

Protein family review
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Supplementary Tables

The RBR protein family

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Abbreviations: see list attached

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List of abbreviations and synonyms:

4EHP	eukaryotic translation initiation factor 4E homologous protein, EIF4E2; IF4e; 4E-LP; EIF4EL3
AA	amino acid(s)
ARM/HEAT	Armadillo/HEAT repeat
ARA54	androgen receptor-associated protein 54
AtARI	Arabidopsis thaliana ARIADNE
AR-JP	autosomal recessive juvenile parkinsonism
BAG5	bcl-2-associated athanogene 5
BG4	homolog of human FADD, Fas associated protein with a novel death domain
BLAST	Basic Local Alignment Search Tool
brk	brinker
CaR	Calcium-sensing receptor
CDCrel-1/SEPT5	cell division control-related protein 1; synaptic vesicle-enriched septin GTPase, Septin-5; PNUTL1 (peanut-like protein 1); H5; PNUTL1 (peanut-like protein 1); H5
CBP	CREB-binding protein
CHIP	C-terminus of the Hsc-70-interacting protein
CHN-1	C-terminus of Hsp70-interacting protein, CHIP family
clawless/HOX11	homeobox gene
C-RING	C-terminal ring, RING2
cycK	cyclin K
dlg1	discs large 1
CKII alpha-i3	CKII- subunit interactor-3
CK1	casein kinase-1
Cys	cysteine
DAT	dopamine transporter
Dpp	decapentaplegic
DEXDc	DExH/D-box proteins, DEAD/DEAH box helicase
dsx	doublesex
dup	double parked protein
dx	deltex
Dorfin	Double ring-finger protein
DRIL	double ring finger linked
E2	ubiquitin-conjugating enzymes
E3	E3 ubiquitin ligase
E4	additional ubiquitination factor
EGFR	epidermal growth factor receptor
Eip71CD	Ecdysone-induced protein 28/29 kD; Peptide methionine sulfoxide reductase (PMSR)
EPS15	epidermal growth factor receptor pathway substrate 15
ER	endoplasmatic reticulum
ERAD	endoplasmatic reticulum-associated protein degradation
FLRF/Nrdp1	fetal liver ring finger/neuregulin receptor degradation protein-1
FBP-1	far up stream element binding protein 1; FUSE-binding protein 1

F-box	motif found in cyclin-F that interacts with the protein SKP1
GFP	green-fluorescence protein
Glup/PACRG	gene located upstream of parkin, parkin co-regulated gene
HΦ	hydrophobic region
HDAC4	histone deacetylase4
Hdj-2	human 40 kD heat shock protein (Hsp40), DNAJ-like 2
HDH V	DNA helicase V
HELICc	Helicase_C terminal
HHARI	Ariadne-1 homolog, ARI-1; UbcH7-binding protein; UbcM4-interacting protein; H7- AP2
HIV1	human immunodeficiency virus type 1
HLH4C	helix-loop-helix 4C transcription factor
HLH4C	Helix loop helix protein 4C
HOIL-1	heme-oxidized IRP2 ubiquitin ligase
HRS	Hepatocyte growth factor regulated tyrosine kinase substrate
hSel-10	hcdc4, Archipelago, Fbw7
Hsp70	heat-shock protein 70
IBRDC1	IBR domain-containing protein 1
IRP2	iron-responsive element-binding protein; iron regulatory protein 2
IBR	in-between rings
IRP2	Iron regulatory protein 2
KH	K homology domain
krz	kurtz, arrestin
LB	Lewy Body
LRRK2	leucine-rich repeat kinase 2, dardarin, Parkinson disease 8
Lys	Lysin
MuSK	muscle-specific receptor tyrosine kinase, Mlk muscle localized kinase, Mdk4; Nsk1 (neuronal specific kinase), Nsk2; Nsk3
NF- κB	nuclear factor κB
Nmt	N-myristoyl transferase
NO	nitric-oxid
N-RING	N-terminal ring, RING1
Ogt	O-glycosyltransferase, Yp3 (Yolk protein 3, Vitellogenin III),
p21 ^{WAF1}	wild-type p53-activated fragment 1); CIP (CDK-interaction protein 1); cyclin-dependent kinase inhibitor 1; melanoma differentiation associated protein 6, DNA synthesis inhibitor
p38/JTV-1	subunit of the aminoacyl tRNA synthase
p53RFP	p53-inducible RING-finger protein
Pael-R	Parkin-associated endothelin receptor-like receptor
PAS	domain named after Per- period, Arnt- Ah receptor, Sim- single-minded protein
Parc	p53 associated, parkin-like cytoplasmic protein
PDB	protein structure databank (http://www.rcsb.org)
Pk17E	Protein kinase-like 17E
PRT-2	proteasomal subunit
RBCK1, -2	RBCC protein interacting with PKC 1
PKCβI	protein kinase C β-interacting protein
UBC	ubiquitin-conjugating enzymes

PAUL	putative <u>A</u> riadne-like E3 ubiquitin <u>l</u> igase
PSI-BLAST	Position specific iterative BLAST
PML	promyelocytic leukemia protein
RanBP2	ran-binding protein 2; NUP358 (358 kDa nucleoporin)
RBR	ring between rings
RIP	receptor-interacting protein
RNF144	RING finger protein 144
Rpn10	26S proteasome regulatory subunit
RpS3	Ribosomal protein S3
RRM	RNA recognition motif
RWD	eukaryotic domain found in RING finger and WD repeat containing proteins and DEXDc-like helicases subfamily related to the ubiquitin-conjugating enzymes domain
SCF-complex	Skp1-Cullin-F-box like complex
Septin5_v2/SEPT4	Septin 4; PNUTL2 (peanut-like 2); CDCrel-2 (cell division control-related protein 2); cerebral protein 7; bradeion
SKP1	S phase kinase-associated protein
SIM2	single-minded 2
SOCS6	suppressor of cytokine signaling
SOD1	superoxide dismutase-1
sol	small optic lobes
SUMO	small ubiquitin-related modifier
Traf3	Tnf Receptor Associated Factor 3
TRIAD3	two RING fingers and DRIL
TLR4,-9	Toll-like receptors
TM	transmembrane
UBA	Ubiquitin-associated
UbcM4/ UbcH7	ubiquitin activating enzyme
Ubl	ubiquitin-like domain
UBQ	ubiquitin
UIM	Ubiquitin interacting motif
VCP	Valosin-containing protein, p97, Cdc48 homologue
Vif	virion infectivity factor of human immuno-deficiency virus type 1
WD	WD-40 repeats, beta-transducin repeats
XAP3	hepatitis B virus X associated protein
ZIN	zink finger protein inhibiting NF-κB protein

Supplementary Table 1 Occurrence of RBR proteins in the non-redundant protein database for each subfamily and taxonomic class

The numbers of RBR domain-containing proteins depend on the uncertainty of complete genomes with regard to sequencing and genome fusion errors as well as the accuracy of gene discovery. The number of genes is indicated in brackets. Abbreviations for the species are Aa *Aedes aegypti*, Af *Aspergillus fumigatus*, Ag *Anopheles gambiae*, Ago *Ashbya gossypii*, Am *Apis mellifera*, An *Aspergillus nidulans*, At *Arabidopsis thaliana*, Atv *Ambystoma tigrinum virus*, Br *Brassica rapa*, Bt *Bos taurus*, Ca *Candida albicans*, Cb *Caenorhabditis briggsae*, Ce *Caenorhabditis elegans*, Cf *Canis familiaris*, Cg *Candida glabrata*, Cn *Cryptococcus neomans*, Dd *Dictyostelium discoideum*, Dh *Debaryomyces hansenii*, Dm *Drosophila melanogaster*, Dp *Drosophila pseudoobscura*, Dr *Danio rerio*, Eh *Entamoeba histolytica*, Fv *Frog virus 3*, Gg *Gallus gallus*, Gi *Grouper iridovirus*, Gz *Gibberella zeae*, Hs *Homo sapiens*, Kl *Kluyveromyces lactis*, Ld *Lymphocystis disease virus*, Lm *Leishmania major*, Ma *Musa acuminata*, Mf *Macaca fascicularis*, Mg *Magnaporthe grisea*, Mm *Mus musculus*, Ms *Melanoplus sanguinipes entomopoxvirus*, Nc *Neurospora crassa*, Np *Nicotiana plumbaginifolia*, Os *Oryza sativa*, Pc *Plasmodium chabaudi*, Pd *Pleurotus djamor*, Pf *Plasmodium falciparum*, Ppy *Pongo pygmaeus*, Pb *Plasmodium berghei*, Pt *Pan troglodytes*, Pte *Paramecium tetraurelia*, Pv *Plasmodium vivax*, Py *Plasmodium yoelii*, Rn *Rattus norvegicus*, Sc *Saccharomyces cerevisiae*, Sd *Solanum demissum*, Sj *Schistosoma japonicum*, Spu *Strongylocentrotus purpuratus*, Sp *Schizosaccharomyces pombe*, Ss *Sus scrofa*, Tb *Trypanosoma brucei*, Tc *Trypanosoma cruzi*, Tn *Tetraodon nigroviridis*, Tr *Takifugu rubripes*, Tf *Tiger frog virus*, Um *Ustilago maydis*, Xl *Xenopus laevis*, Xt *Xenopus tropicalis*, Yl *Yarrowia lipolytica*. The abbreviations of human and the model organisms are in bold.

The collection of the full family of RBR proteins is not a trivial task. There is considerable sequence diversity even among subgroups of RBR proteins that can be defined by thresholds of sequence similarity in the RBR region and common protein sequence architecture. Sometimes, the sequence similarity is far below 50%. For collecting a subfamily, it is necessary to find a seed sequence segment group with BLAST [1] followed by iterative repetition of subfamily alignment construction and family enrichment with hidden Markov model (HMM) searches in the non-

redundant protein sequence database [2]. A RBR-family subgroup can be delimited from nearest non-subfamily members by a gap in E-value significances in the HMM search output. The traditional procedure of family collection with PSI-BLAST [1] is not applicable since the outputs become polluted by masses of ordinary RING finger (but non-RBR-domain) proteins.

Family	Viruses	Protists	Fungi	Plants	Echino- derms	Insects	Nematodes	Chordata					
								Fishes	Amphibans	Birds	Mammals		
Ariadne (A)		Dd (4) Eh (9) Lm (1) Pf (1) Pv (1) Py (1) Pc (1) Pb (1) Tb (1) Tc (2)	Ag (1) Af (1) An (1) Ca (1) Cg (1) Cn (1) Dh (1) Gz (1) Kl (1) Mg (1) Nc (1) Sc (1) Sp (1) Um (1) Yl (1)	At (15) Ma (1) Np (1) Os (9)	Sp (4)	Ag (2) Am (2) Dm (3) Dp (2)	Cb (6) Ce (5)	Dr (6) Tn (5)	Xl (2) Xt (1)	Gg (4)	Bt (5) Cf (4) Hs (4) Mf (1) Mm (5) Pt (4) Rn (4)		
	ARA54 (B)		Dd (1)	Af (1) An (1) Ca (1) Cg (1) Cn (1) Dh (1) Gz (1) Mg (1) Nc (1) Sp (1) Sc (1) Um (1) Yl (1)	At (1) Os (5)	Sp (1)	Am (1)	Cb (1) Ce (2)	Dr (4) Tn (2)	Xl (2) Xt (1)		Bt (1) Cf (1) Hs (1) Mf (1) Mm (1) Pt (1) Pp (1) Rn (1)	
		RNF 144 (C)						Ag (1) Am (1) Dm (1)		Dr (3) Tn (2)		Gg (2)	Bt (2) Cf (2) Hs (2) Mm (2) Pt (2) Rn (2)

Family	Viruses	Protists	Fungi	Plants	Echino- derms	Insects	Nematodes	Chordata			
								Fishes	Amphibans	Birds	Mammals
Parkin (P)					Sp (1)	Ag (1) Am (1) Dm (1) Dp (1)	Cb (1) Ce (1)	Dr (1) Tr (1) Tn (1)		Gg (1)	Cf (1) Hs (1) Mm (1) Pt (1) Pp (1) Rn (1)
Dorfin (D)		Dd (3)			Sp (1) Sj (1)	Aa (1) Ag (1) Am (1)	Cb (2) Ce (2)	Dr (3) Tn (3)	Xl (1)	Gg (2)	Bt (2) Cf (2) Hs (2) Mf (1) Mm (3) Pt (1) Rn (2) Ss (1)
XAP (X)					Sp (1)	Ag (1) Am (1)		Dr (2) Tn (2)			Bt (1) Cf (1) Hs (1) Mm (1) Pt (1) Rn (1)
PAUL (U)					Sp (1)	Ag (1) Am (1) Dm (1) Dp (1)		Dr (2) Tn (2)			Bt (1) Cf (1) Hs (1) Mm (1) Pt (1) Rn (1)
TRIAD3 (T)			Af (2) An (2) Cn (2) Gz (2) Mg (2)		Sp (1)			Dr (1)	Xt (1)	Gg (1)	Bt (1) Cf (1) Hs (1) Mm (1) Pt (1) Rn (1)
IBRDC1 (I)								Dr (1) Tn (1)	Xl (1)		Bt (1) Cf (1) Hs (1) Mm (1) Pt (1) Rn (1)
Plant I (H)				At (2) Br (1) Os (1)							

Family	Viruses	Protists	Fungi	Plants	Echino- derms	Insects	Nematodes	Chordata			
								Fishes	Amphibans	Birds	Mammals
Plant II (G)				At (21) Os (7) Sd (1)							
Fungi II (F)			Af (4) Gz (7) Mg (1) Nc (1) Pd (1)								
Fungi I (E)			Gz (1) Nc (1)								
Protozoa (Z)		Dd (5) Eh (2)									
Viruses (S)	Ld (2) Gi (1) Fv (1) Atv (1) Tf (1) Mse (1)										

Supplementary Table 2 Sequence pattern variability in the N-RING, IBR and C-RING of RBR domain segments among subfamilies

The general pattern C-loop-C-loop-C-loop-H/C-loop-C-loop-C-loop-C/H-loop-C (with C₆HC for the IBR and C₃HC₄ for the surrounding rings) is varied both with respect to the cysteine/histidine sites and the loop sizes. The cysteine/histidine pattern involves strictly conserved sites with either cysteine (blue) or histidine (red) but some positions are more variable (indicated with green markers; \$: either C or H are observed within the subfamily; &: [L,N,S]; @: [A,L]; #: [H,R]; %: [H,L]; ^: [H,Q,R,Y]; *: [H,K,M,R]; +: [F,H,Q,R,Y]; !: [D,N,S]; >: [K,R]; ?: [F,H,W,Y]). The loops are sometimes strictly conserved, and then the loop length is indicated with numbers. Otherwise, a two-letter code is used to show the observed ranges (xa: 09-15 AA; xb: 10-20 AA; xc: 15-30 AA; xd: some representatives with > 30 AA; xe: occurrence of a hydrophobic region with >20AA inside the IBR motif; xf: 09-30 AA; ya: 01-04 AA; yb: 02-04 AA; yc: 03-05 AA; yd: 04-06 AA; ye: 02-08 AA; yf: 03-16 AA).

Token	Protein Family	N-RING	IBR	C-RING
A0	Ariadne/Ank	C02C14C01H02C02C18C04C	C04CxdC03H02C02C04H04C	C02C09C01H02C02C04C02C
A1	Ariadne/Ari1	C02CxbC01H02C02CxbC04C	C04CxcC01C04C02CydH04C	C02C09C01H02CyaC04C02C
A2	Ariadne/Ari2	C02CxaC01H02C02CxbC04C	C04C15C02C04C02C04H04C	C02C09C01H02C02C04C02C
A3	Ariadne/PARC	C02C13C01H02C02CxbC04C	C05C14C02C04C02C05H04C	C02C09C01H02C02C04C02C
A4	Ariadne/fungi	C02CxaC01H02C02CxbCybc	C04CxcCybHybc02CydH04C	C02C09C01H02C02C04C02C
A5	Ariadne/plantA	C02CxaC01H02C02CxbC04C	C05CxcC01C04C02C04H04C	C02C09C01%02C01C04C02C
A6	Ariadne/plantB	C02C13C01H02C02C19C04C	C04CxcC01C04C02C04H04C	C02C09C01H02C03C04C02C
A7	Ariadne/plantC	C02CxcC01H02C02C20C04C	C04CxcC01C04C02C04H04C	C02Cxa@01F02C01C04C02C
A8	Ariadne/prot	C02CxaC01Hybc02CxbC04C	CydCxcCyaC04C02CyeH04C	C02C09C01?02CyeC04C02C
A9	Ariadne/worms	C02CxaC01H02C02CxbC04C	C04CxcC01C04C02C04H04C	C02C09C01^02Cybc04C02C
B	ARA54	C02CxaC01\$02C02C18Cybc	CybcxdC02C04C02C04Hydc	C02C09C01*02CyaC04C02C
C	RNF144	C02CxaC01C02C02C18C04C	C04CxdC02C04C02C04Hycc	C02C09C01Q02C02C04C02C
D	Dorfin	C02CxaC01H02C02CxaCybc	C04CxcCybc04C02C04Hycc	C02CxaC01#02C02C04C02C
E	Fungil	C02C11C01H02C02CxaCyfc	C04CxcC02C04C02C03Hydc	C02C09C01H02C02C04C02C
F	Fungi2	C02CxaC01\$02C02C18C00C	C04CxdC02C04C02C04Hycc	C02C09C01#02C02C04C02C
G	Plant2	C02CxaC01H02C02CxaC04C	C04CxcC02C04C02C04H04C	C02C09C01+02CyaC04C02C
H	Plant1	C02C12C01H02C02CxaC04C	C04CxcC02C04C02C04H04C	C02C09C01H02C01C04C02C
I	IBRDCL	C02C10C00C04C02CxaC04C	C02C25C02C04C02C04H04C	C02C09C01H02C02C04C02C
P	Parkin	C02C11CyaH02C02CxbCycc	C04CxbCyec04C02C04\$yac	C02CxdC01H02Cybc04C02C
S1	Viruses/Irido	C02CxaC03C04C02Cybc01C	C04CxaC02C04C02CyfH01C	C02C09C01!02C02C04&02T
S2	Viruses/Pox	C02C09C02C04C02C08C02C	C04C10C02C04C02C08H01C	C02C09C01D02C02C04C02T
T1	TRIAD3/animals	C02C11C03H02C02C18C04C	C02C14Cybc04C02C06H04C	C02C09C01>02C01C04C02C
T2	TRIAD3/fun1	C02C11C04H02C02C26Cyec	C02CxeC04C04C02C07H01C	C02C09C01K02C01C04C02C
T3	TRIAD3/fun2	C02C11CyccH02C02C17C05C	C02C16C04C04C02C04H04C	C02CxfC01K02Cybc04C02C
U	PAUL	CyaCxaC01\$02C02C18C02C	C02C14C02C04C02C07H04C	C02CxdC01H02C02C04C02C
X	XAP	C02C14C01H02C02C14Cyec	C04C14C02C04C02CyfH04C	C02C09C01W02C02C04C02T
Z1	Protozoal	C02CxaC01H02C02CxaC04C	C04CxdC01C04C02C04H04C	C02C09C01?02C02C04C02C
Z2	Protozoa2	C02CxaC01H02C02C20C04C	C04CxdCybcHybc02C05H04C	C02C09C01H02C02C04C02C

Supplementary Table 3 Ubiquitination substrates of RBR protein

A “*” designates ability for auto-ubiquitination.

Organism	Protein name Synonyms	Interactors Synonyms	Interaction domain on the RBR protein	Ref.
Ariadne (A)				
<i>H. sapiens</i>	HHARI; ARI-1 (<i>ariadne-1</i> homolog); UbcH7-binding protein; UbcM4-interacting protein	4EHP (<i>translation initiation factor 4E</i> homologous protein); EIF4E2; IF4e; 4E-LP; EIF4EL3	N-RING	[3]
<i>H. sapiens</i>	HHARI	SIM2 (<i>single-minded 2</i>)	n.d.	[4]
ARA54 (B)				
<i>H. sapiens</i>	ARA54 (<i>androgen receptor-associated protein 54</i>)	AR (<i>androgen receptor</i>)	n.d.	[5]
RNF144 (C)				
<i>H. sapiens</i>	p53RFP* (<i>p53-inducible RING finger protein</i>)	p21^{WAF1} (<i>wild-type p53-activated fragment 1</i>); CIP (<i>CDK-interaction protein 1</i>); cyclin-dependent kinase inhibitor 1; melanoma differentiation associated protein 6; DNA synthesis inhibitor	n.d.	[6]
Dorfin (D)				
<i>H. sapiens</i>	Dorfin (<i>Double ring-finger protein</i>)	CaR (<i>calcium-sensing receptor</i>)	C-terminus	[7]
<i>H. sapiens</i>	Dorfin	Synphilin-1	C-terminus	[8]
<i>H. sapiens</i>	Dorfin	SOD1 (<i>superoxide dismutase 1</i>)	C-terminus	[9]
Parkin (P)				
<i>H. sapiens</i>	Parkin	Pael-R (<i>Parkin-associated endothelin receptor-like receptor</i>)	RBR	[10]
<i>H. sapiens</i>	Parkin	SIM2 (<i>single-minded 2</i>)	IBR, C-RING AA 294–465	[4]
<i>H. sapiens</i>	Parkin	p38 (<i>subunit of the aminoacyl tRNA synthase</i>); JTV1	N-RING	[11,12]
<i>H. sapiens</i>	Parkin*	CDCrel-1 (<i>cell division control-related protein 1</i>); synaptic vesicle-enriched septin GTPase; SEPT5 (<i>septin-5</i>); PNUTL1 (<i>peanut-like protein 1</i>); H5	RBR	[13]
<i>H. sapiens</i>	Parkin	septin5_v2 ; SEPT4 (<i>septin 4</i>); PNUTL2 (<i>peanut-like 2</i>); CDCrel-2 (<i>cell division control-related protein 2</i>); cerebral protein 7; bradeion	N-RING	[14]
<i>H. sapiens</i>	Parkin	Synaptotagmin XI	N-RING	[15]
<i>R. norvegicus</i>	Parkin	Synphilin-1	C-RING	[16]

Organism	Protein name Synonyms	Interactors Synonyms	Interaction domain on the RBR protein	Ref.
<i>H. sapiens</i>	Parkin	DAT (<i>dopamine transporter</i>)	n.d.	[17]
<i>H. sapiens</i>	Parkin	Cyclin E	no direct interaction	[18]
<i>H. sapiens</i>	Parkin	Alpha/beta tubulin	n.d.	[19]
<i>H. sapiens</i>	Parkin	FBP-1 (<i>far up stream element binding protein-1</i>); <i>FUSE-binding protein 1</i> ; <i>DNA helicase V (HDH V)</i>	n.d.	[20]
<i>H. sapiens</i>	Parkin	LRRK2 (<i>leucine-rich repeat kinase 2</i> ; <i>dardarin</i> ; <i>Parkinson disease 8</i>)	C-RING	[21]
<i>H. sapiens</i>	Parkin	RanBP2 (<i>ran-binding protein 2</i> ; <i>NUP358 (358 kDa nucleoporin)</i>)	n.d.	[22]
<i>H. sapiens</i>	Parkin	EPS15 (<i>epidermal growth factor receptor pathway 15</i>)	Ubl and N-RING	[23]
TRIAD3 (T)				
<i>H. sapiens</i>	<i>ZIN (zink finger protein inhibiting NF-κB protein)</i>	RIP (<i>receptor-interacting protein</i>)	RBR	[24]
<i>H. sapiens</i>	ZIN	Vif HIV-1 (<i>virion infectivity factor of human immuno-deficiency virus type 1</i>)	n.d.	[25]
<i>H. sapiens</i>	TRIAD3* (<i>two RING fingers and DRIL</i>)	TLR4 (<i>toll-like receptor 4 precursor</i>); TLR9 (<i>toll-like receptor 9 precursor</i>)	n.d.	[26]
PAUL (U)				
<i>M. musculus</i>	PAUL (<i>Rnf31, ring finger protein 13</i>)	MuSK (<i>muscle-specific receptor tyrosine kinase</i>); Mlk (<i>muscle localized kinase</i>); Mdk4 ; Nsk1 (<i>neuronal specific kinase</i>); Nsk2 ; Nsk3	RBR is not required for interaction	[27]
XAP (X)				
<i>H. sapiens</i>	HOIL-1 (<i>heme-oxidized IRP2 ubiquitin ligase-1</i>), XAP3 (<i>hepatitis B virus X-associated protein</i>)	IRP2 (<i>iron-responsive element-binding protein; iron regulatory protein 2</i>)	Ubl N-RING is necessary for ubiquitination	[28]

Supplementary Table 4 Non-substrate interaction partners of RBR proteins

A “*” designates ability for auto-ubiquitination.

Organism	Protein name Synonyms	Interactors Synonyms	Interaction domain on the RBR protein	Ref.
Ariadne (A)				
<i>M. musculus</i>	UIP48 (<i>UbcM4-interacting protein 48</i>); ARI-2	UbcM4/UbcH7 (<i>ubiquitin activating enzyme</i>)	N-RING	[29]
<i>H. sapiens</i>	HHARI	UbcH7	N-RING, IBR AA 118–293	[30]
<i>H. sapiens</i>	TRIAD1*	UbcH7 , weaker with UBCH6, UBCH13	N-RING	[31]
<i>D. melanogaster</i>	ARI-1	UbcD10	N-RING	[32]
<i>D. melanogaster</i>	ARI-1a (CG5659)	CG7386, CG10263	n.d.	[33]
<i>D. melanogaster</i>	ARI-1b (CG12362)	UbcD10, sol (<i>small optic lobes</i>), krz (<i>kurtz, arrestin</i>), cycK (<i>cyclin K</i>), Pk17E (<i>Protein kinase-like 17E</i>), beta-tubulin 56D, CG17050, CG8004	n.d.	[33]
<i>D. melanogaster</i>	ARI-2 (CG5709)	Ubc84D, UbcD10, Ogt (<i>O-glycosyltransferase</i>), Yp3 (<i>Yolk protein 3, Vitellogenin III</i>), BG4 (<i>homolog of human FADD, Fas associated protein with a novel death domain</i>), HLH4C (<i>Helix loop helix protein 4C</i>), CKII alpha-i3 (<i>CKII- subunit interactor-3</i>), Traf3 (<i>Tnf Receptor Associated Factor 3</i>), RpS3 (<i>Ribosomal protein S3</i>), dx (<i>deltex</i>), Eip71CD (<i>Ecdysone-induced protein 28/29 kD; Peptide methionine sulfoxide reductase, PMSR</i>), Nmt (<i>N-myristoyl transferase</i>), clawless/HOX11, dup (<i>double parked</i>), karyopherin 3 (<i>importin alpha3</i>), CG7262, CG1216, CG10263, CG13097, CG15529, CG15631, CG17666, CG18619, CG30403, CG2865, CG3338, CG3792, CG4286, CG5355, CG5522, CG6770	n.d.	[33]
<i>A. thaliana</i>	ARI8	AtUBC8, AtUBC10, AtUBC11	n.d.	[34,35]
<i>M. musculus</i>	Parc (<i>p53 associated, parkin-like cytoplasmic protein</i>)	CUL7 (<i>cullin7</i>)	N-terminus	[36,37]
<i>H. sapiens</i>	Parc*	p53	AA 1–1960 including the C-terminal Cullin homology domain (CCH)	[37,38]

Organism	Protein name Synonyms	Interactors Synonyms	Interaction domain on the RBR protein	Ref.
ARA54 (B)				
<i>H. sapiens</i>	ARA54*	UBE2E2, UbcH6, UBE2E3 (ubiquitin activating enzymes)	RBR AA 220-361	[39]
RNF144 (C)				
<i>H. sapiens</i>	p53RFP	UbcH7/UbcH8 (ubiquitin activating enzymes)	RBR	[40]
<i>H. sapiens</i>	hUIP4 (<i>UbcM4-interacting protein 4</i>); Kiaa0161; Ubc7ip4	UbcM4/ UbcH7	N-RING	[29]
<i>D. melanogaster</i>	CG33144	Prm (<i>Paramyosin</i>), CG10989, CG11200, CG12001, CG12227, CG14053, CG14232, CG18259, CG9424	n.d.	[33]
Dorfin (D)				
<i>H. sapiens</i>	Dorfin*	UbcH7, UbcH8	RBR	[41]
<i>H. sapiens</i>	Dorfin	VCP (<i>Valosin-containing protein</i>), p97, Cdc48 homologue	RBR	[42]
Parkin (P)				
<i>H. sapiens</i>	Parkin	Proteasome subunit alpha-4	IBR, C-RING	[43]
<i>H. sapiens</i>	Parkin	UbcH8, UBC6, UBC7	C-RING	[13,44]
<i>H. sapiens</i>	Parkin	HDJ-1 (<i>human Hsp40</i>); <i>PARK7</i>	whole protein	[45]
<i>H. sapiens</i>	Parkin	hSel-10 (<i>hcdc4, Archipelago, Fbw7</i>)	N-RING, RBR	[18]
<i>H. sapiens</i>	Parkin	CHIP (<i>C-terminus of the Hsp70-interacting protein</i>)	N-RING	[46]
<i>H. sapiens</i>	Parkin	Hsp70 (<i>heat-shock protein 70</i>)	N-RING	[46,47]
<i>H. sapiens</i>	Parkin	BAG5 (<i>interactor bcl-2-associated athanogene 5</i>)	Linker, IBR, R2	[48]
<i>H. sapiens</i>	Parkin	Rpn10 (<i>26S proteasome regulatory subunit</i>)	Ubl, Arg 41	[49]
<i>H. sapiens</i>	Parkin	O-glycosylated alpha-synuclein	Ubl	[16,50,51]
<i>H. sapiens</i>	Parkin	14-3-3-η	AA 76-239 Linker region	[52]
<i>H. sapiens</i> <i>D.melanogaster</i>	Parkin	FLRF/Nrdp1 (<i>fetal liver ring /finger neuregulin receptor degradation protein-1</i>)	N-terminus AA 1-98	[53]
<i>H. sapiens</i>	Parkin	Microtubules	N-RING, IBR, C-RING	[54]
<i>H. sapiens</i>	Parkin	Glup/PACRG (<i>gene located upstream of parkin, parkin co-regulated gene</i>)	n.d.	[55]
<i>H. sapiens</i>	Parkin	HRS (<i>Hepatocyte growth factor regulated tyrosine kinase substrate</i>)	Ubl	[23]
<i>H. sapiens</i>	Parkin	SUMO-1 (<i>small ubiquitin-related modifier</i>)	Ubl	[56]
<i>C. elegans</i>	PDR-1* (<i>Parkinson's disease related gene-1</i>)	UBC-2, UBC-18, UBC-15	IBR, C-RING	[57]

Organism	Protein name Synonyms	Interactors Synonyms	Interaction domain on the RBR protein	Ref.
<i>C. elegans</i>	PDR-1	CHN-1 (<i>C-terminus of Hsp70-interacting protein</i>); (<i>CHIP family</i>)	IBR, C-RING	[57]
<i>C. elegans</i>	PDR-1	PRT-2 (<i>proteasomal subunit</i>)	Ubl	[57]
<i>D. melanogaster</i>	Parkin (CG10523)	Ogt (<i>O-glycosyltransferase</i>), dsx (<i>doublesex</i>), dlg1 (<i>discs large 1</i>), brk (<i>brinker</i>), CG10263, CG11094, CG12860, CG13159, CG5134	n.d.	[33]
TRIAD3 (T)				
<i>H. sapiens</i>	TRIAD3* (<i>two RING fingers and DRIL</i>)	UbcH7, UBCH8	n.d.	[26]
PAUL (U)				
<i>D. melanogaster</i>	PAUL (CG11321)	CG9902	n.d.	[33]
XAP (X)				
<i>H. sapiens</i>	XAP3	hepatitis B virus X protein	N-terminus (AA 13-74)	[58,59]
<i>M. musculus</i>	mUIP28 (<i>UbcM4 interacting protein 28</i>)	UbcM4 (<i>ubiquitin activating enzyme</i>)	N-RING	[29]
<i>R. norvegicus</i>	RBCK1 (<i>RBCC protein interacting with PKC 1</i>)	CBP (<i>CREB-binding protein</i>)	n.d.	[60]
<i>R. norvegicus</i>	RBCK1	PML (<i>promyelocytic leukemia protein</i>)	n.d.	[60]
<i>H. sapiens</i>	HOIL-1	SOCS6 (<i>suppressor of cytokine signaling</i>)	Ubl	[61]

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