

**Table S2.** Function of genes that significantly interacted with *MCL1* gene during gene-gene interaction network as predicted by GeneMANIA and gene functional activity from GeneCards.

| Gene           | Score   | Description                                                       | Function                                                                                                                                                              |
|----------------|---------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>MCL1</i>    | 0.8960  | MCL1 apoptosis regulator, BCL2 family member                      | Anti-apoptotic BCL-2 family protein that inhibits apoptosis by binding and neutralizing BAK and BAX, preventing mitochondrial outer membrane permeabilization (MOMP). |
| <i>BAK1</i>    | 0.0054  | BCL2 antagonist/killer 1                                          | Pro-apoptotic effector that oligomerizes in the mitochondrial outer membrane to form pores that release cytochrome-c and activate the caspase cascade.                |
| <i>BCL2L11</i> | 0.0043  | BCL2 like 11                                                      | BH3-only protein that initiates apoptosis by activating BAX/BAK and antagonizing anti-apoptotic BCL-2 proteins.                                                       |
| <i>PMAIP1</i>  | 0.0022  | Phorbol-12-myristate-13-acetate-induced protein 1                 | Stress-induced BH3-only protein that selectively antagonizes MCL-1, promoting apoptosis.                                                                              |
| <i>BAX</i>     | 0.0013  | BCL2 associated X, apoptosis regulator                            | Pro-apoptotic protein that oligomerizes with BAK in mitochondria to induce membrane permeabilization and apoptosis.                                                   |
| <i>HRK</i>     | 0.00129 | Harakiri, BCL2 interacting protein                                | BH3-only protein that promotes apoptosis by binding and inhibiting anti-apoptotic BCL-2 proteins.                                                                     |
| <i>BOK</i>     | 0.00128 | BCL2 family apoptosis regulator BOK                               | Pro-apoptotic BCL-2 family member that promotes mitochondrial apoptosis and regulates ER-mitochondria Ca <sup>2+</sup> signaling.                                     |
| <i>TPT1</i>    | 0.00127 | Tumor protein, translationally controlled 1                       | Multifunctional protein involved in cell growth and survival; suppresses apoptosis and contributes to tumor progression.                                              |
| <i>BID</i>     | 0.00122 | BH3 interacting domain death agonist                              | BH3-only protein cleaved into tBID, which activates BAX/BAK to initiate mitochondrial apoptosis.                                                                      |
| <i>HUWE1</i>   | 0.00113 | HECT, UBA and WWE domain containing E3 ubiquitin protein ligase 1 | E3 ubiquitin ligase that regulates apoptosis by ubiquitinating MCL-1, controlling its degradation.                                                                    |
| <i>BIK</i>     | 0.00106 | BCL2 interacting killer                                           | Pro-apoptotic BH3-only protein that promotes apoptosis by neutralizing anti-apoptotic BCL-2 proteins.                                                                 |
| <i>DAD1</i>    | 0.00105 | Defender against cell death 1                                     | Anti-apoptotic protein required for N-linked glycosylation and cell survival.                                                                                         |

|                 |         |                                                     |                                                                                                                                                |
|-----------------|---------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>BMF</i>      | 0.00102 | BCL2 modifying factor                               | BH3-only protein that triggers apoptosis by binding BCL-2 and BCL-XL during cellular stress.                                                   |
| <i>HSP90AA1</i> | 0.00087 | Heat shock protein 90 alpha family class A member 1 | Molecular chaperone that stabilizes client proteins involved in cell survival and cancer signaling pathways.                                   |
| <i>IER3</i>     | 0.00079 | Immediate early response 3                          | Immediate early response gene that regulates apoptosis and stress-induced signaling pathways.                                                  |
| <i>ELK1</i>     | 0.00078 | ETS transcription factor<br>ELK1                    | ETS transcription factor regulating genes involved in cell proliferation, differentiation, and apoptosis.                                      |
| <i>BCL2L1</i>   | 0.00076 | BCL2 like 1                                         | Anti-apoptotic protein that prevents BAX/BAK activation and inhibits mitochondrial apoptosis.                                                  |
| <i>TRIM17</i>   | 0.00065 | Tripartite motif containing<br>17                   | E3 ubiquitin ligase that regulates apoptosis by promoting ubiquitination and proteasomal degradation of anti-apoptotic proteins such as MCL-1. |
| <i>BCL2</i>     | 0.00062 | BCL2 apoptosis regulator                            | Major anti-apoptotic protein that blocks mitochondrial cytochrome-c release and caspase activation.                                            |
| <i>BCL2A1</i>   | 0.00061 | BCL2 related protein A1                             | Anti-apoptotic BCL-2 family protein that inhibits apoptosis and supports cell survival in immune cells.                                        |
| <i>DOT1L</i>    | 0.00057 | DOT1 like histone lysine<br>methyltransferase       | Histone methyltransferase responsible for H3K79 methylation, regulating gene transcription and leukemia development.                           |

