

## Alzheimer's Disease IHC Staining

GPCR	Symbol	Staining in Senile Plaques	Staining in NF Tangles	Other IHC Findings	Antibodies
EGF-Like Module-Containing Mucin-Like Receptor 3 (EMR3) / ADGRE3	ADGRE3	Positive	Negative		LS-A6609
Adenosine A3 Receptor	ADORA3	Faint	Positive		LS-A686
Leukotriene B4 Receptor BLT1	BLT1	Positive	Negative		LS-A1494
Anaphylatoxin C3a Receptor	C3AR	Positive	Negative		LS-A27
C-C Chemokine Receptor 3	CCR3	Faint	Faint	Increased in Astrocytes	LS-A1389
CDC7-Related Protein Kinase (CDC7L1)	CDC7	Faint	Negative to Moderate		LS-A7979, LS-A7980
CDC2-Related Protein Kinase 7 (CRK7)	CDK12	Faint	Negative		LS-A7320
CELSR2	CELSR2	Faint	Positive		LS-A1940
CELSR3	CELSR3	Positive	Positive		LS-A2736
Dopamine Receptor D1	DRD1	Negative	Negative	Increased in Astrocytes	LS-A43
Endothelin B Receptor	EDNRB	Positive	Negative	Increased in Astrocytes	LS-A54, LS-A56
Glucagon-Like Peptide 2 Receptor	GLP2R	Positive	Negative		LS-A1312
G Protein-Coupled Receptor GPR119	GPR119	Positive	Negative	Increased in Granulovacuolar degeneration	LS-A548, LS-A549
G Protein-Coupled Receptor GPR160/GPCR150	GPR160	Faint	Negative		LS-A542, LS-A619
GPR162	GPR162	Faint	Positive		LS-A1692
G Protein-Coupled Receptor GPR17	GPR17	Negative	Positive		LS-A4228
GPR173 / SREB3	GPR173	Positive	Occasionally positive		LS-A516, LS-A527
G Protein-Coupled Receptor GPR30 (GPER1)	GPR30	Positive	Positive		LS-A4290, LS-A1183

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G Protein-Coupled Receptor GPR55	GPR55	Faint	Negative	Increased in astrocytes, neurons	LS-A164
G Protein-Coupled Receptor GPR78	GPR78	Positive	Positive		LS-A3278, LS-A443
Chemokine Receptor FKSG80/GPR81	GPR81	Positive	Negative		LS-A2091
G Protein-Coupled Receptor EX33 (GPR84)	GPR84	Positive	Occasionally positive		LS-A343, LS-A344
G Protein-Coupled Receptor GPR87/GPR95	GPR87	Positive	Negative	Increased in dystrophic neurites	LS-A1580, LS-A1585
5-HT7 Receptor	HTR7	Faint	Positive		LS-A6675
Neuropeptide FF 2 Receptor	NPFFR2	Positive	Positive		LS-A463
Nuclear Receptor Rev-Erba Alpha (NR1D1)	NR1D1	Positive	Negative		LS-A6006, LS-A8045
OR51E1	OR51E1	Positive	Positive		LS-A1851, LS-A1854
Protein Kinase C, Zeta (PKC-Zeta)	PRKCZ	Positive	Negative		LS-A8392
G Protein-Coupled Receptor RXFP3/SALPR/GPCR135	RXFP3	Positive	Negative		LS-A1745
Trace Amine Receptor 3 (TA3)	TAAR9	Negative to Faint	Negative		LS-A1969, LS-A2573
Transient receptor potential cation channel, subfamily A, member 1 (TRPA1)	TRPA1	Positive	Positive	Increased in Granulovacuolar degeneration	LS-A9097
Transient Receptor Potential Cation Channel, Subfamily V, Member 2 (VRL1)	TRPV2	Negative	Negative	Increased in astrocytes, neurons	LS-A8597

## Literature DrugTarget Reference

GPCR	Symbol	LiteratureDrugTargetURL	Bibliography
EGF-Like Module-Containing Mucin-Like Receptor 3 (EMR3) / ADGRE3	ADGRE3		
Adenosine A3 Receptor	ADORA3		
Leukotriene B4 Receptor BLT1	BLT1	<a href="https://www.sciencedirect.com/science/article/pii/S1359644618301570">https://www.sciencedirect.com/science/article/pii/S1359644618301570</a>	Michael J, Marschallinger J, Aigner L. The leukotriene signaling pathway: a druggable target in Alzheimer's disease. <i>Drug Discov Today</i> . 2019 Feb;24(2):505-516. doi: 10.1016/j.drudis.2018.09.008. Epub 2018 Sep 18. PMID: 30240876.
Anaphylatoxin C3a Receptor	C3AR	<a href="https://pubmed.ncbi.nlm.nih.gov/30415998/">https://pubmed.ncbi.nlm.nih.gov/30415998/</a>	Litvinchuk A, Wan YW, Swartzlander DB, Chen F, Cole A, Propson NE, Wang Q, Zhang B, Liu Z, Zheng H. Complement C3aR Inactivation Attenuates Tau Pathology and Reverses an Immune Network Deregulated in Tauopathy Models and Alzheimer's Disease. <i>Neuron</i> . 2018 Dec 19;100(6):1337-1353.e5. doi: 10.1016/j.neuron.2018.10.031. Epub 2018 Nov 8. PMID: 30415998; PMCID: PMC6309202.
C-C Chemokine Receptor 3	CCR3	<a href="https://pubmed.ncbi.nlm.nih.gov/27878757/">https://pubmed.ncbi.nlm.nih.gov/27878757/</a>	Zhu C, Xu B, Sun X, Zhu Q, Sui Y. Targeting CCR3 to Reduce Amyloid- $\beta$ Production, Tau Hyperphosphorylation, and Synaptic Loss in a Mouse Model of Alzheimer's Disease. <i>Mol Neurobiol</i> . 2017 Dec;54(10):7964-7978. doi: 10.1007/s12035-016-0269-5. Epub 2016 Nov 23. PMID: 27878757.
CDC7-Related Protein Kinase (CDC7L1)	CDC7	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3775949/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3775949/</a>	Liachko NF, McMillan PJ, Guthrie CR, Bird TD, Leverenz JB, Kraemer BC. CDC7 inhibition blocks pathological TDP-43 phosphorylation and neurodegeneration. <i>Ann Neurol</i> . 2013 Jul;74(1):39-52. doi: 10.1002/ana.23870. Epub 2013 Jul 8. PMID: 23424178; PMCID: PMC3775949.
CDC2-Related Protein Kinase 7 (CRK7)	CDK12	<a href="https://academic.oup.com/cercor/article/27/3/2289/3056335">https://academic.oup.com/cercor/article/27/3/2289/3056335</a>	Chen, H, Juan, H, Wong, Y et al. Cdk12 Regulates Neurogenesis and Late-Arising Neuronal Migration in the Developing Cerebral Cortex, <i>Cerebral Cortex</i> , Volume 27, Issue 3, March 2017, Pages 2289–2302, <a href="https://doi.org/10.1093/cercor/bhw081">https://doi.org/10.1093/cercor/bhw081</a>
CELSR2	CELSR2		
CELSR3	CELSR3		
Dopamine Receptor D1	DRD1	<a href="https://stm.sciencemag.org/content/11/505/eaav6278?rss=1">https://stm.sciencemag.org/content/11/505/eaav6278?rss=1</a>	Tian, J, Guo, L et al. Disrupted hippocampal growth hormone secretagogue receptor 1 $\alpha$ interaction with dopamine receptor D1 plays a role in Alzheimer's disease. <i>Science Translational Medicine</i> 14 Aug 2019; Vol. 11, Issue 505, eaav6278 DOI:10.1126/scitranslmed.aav6278

## Literature DrugTarget Reference

GPCR	Symbol	LiteratureDrugTargetURL	Bibliography
Endothelin B Receptor	EDNRB		
Glucagon-Like Peptide 2 Receptor	GLP2R		
G Protein-Coupled Receptor GPR119	GPR119		
G Protein-Coupled Receptor GPR160/GPCR150	GPR160		
GPR162	GPR162		
G Protein-Coupled Receptor GPR17	GPR17		
GPR173 / SREB3	GPR173		
G Protein-Coupled Receptor GPR30 (GPER1)	GPR30	<a href="https://link.springer.com/article/10.1134/S1819712419010148">https://link.springer.com/article/10.1134/S1819712419010148</a>	Kurt, A.H., Yuksel, K.Z., Uremis, N. et al. Protective Effects of G Protein-Coupled Estrogen Receptor 1 (GPER1) on $\beta$ -Amyloid-Induced Neurotoxicity: Implications for Alzheimer's Disease. <i>Neurochem. J.</i> 13, 99–104 (2019). <a href="https://doi.org/10.1134/S1819712419010148">https://doi.org/10.1134/S1819712419010148</a>
G Protein-Coupled Receptor GPR55	GPR55		
G Protein-Coupled Receptor GPR78	GPR78	<a href="https://pubmed.ncbi.nlm.nih.gov/23750325/">https://pubmed.ncbi.nlm.nih.gov/23750325/</a>	Gorbatyuk MS, Gorbatyuk OS. The Molecular Chaperone GRP78/BiP as a Therapeutic Target for Neurodegenerative Disorders: A Mini Review. <i>J Genet Syndr Gene Ther.</i> 2013 Mar 11;4(2):128. doi: 10.4172/2157-7412.1000128. PMID: 23750325; PMCID: PMC3674964.
Chemokine Receptor FKSG80/GPR81	GPR81	<a href="https://pubmed.ncbi.nlm.nih.gov/25881750/">https://pubmed.ncbi.nlm.nih.gov/25881750/</a>	Morland C, Lauritzen KH, Puchades M, Holm-Hansen S, Andersson K, Gjedde A, Attramadal H, Storm-Mathisen J, Bergersen LH. The lactate receptor, G-protein-coupled receptor 81/hydroxycarboxylic acid receptor 1: Expression and action in brain. <i>J Neurosci Res.</i> 2015 Jul;93(7):1045-55. doi: 10.1002/jnr.23593. Epub 2015 Apr 16. PMID: 25881750.
G Protein-Coupled Receptor EX33 (GPR84)	GPR84		
G Protein-Coupled Receptor GPR87/GPR95	GPR87		

## Literature DrugTarget Reference

GPCR	Symbol	LiteratureDrugTargetURL	Bibliography
5-HT7 Receptor	HTR7	<a href="https://link.springer.com/article/10.1007/s00213-018-4862-3">https://link.springer.com/article/10.1007/s00213-018-4862-3</a>	Shahidi, S., Asl, S.S., Komaki, A. et al. The effect of chronic stimulation of serotonin receptor type 7 on recognition, passive avoidance memory, hippocampal long-term potentiation, and neuronal apoptosis in the amyloid $\beta$ protein treated rat. <i>Psychopharmacology</i> 235, 1513–1525 (2018). <a href="https://doi.org/10.1007/s00213-018-4862-3">https://doi.org/10.1007/s00213-018-4862-3</a>
Neuropeptide FF 2 Receptor	NPFFR2		
Nuclear Receptor Rev-ErbA Alpha (NR1D1)	NR1D1	<a href="https://www.pnas.org/content/116/11/5102">https://www.pnas.org/content/116/11/5102</a>	Griffin, P, Dimitry, J, Sheehan, P et al. Circadian clock protein Rev-erb $\alpha$ regulates neuroinflammation. <i>Proceedings of the National Academy of Sciences</i> . Mar 2019, 116 (11) 5102-5107; DOI: 10.1073/pnas.1812405116
OR51E1	OR51E1		
Protein Kinase C, Zeta (PKC-Zeta)	PRKCZ		
G Protein-Coupled Receptor RXFP3/SALPR/GPCR135	RXFP3	<a href="https://www.frontiersin.org/10.3389/conf.fnagi.2016.03.00042/event_abstract">https://www.frontiersin.org/10.3389/conf.fnagi.2016.03.00042/event_abstract</a>	van Gastel, Jaana & Janssens, Jonathan & Harmonie, Etienne & Azmi, Abdelkrim & Maudsley, Stuart. (2016). The synergistic GIT2-RXFP3 system in the brain and its importance in age-related disorders. <i>Frontiers in Aging Neuroscience</i> . 8. 10.3389/conf.fnagi.2016.03.00042.
Trace Amine Receptor 3 (TA3)	TAAR9		
Transient receptor potential cation channel, subfamily A, member 1 (TRPA1)	TRPA1		
Transient Receptor Potential Cation Channel, Subfamily V, Member 2 (VRL1)	TRPV2		

## Literature Disease Association

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5-HT7 Receptor	HTR7			
Adenosine A3 Receptor	ADORA3			
C-C Chemokine Receptor 3	CCR3	AD Marker	<a href="https://pubmed.ncbi.nlm.nih.gov/9665462/">https://pubmed.ncbi.nlm.nih.gov/9665462/</a>	Xia MQ, Qin SX, Wu LJ, Mackay CR, Hyman BT. Immunohistochemical study of the beta-chemokine receptors CCR3 and CCR5 and their ligands in normal and Alzheimer's disease brains. <i>Am J Pathol</i> . 1998 Jul;153(1):31-7. doi: 10.1016/s0002-9440(10)65542-3. PMID: 9665462; PMCID: PMC1852933.
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CDC7-Related Protein Kinase (CDC7L1)	CDC7			
G Protein-Coupled Receptor GPR30 (GPER1)	GPR30			
Dopamine Receptor D1	DRD1			
Endothelin B Receptor	EDNRB	Associated with AD Progression	<a href="https://www.researchsquare.com/article/rs-30210/v1">https://www.researchsquare.com/article/rs-30210/v1</a>	Jiang, Z, Tan, G, Wang, Z. Comprehensive Analysis Reveals A Six-Gene Signature and Associated Drugs in Alzheimer Disease. <i>Research Square</i> . Preprint. 2020. Version 1. DOI: 10.21203/rs.3.rs-30210/v1
Protein Kinase C, Zeta (PKC-Zeta)	PRKCZ	Associated with AD Progression	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3348019/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3348019/</a>	Park B, Lee W, Han K. Modeling the interactions of Alzheimer-related genes from the whole brain microarray data and diffusion tensor images of human brain. <i>BMC Bioinformatics</i> . 2012 May 8;13 Suppl 7(Suppl 7):S10. doi: 10.1186/1471-2105-13-S7-S10. PMID: 22594996; PMCID: PMC3348019.
G Protein-Coupled Receptor GPR17	GPR17	AD Marker		
Neuropeptide FF 2 Receptor	NPF2R2	Associated with AD Progression	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2570675/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2570675/</a>	Abraham R, Moskvina V, Sims R, Hollingworth P, Morgan A, Georgieva L, Dowzell K, Cichon S, Hillmer AM, O'Donovan MC, Williams J, Owen MJ, Kirov G. A genome-wide association study for late-onset Alzheimer's disease using DNA pooling. <i>BMC Med Genomics</i> . 2008 Sep 29;1:44. doi: 10.1186/1755-8794-1-44. PMID: 18823527; PMCID: PMC2570675.
OR51E1	OR51E1	Parkinson's Disease association	<a href="https://academic.oup.com/jnen/article/72/6/524/2917608">https://academic.oup.com/jnen/article/72/6/524/2917608</a>	Garcia-Esparcia, P, Schlüter, A, Carmona, M, et al. Functional Genomics Reveals Dysregulation of Cortical Olfactory Receptors in Parkinson Disease: Novel Putative Chemoreceptors in the Human Brain. <i>Journal of Neuropathology &amp; Experimental Neurology</i> . Volume 72, Issue 6, June 2013, Pages 524–539, DOI: 10.1097/NEN.0b013e318294fd76

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G Protein-Coupled Receptor GPR55	GPR55	AD Marker		
G Protein-Coupled Receptor GPR87/GPR95	GPR87			
Glucagon-Like Peptide 2 Receptor	GLP2R	Associated with spatial cognitive dysfunction and chronic cerebral hypoperfusion and may be relevant to AD	<a href="https://pubmed.ncbi.nlm.nih.gov/30452417/">https://pubmed.ncbi.nlm.nih.gov/30452417/</a>	Xie YC, Yao ZH, Yao XL, Pan JZ, Zhang SF, Zhang Y, Hu JC. Glucagon-Like Peptide-2 Receptor is Involved in Spatial Cognitive Dysfunction in Rats After Chronic Cerebral Hypoperfusion. <i>J Alzheimers Dis.</i> 2018;66(4):1559-1576. doi: 10.3233/JAD-180782. PMID: 30452417.
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GPR162	GPR162	Associated with AD Progression	<a href="https://www.biorxiv.org/content/10.1101/610345v1.full">https://www.biorxiv.org/content/10.1101/610345v1.full</a>	Srinivasan, K, Friedman, B, Etxeberria, A, et al. Alzheimer's patient brain myeloid cells exhibit enhanced aging and unique transcriptional activation. <i>bioRxiv.</i> Preprint. 2019. 610345. DOI: <a href="https://doi.org/10.1101/610345">https://doi.org/10.1101/610345</a>
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G Protein-Coupled Receptor GPR78	GPR78	AD Marker, Associated with AD Progression (may have neuroprotective functions)	<a href="https://www.frontiersin.org/articles/10.3389/fnins.2017.00177/full">https://www.frontiersin.org/articles/10.3389/fnins.2017.00177/full</a>	Casas Caty. GRP78 at the Centre of the Stage in Cancer and Neuroprotection. <i>Frontiers in Neuroscience.</i> 2017. 11:177. DOI: 10.3389/fnins.2017.00177
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GPR173 / SREB3	GPR173	GPR173 is a primary receptor for Phoenixin, which is associated with Alzheimer's Disease	<a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6092957">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6092957</a>	Stein LM, Haddock CJ, Samson WK, Kolar GR, Yosten GLC. The phoenixins: From discovery of the hormone to identification of the receptor and potential physiologic actions. <i>Peptides</i> . 2018 Aug;106:45-48. doi: 10.1016/j.peptides.2018.06.005. Epub 2018 Jun 19. PMID: 29933026; PMCID: PMC6092957.
G Protein-Coupled Receptor GPR119	GPR119			
Leukotriene B4 Receptor BLT1	BLT1	Associated with AD Progression	<a href="https://pubmed.ncbi.nlm.nih.gov/31912564/">https://pubmed.ncbi.nlm.nih.gov/31912564/</a>	Emre C, Hjorth E, Bharani K, Carroll S, Granholm AC, Schultzberg M. Receptors for pro-resolving mediators are increased in Alzheimer's disease brain. <i>Brain Pathol</i> . 2020 May;30(3):614-640. doi: 10.1111/bpa.12812. Epub 2020 Jan 21. PMID: 31912564.
Nuclear Receptor Rev-Erba Alpha (NR1D1)	NR1D1			
Trace Amine Receptor 3 (TA3)	TAAR9			
CDC2-Related Protein Kinase 7 (CRK7)	CDK12			
EGF-Like Module-Containing Mucin-Like Receptor 3 (EMR3) / ADGRE3	ADGRE3			
CELSR3	CELSR3	Associated with AD Progression	<a href="https://www.biorxiv.org/content/10.1101/2020.09.09.273011v1.full">https://www.biorxiv.org/content/10.1101/2020.09.09.273011v1.full</a>	Feng, B, Freitas, A, Tian, R, et al. Protecting synapses from amyloid $\beta$ -associated degeneration by manipulations of Wnt/planar cell polarity signaling. <i>bioRxiv</i> . Preprint. 2020. DOI: 10.1101/2020.09.09.273011
Chemokine Receptor FKSG80/GPR81	GPR81	Associated with AD Progression	<a href="https://www.frontiersin.org/articles/10.3389/fnagi.2019.00143">https://www.frontiersin.org/articles/10.3389/fnagi.2019.00143</a>	Osorio, C., Kanukuntla, T., Diaz, E., et al. The Post-amyloid Era in Alzheimer's Disease: Trust Your Gut Feeling. <i>Front. Aging Neurosci.</i> , 26 June 2019. DOI: 10.3389/fnagi.2019.00143