	•		
<i>Cardiac Dysfunction</i>	•	•	•		
<i>Nephropathy</i>	•	•	•		
<i>Hypertension</i>	•	•		•	•

EVERY STEP OF THE WAY

Spontaneous Development of Obesity and Hyperglycemia, and Impaired Glucose Disposal



Animals were fed Purina Lab Diet #5008

ZDSD References:

1. Molecular changes in hepatic metabolism in ZDSD rats-A new polygenic rodent model of obesity, metabolic syndrome, and diabetes. Han L, Bittner S, Dong D, Cortez Y, Bittner A, Chan J, Umar M, Shen WJ, Peterson RG, Kraemer FB, Azhar S. *Biochim Biophys Acta Mol Basis Dis.* 2020 May 1; 1866(5):165688. doi: 10.1016/j.bbdis.2020.165688. Epub 2020 Jan 24. PMID:31987840. <https://www.ncbi.nlm.nih.gov/pubmed/31987840>
2. Zucker Diabetic Sprague Dawley (ZDSD) Rat, A Spontaneously Diabetic Rat Model Develops Cardiac Dysfunction and Compromised Cardiac Reserve. Sun G, Zhang G, Jackson CV, Wang Y-X. *Cardiology Research and Cardiovascular Medicine* 2018; CRCM-133, DOI: 10.29011/CRCM-133.000033. <https://www.crownbio.com/publication/zdsd-cardiac-function>
3. The impact of type 2 diabetes on bone metabolism and growth after spinal fusion. Bhamb N, Kanim LEA, Maldonado RC, Nelson TJ, Salehi K, Glaeser JD, Metzger MF. *Spine J.* 2019 Jun;19(6):1085-1093. doi: 10.1016/j.spinee.2018.12.003. Epub 2018 Dec 7. PMID:30529784. <https://www.ncbi.nlm.nih.gov/pubmed/30529784>
4. The ZDSD rat: a novel model of diabetic nephropathy. Peterson RG, Jackson CV, Zimmerman KM. *Am J Transl Res.* 2017 Sep 15;9(9):4236-4249. eCollection 2017. PMID:28979697. <https://www.ncbi.nlm.nih.gov/pubmed/28979697>
5. Wound Healing Delay in the ZDSD Rat. Suckow MA, Gobbett TA, Peterson RG. *In Vivo.* 2017 Jan 2;31(1):55-60. PMID:28064221. <https://www.ncbi.nlm.nih.gov/pubmed/28064221>
6. Modeling the Disease Progression from Healthy to Overt Diabetes in ZDSD Rats. Choy S, de Winter W, Karlsson MO, Kjellsson MC. *AAPS J.* 2016 May 31. [Epub ahead of print] PMID: 27245226.
7. Changes in the Fracture Resistance of Bone with the Progression of Type 2 Diabetes in the ZDSD Rat. Creecy A, Uppuganti S, Merkel AR, O'Neal D, Makowski AJ, Granke M, Voziyan P, Nyman JS. *Calcif Tissue Int.* 2016 Sep;99(3):289-301. doi: 10.1007/s00223-016-0149-z. Epub 2016 May 21. PMID: 27209312.
8. Characterization of the ZDSD Rat: A Translational Model for the Study of Metabolic Syndrome and Type 2 Diabetes. Peterson RG, Jackson CV, Zimmerman K, de Winter W, Huebert N, Hansen MK. *J Diabetes Res.* 2015;2015:487816. doi: 10.1155/2015/487816. Epub 2015 Apr 16. PMID: 25961053 Free PMC Article.
9. Effect of dipeptidyl peptidase 4 inhibition on arterial blood pressure is context dependent. Jackson EK, Mi Z, Tofovic SP, Gillespie DG. *Hypertension.* 2015 Jan;65(1):238-49. doi: 10.1161/HYPERTENSIONAHA.114.04631. Epub 2014 Nov 3. Erratum in: *Hypertension.* 2015 Apr;65(4):e17. PMID: 25368027 Free PMC Article.

10. Characterization of diabetic neuropathy in the Zucker diabetic Sprague-Dawley rat: a new animal model for type 2 diabetes. Davidson EP, Coppey LJ, Holmes A, Lupachyk S, Dake BL, Oltman CL, Peterson RG, Yorek MA. *J Diabetes Res.* 2014;2014:714273. doi: 10.1155/2014/714273. Epub 2014 Oct 13. PMID: 25371906 Free PMC Article.
11. Raloxifene prevents skeletal fragility in adult female Zucker Diabetic Sprague-Dawley rats. Hill Gallant KM, Gallant MA, Brown DM, Sato AY, Williams JN, Burr DB. *PLoS One.* 2014 Sep 22;9(9):e108262. doi: 10.1371/journal.pone.0108262. eCollection 2014. PMID: 25243714 Free PMC Article.
12. A review of rodent models of type 2 diabetic skeletal fragility. Fajardo RJ, Karim L, Calley VI, Bouxsein ML. *J Bone Miner Res.* 2014;29(5):1025-40. doi: 10.1002/jbmr.2210. Review. PMID: 24585709 Free Article.
13. Identification of glyceollin metabolites derived from conjugation with glutathione and glucuronic acid in male ZSD rats by online liquid chromatography-electrospray ionization tandem mass spectrometry. Quadri SS, Stratford RE, Boué SM, Cole RB. *J Agric Food Chem.* 2014 Mar 26;62(12):2692-700. doi: 10.1021/jf403498f. Epub 2014 Mar 11. PMID: 24617284 Free PMC Article.
14. Age-Related Differences in Response to High-Fat Feeding on Adipose Tissue and Metabolic Profile in ZSD Rats. Davis JE, Cain J, Banz WJ, Peterson RG. *ISRN Obes.* 2013 May 20;2013:584547. doi: 10.1155/2013/584547. eCollection 2013. PMID: 24555150 Free PMC Article.
15. Multiscale analysis of morphology and mechanics in tail tendon from the ZSD rat model of type 2 diabetes. Gonzalez AD, Gallant MA, Burr DB, Wallace JM. *J Biomech.* 2014 Feb 7;47(3):681-6. doi: 10.1016/j.jbiomech.2013.11.045. Epub 2013 Dec 6. PMID: 24360194 Free PMC Article.
16. Nanoscale changes in collagen are reflected in physical and mechanical properties of bone at the microscale in diabetic rats. Hammond MA, Gallant MA, Burr DB, Wallace JM. *Bone.* 2014 Mar;60:26-32. doi: 10.1016/j.bone.2013.11.015. Epub 2013 Nov 21. PMID: 24269519 Free PMC Article.
17. Skeletal changes associated with the onset of type 2 diabetes in the ZDF and ZSD rodent models. Reinwald S, Peterson RG, Allen MR, Burr DB. *Am J Physiol Endocrinol Metab.* 2009 Apr;296(4):E765-74. doi: 10.1152/ajpendo.90937.2008. Epub 2009 Jan 21. PMID: 19158319 Free PMC Article.