NDRG1 overexpression promotes the progression of esophageal squamous cell carcinoma through modulating Wnt signaling pathway

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Supporting Information

Supplementary Table 1. The expression change of NDRG1 from KYSE30- Ctrl and KYSE30-NDRG1 cells in Human Cancer Pathway Finder PCR array (PAHS-033A).

Supplementary Table 2. The expression change of NDRG1 from KYSE30- Ctrl and KYSE30-NDRG1 cells in Epithelial Mesenchymal Transition PCR array (PAHS-090A).

Supplementary Table 3. The expression change of NDRG1 from KYSE30- Ctrl and KYSE30-NDRG1 cells in Wnt Signaling Pathway PCR array (PAHS-043A).

Supplementary Table 4. Description of primers selected for validation by Real-Time RT-PCR

Supplementary Table 1. The expression change of NDRG1 from KYSE30- Ctrl and KYSE30-NDRG1 cells in Human Cancer Pathway Finder PCR array (PAHS-033A).

Symbol	Description	Fold change (NDRG1 vs Ctrl)
MMP1	Matrix metallopeptidase 1 (interstitial collagenase)	6.43
MTSS1	Metastasis suppressor 1	3.18
TNFRSF25	Tumor necrosis factor receptor superfamily, member 25	2.40
SYK	Spleen tyrosine kinase	2.07
CDC25A	Cell division cycle 25 homolog A (S. pombe)	1.83
PLAUR	Plasminogen activator, urokinase receptor	1.83
TGFB1	Transforming growth factor, beta 1	1.80
SERPINB5	Serpin peptidase inhibitor, clade B (ovalbumin), member 5	1.67
MYC	V-mycmyelocytomatosis viral oncogene homolog (avian)	1.64
MMP2	Matrix metallopeptidase 2 (gelatinase A, 72kDa gelatinase, 72kDa type IV collagenase)	1.61
ANGPT1	Angiopoietin 1	1.57
CDK4	Cyclin-dependent kinase 4	1.48
THBS1	Thrombospondin 1	1.31
MET	Met proto-oncogene (hepatocyte growth factor receptor)	1.21
CCNE1	Cyclin E1	1.20
E2F1	E2F transcription factor 1	1.19
GZMA	Granzyme A (granzyme 1, cytotoxic T-lymphocyte-associated serine esterase 3)	1.15
CDK2	Cyclin-dependent kinase 2	1.13
RAF1	V-raf-1 murine leukemia viral oncogene homolog 1	1.12
ACTB	Actin, beta	1.06
TIMP1	TIMP metallopeptidase inhibitor 1	1.06
ITGB5	Integrin, beta 5	1.04
GAPDH	Glyceraldehyde-3-phosphate dehydrogenase	1.04
NME4	Non-metastatic cells 4, protein expressed in	1.02
MTA2	Metastasis associated 1 family, member 2	1.02
ITGB3	Integrin, beta 3 (platelet glycoprotein IIIa, antigen CD61)	1.01
B2M	Beta-2-microglobulin	0.99
ANGPT2	Angiopoietin 2	0.96
MAP2K1	Mitogen-activated protein kinase kinase 1	0.96
NFKB1	Nuclear factor of kappa light polypeptide gene enhancer in B-cells 1	0.95

SERPINE1	Serpin peptidase inhibitor, clade E (nexin, plasminogen activator inhibitor type 1), member 1	0.95
NME1	Non-metastatic cells 1, protein (NM23A) expressed in	0.95
HPRT1	Hypoxanthine phosphoribosyltransferase 1	0.95
JUN	Jun proto-oncogene	0.94
EPDR1	Ependymin related protein 1 (zebrafish)	0.94
BAX	BCL2-associated X protein	0.91
BCL2	B-cell CLL/lymphoma 2	0.87
TEK	TEK tyrosine kinase, endothelial	0.86
BCL2L1	BCL2-like 1	0.85
IFNA1	Interferon, alpha 1	0.85
CDKN1A	Cyclin-dependent kinase inhibitor 1A (p21, Cip1)	0.85
TP53	Tumor protein p53	0.84
ITGB1	Integrin, beta 1 (fibronectin receptor, beta polypeptide, antigen CD29 includes MDF2, MSK12)	0.83
BAD	BCL2-associated agonist of cell death	0.83
TWIST1	Twist homolog 1 (Drosophila)	0.82
PNN	Pinin, desmosome associated protein	0.81
IFNB1	Interferon, beta 1, fibroblast	0.80
PDGFB	Platelet-derived growth factor beta polypeptide	0.79
CFLAR	CASP8 and FADD-like apoptosis regulator	0.79
PIK3R1	Phosphoinositide-3-kinase, regulatory subunit 1 (alpha)	0.79
CASP8	Caspase 8, apoptosis-related cysteine peptidase	0.77
MCAM	Melanoma cell adhesion molecule	0.76
CHEK2	CHK2 checkpoint homolog (S. pombe)	0.76
PDGFA	Platelet-derived growth factor alpha polypeptide	0.73
TERT	Telomerase reverse transcriptase	0.72
FOS	FBJ murine osteosarcoma viral oncogene homolog	0.71
TNF	Tumor necrosis factor	0.71
ETS2	V-Etserythroblastosis virus E26 oncogene homolog 2 (avian)	0.71
ITGA2	Integrin, alpha 2 (CD49B, alpha 2 subunit of VLA-2 receptor)	0.71
MDM2	Mdm2 p53 binding protein homolog (mouse)	0.69
RB1	Retinoblastoma 1	0.69
TNFRSF1A	Tumor necrosis factor receptor superfamily, member 1A	0.68
HTATIP2	HIV-1 Tat interactive protein 2, 30kDa	0.68
ITGA3	Integrin, alpha 3 (antigen CD49C, alpha 3 subunit of VLA-3 receptor)	0.67
COL18A1	Collagen, type XVIII, alpha 1	0.65

MTA1	Metastasis associated 1	0.64
TNFRSF10B	Tumor necrosis factor receptor superfamily, member 10b	0.64
NFKBIA	Nuclear factor of kappa light polypeptide gene enhancer in B-cells inhibitor, alpha	0.62
AKT1	V-akt murine thymoma viral oncogene homolog 1	0.59
TGFBR1	Transforming growth factor, beta receptor 1	0.59
APAF1	Apoptotic peptidase activating factor 1	0.59
RPL13A	Ribosomal protein L13a	0.58
IGF1	Insulin-like growth factor 1 (somatomedin C)	0.56
ATM	Ataxia telangiectasia mutated	0.56
PLAU	Plasminogen activator, urokinase	0.55
BRCA1	Breast cancer 1, early onset	0.54
SNCG	Synuclein, gamma (breast cancer-specific protein 1)	0.54
VEGFA	Vascular endothelial growth factor A	0.53
ITGA1	Integrin, alpha 1	0.52
CDKN2A	Cyclin-dependent kinase inhibitor 2A (melanoma, p16, inhibits CDK4)	0.50
FGFR2	Fibroblast growth factor receptor 2	0.48
FAS	Fas (TNF receptor superfamily, member 6)	0.48
ITGA4	Integrin, alpha 4 (antigen CD49D, alpha 4 subunit of VLA-4 receptor)	0.48
ERBB2	V-erb-b2 erythroblastic leukemia viral oncogene homolog 2, neuro/glioblastoma derived oncogene homolog (avian)	0.47
IL8	Interleukin 8	0.45
MMP9	Matrix metallopeptidase 9 (gelatinase B, 92kDa gelatinase, 92kDa type IV collagenase)	0.44
S100A4	S100 calcium binding protein A4	0.44
ITGAV	Integrin, alpha V (vitronectin receptor, alpha polypeptide, antigen CD51)	0.33
TIMP3	TIMP metallopeptidase inhibitor 3	0.21

Supplementary Table 2. The expression change of NDRG1 from KYSE30- Ctrl and KYSE30-NDRG1 cells in Epithelial Mesenchymal Transition PCR array (PAHS-090A).

Symbol	Description	Fold change (NDRG1 vs Ctrl)
MSN	Moesin	32.79
WNT5A	Wingless-type MMTV integration site family, member 5A	2.76
CDH2	Cadherin 2, type 1, N-cadherin (neuronal)	2.41
VIM	Vimentin	2.06
RGS2	Regulator of G-protein signaling 2, 24kDa	2.05
PLEK2	Pleckstrin 2	1.82
PTP4A1	Protein tyrosine phosphatase type IVA, member 1	1.54
ITGA5	Integrin, alpha 5 (fibronectin receptor, alpha polypeptide)	1.49
PPPDE2	PPPDE peptidase domain containing 2	1.48
AHNAK	AHNAK nucleoprotein	1.45
TWIST1	Twist homolog 1 (Drosophila)	1.43
BMP1	Bone morphogenetic protein 1	1.40
TGFB1	Transforming growth factor, beta 1	1.40
MMP2	Matrix metallopeptidase 2 (gelatinase A, 72kDa gelatinase, 72kDa type IV collagenase)	1.35
ZEB1	Zinc finger E-box binding homeobox 1	1.35
TFPI2	Tissue factor pathway inhibitor 2	1.30
STEAP1	Six transmembrane epithelial antigen of the prostate 1	1.28
CAMK2N1	Calcium/calmodulin-dependent protein kinase II inhibitor 1	1.25
WNT5B	Wingless-type MMTV integration site family, member 5B	1.22
TIMP1	TIMP metallopeptidase inhibitor 1	1.16
COL1A2	Collagen, type I, alpha 2	1.13
ACTB	Actin, beta	1.12
KRT14	Keratin 14	1.10
WNT11	Wingless-type MMTV integration site family, member 11	1.08
SIP1	Survival of motor neuron protein interacting protein 1	1.05
B2M	Beta-2-microglobulin	1.02
COL3A1	Collagen, type III, alpha 1	0.99
MST1R	Macrophage stimulating 1 receptor (c-met-related tyrosine kinase)	0.99
FOXC2	Forkhead box C2 (MFH-1, mesenchyme forkhead	0.97

	1)	
SNAI1	Snail homolog 1 (Drosophila)	0.96
KRT7	Keratin 7	0.95
NODAL	Nodal homolog (mouse)	0.92
IL1RN	Interleukin 1 receptor antagonist	0.92
FZD7	Frizzled family receptor 7	0.90
IGFBP4	Insulin-like growth factor binding protein 4	0.90
SERPINE1	Serpin peptidase inhibitor, clade E (nexin, plasminogen activator inhibitor type 1), member 1	0.88
HPRT1	Hypoxanthine phosphoribosyltransferase 1	0.88
PTK2	PTK2 protein tyrosine kinase 2	0.85
SNAI2	Snail homolog 2 (Drosophila)	0.82
FN1	Fibronectin 1	0.82
RAC1	Ras-related C3 botulinum toxin substrate 1 (rho family, small GTP binding protein Rac1)	0.82
TMEFF1	Transmembrane protein with EGF-like and two follistatin-like domains 1	0.79
TMEM132A	Transmembrane protein 132A	0.78
COL5A2	Collagen, type V, alpha 2	0.74
NOTCH1	Notch 1	0.73
DSP	Desmoplakin	0.73
JAG1	Jagged 1	0.73
CTNNB1	Catenin (cadherin-associated protein), beta 1, 88kDa	0.73
BMP7	Bone morphogenetic protein 7	0.72
STAT3	Signal transducer and activator of transcription 3 (acute-phase response factor)	0.72
TGFB3	Transforming growth factor, beta 3	0.69
ESR1	Estrogen receptor 1	0.67
ERBB3	V-erb-b2 erythroblastic leukemia viral oncogene homolog 3 (avian)	0.67
F11R	F11 receptor	0.66
GSK3B	Glycogen synthase kinase 3 beta	0.65
TSPAN13	Tetraspanin 13	0.65
GNG11	Guanine nucleotide binding protein (G protein), gamma 11	0.65
DSC2	Desmocollin 2	0.64
ZEB2	Zinc finger E-box binding homeobox 2	0.63
NUDT13	Nudix (nucleoside diphosphate linked moiety X)-type motif 13	0.62
SPARC	Secreted protein, acidic, cysteine-rich (osteonectin)	0.62
TCF3	Transcription factor 3 (E2A immunoglobulin	0.61

	enhancer binding factors E12/E47)	
RPL13A	Ribosomal protein L13a	0.60
CAV2	Caveolin 2	0.60
ITGB1	Integrin, beta 1 (fibronectin receptor, beta polypeptide, antigen CD29 includes MDF2, MSK12)	0.59
EGFR	Epidermal growth factor receptor	0.59
CDH1	Cadherin 1, type 1, E-cadherin (epithelial)	0.57
ILK	Integrin-linked kinase	0.54
GAPDH	Glyceraldehyde-3-phosphate dehydrogenase	0.54
GSC	Goosecoidhomeobox	0.51
FGFBP1	Fibroblast growth factor binding protein 1	0.51
OCLN	Occludin	0.50
CALD1	Caldesmon 1	0.49
KRT19	Keratin 19	0.49
SPP1	Secreted phosphoprotein 1	0.47
PDGFRB	Platelet-derived growth factor receptor, beta polypeptide	0.44
SMAD2	SMAD family member 2	0.43
MMP9	Matrix metallopeptidase 9 (gelatinase B, 92kDa gelatinase, 92kDa type IV collagenase)	0.41
MAP1B	Microtubule-associated protein 1B	0.39
SOX10	SRY (sex determining region Y)-box 10	0.39
SNAI3	Snail homolog 3 (Drosophila)	0.35
TCF4	Transcription factor 4	0.34
ITGAV	Integrin, alpha V (vitronectin receptor, alpha polypeptide, antigen CD51)	0.34
MITF	Microphthalmia-associated transcription factor	0.33
VPS13A	Vacuolar protein sorting 13 homolog A (S. cerevisiae)	0.31
TGFB2	Transforming growth factor, beta 2	0.31
MMP3	Matrix metallopeptidase 3 (stromelysin 1, progelatinase)	0.27
AKT1	V-akt murine thymoma viral oncogene homolog 1	0.19
VCAN	Versican	0.13

Supplementary Table 3. The expression change of NDRG1 from KYSE30- Ctrl and KYSE30-NDRG1 cells in Wnt Signaling Pathway PCR array (PAHS-043A).

Symbol	Description	Fold change (NDRG1 vs Ctrl)
FZD8	Frizzled family receptor 8	2.20
MYC	V-mycmyelocytomatosis viral oncogene homolog (avian)	1.56
JUN	Jun proto-oncogene	1.43
FOSL1	FOS-like antigen 1	1.37
WIF1	WNT inhibitory factor 1	1.35
ACTB	Actin, beta	1.34
FRZB	Frizzled-related protein	1.26
AXIN1	Axin 1	1.25
DVL1	Dishevelled, dsh homolog 1 (Drosophila)	1.23
WNT3	Wingless-type MMTV integration site family, member 3	1.20
GSK3B	Glycogen synthase kinase 3 beta	1.17
WNT9A	Wingless-type MMTV integration site family, member 9A	1.14
TCF7	Transcription factor 7 (T-cell specific, HMG-box)	1.13
CTBP1	C-terminal binding protein 1	1.10
GAPDH	Glyceraldehyde-3-phosphate dehydrogenase	1.09
GSK3A	Glycogen synthase kinase 3 alpha	1.09
PORCN	Porcupine homolog (Drosophila)	1.08
FZD4	Frizzled family receptor 4	1.05
CSNK2A1	Casein kinase 2, alpha 1 polypeptide	1.05
LEF1	Lymphoid enhancer-binding factor 1	1.05
FBXW11	F-box and WD repeat domain containing 11	1.04
CCND3	Cyclin D3	1.04
WNT7A	Wingless-type MMTV integration site family, member 7A	1.03
CSNK1A1	Casein kinase 1, alpha 1	1.01
WNT2B	Wingless-type MMTV integration site family, member 2B	1.01
B2M	Beta-2-microglobulin	1.00
TLE1	Transducin-like enhancer of split 1 (E(sp1) homolog, Drosophila)	0.99
PYGO1	Pygopus homolog 1 (Drosophila)	0.98
WNT1	Wingless-type MMTV integration site family, member 1	0.98
T	T, brachyury homolog (mouse)	0.98
CSNK1D	Casein kinase 1, delta	0.98
NLK	Nemo-like kinase	0.98
DVL2	Dishevelled, dsh homolog 2 (Drosophila)	0.98
WNT7B	Wingless-type MMTV integration site family, member	0.97

	7B	
BTRC	Beta-transducin repeat containing	0.94
DKK1	Dickkopf homolog 1 (Xenopuslaevis)	0.94
FBXW2	F-box and WD repeat domain containing 2	0.94
CCND1	Cyclin D1	0.93
SLC9A3R1	Solute carrier family 9 (sodium/hydrogen exchanger), member 3 regulator 1	0.93
FZD6	Frizzled family receptor 6	0.93
SENP2	SUMO1/sentrin/SMT3 specific peptidase 2	0.93
WNT11	Wingless-type MMTV integration site family, member 11	0.92
PPP2CA	Protein phosphatase 2, catalytic subunit, alpha isozyme	0.91
LRP5	Low density lipoprotein receptor-related protein 5	0.90
CTNNB1	Catenin (cadherin-associated protein), beta 1, 88kDa	0.88
NKD1	Naked cuticle homolog 1 (Drosophila)	0.88
PPP2R1A	Protein phosphatase 2, regulatory subunit A, alpha	0.86
WNT3A	Wingless-type MMTV integration site family, member 3A	0.86
FBXW4	F-box and WD repeat domain containing 4	0.86
FZD7	Frizzled family receptor 7	0.85
LRP6	Low density lipoprotein receptor-related protein 6	0.85
WNT2	Wingless-type MMTV integration site family member 2	0.84
WNT5B	Wingless-type MMTV integration site family, member 5B	0.83
RPL13A	Ribosomal protein L13a	0.83
WNT10A	Wingless-type MMTV integration site family, member 10A	0.83
SFRP4	Secreted frizzled-related protein 4	0.82
FZD2	Frizzled family receptor 2	0.81
AES	Amino-terminal enhancer of split	0.80
PITX2	Paired-like homeodomain 2	0.80
CTBP2	C-terminal binding protein 2	0.79
CSNK1G1	Casein kinase 1, gamma 1	0.79
WNT16	Wingless-type MMTV integration site family, member 16	0.77
FZD3	Frizzled family receptor 3	0.77
DAAM1	Dishevelled associated activator of morphogenesis 1	0.77
BCL9	B-cell CLL/lymphoma 9	0.76
SOX17	SRY (sex determining region Y)-box 17	0.75
HPRT1	Hypoxanthine phosphoribosyltransferase 1	0.75
EP300	E1A binding protein p300	0.75
SFRP1	Secreted frizzled-related protein 1	0.75
KREMEN1	Kringle containing transmembrane protein 1	0.74

WNT8A	Wingless-type MMTV integration site family, member 8A	0.71
APC	Adenomatous polyposis coli	0.70
WNT6	Wingless-type MMTV integration site family, member 6	0.69
TCF7L1	Transcription factor 7-like 1 (T-cell specific, HMG-box)	0.67
CXXC4	CXXC finger protein 4	0.67
CTNNBIP1	Catenin, beta interacting protein 1	0.66
WISP1	WNT1 inducible signaling pathway protein 1	0.65
FZD1	Frizzled family receptor 1	0.65
DIXDC1	DIX domain containing 1	0.64
FZD5	Frizzled family receptor 5	0.64
RHOU	Ras homolog gene family, member U	0.64
FRAT1	Frequently rearranged in advanced T-cell lymphomas	0.59
TLE2	Transducin-like enhancer of split 2 (E(sp1) homolog, Drosophila)	0.50
FOXN1	Forkhead box N1	0.49
WNT4	Wingless-type MMTV integration site family, member 4	0.49
FSHB	Follicle stimulating hormone, beta polypeptide	0.45
FGF4	Fibroblast growth factor 4	0.42
WNT5A	Wingless-type MMTV integration site family, member 5A	0.18
CCND2	Cyclin D2	0.06

Supplementary Table 4. Description of primers selected for validation by Real-Time RT-PCR

Gene symbol	Sequence Forward (5' > 3')	Sequence Reverse (5' > 3')
ACTB	AGCCTCGCCTTTGCCGA	CTGGTGCCTGGGGCG
MMP1	TGTCAGGGGAGATCATCGGG	GGCCGAGTTCATGAGCTGCAAC
MTSS1	ATTGGGCCCGGCATGTTCCC	TCGCTTCTCTTTGCGGCGCT
TLE2	CTGCTTGGCGCGTTCTAC	CATAAGCAGGCGGAGATTGT
CDH2	CCATCAAGCCTGTGGGAATC	GCAGATCGGACCGGATACTG
NDRG1	GTGGTTGGGGACAGCTCGC	CAGCAGCACCCGAGTTGGGG
SNAI1	TGCGCTACTGCTCGGCGAAT	AGGGCTGCTGGAAGGTAAACT
TWIST1	CACGAGCGGCTCAGCTACGC	ACAATGACATCTAGGTCTCCGG
ZEB1	AGTGGTCATGATGAAAATGGAA	AGGTGTAACTGCACAGGGAGC
FOXC2	GCCTAAGGACCTGGTGAAGC	TTGACGAAGCACTCGTTGAG
ACTB	AGCCTCGCCTTTGCCGA	CTGGTGCCTGGGGCG
MMP1	TGTCAGGGGAGATCATCGGGAC	GGCCGAGTTCATGAGCTGCAA
MTSS1	ATTGGGCCCGGCATGTTCCC	TCGCTTCTCTTTGCGGCGCT