**Supplementary Table 4. Description of the 212 original studies of non-coding RNAs in sarcoma.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| NO. | First author [Ref] | Year | Journal | Expression | Effect on treatment resistance | Treatment strategies |
| 1 | Xie, [1] | 2020 | Cellular and Molecular Biology | up | enhance | chemotherapy |
| 2 | Li,[2] | 2019 | Pathology Research and Practice | up | enhance | chemotherapy |
| 3 | Lee,[3] | 2021 | International Journal of Molecular Sciences | up | enhance | chemotherapy |
| 4 | Wang,[4] | 2016 | Cancer Letters | down | reduce | chemotherapy |
| 5 | Zhang,[5] | 2021 | European Review for Medical and Pharmacological Sciences | up | enhance | chemotherapy |
| 6 | Li,[6] | 2021 | Frontiers in Pharmacology | up | enhance | chemotherapy |
| 7 | Cheng,[7] | 2019 | OncoTargets and Therapy | up | enhance | chemotherapy |
| 8 | Zhang,[8] | 2017 | Neoplasia | down | reduce | chemotherapy |
| 9 | Sun,[9] | 2022 | American Journal of Cancer Research | up | enhance | chemotherapy |
| 10 | Wang,[10] | 2021 | Frontiers in Oncology | down | reduce | chemotherapy |
| 11 | Song,[11] | 2019 | Journal of Cellular Biochemistry | up | enhance | chemotherapy |
| 12 | Han,[12] | 2018 | Biochemical and Biophysical Research Communications | up | enhance | chemotherapy |
| 13 | Zhou,[13] | 2019 | Journal of Drug Targeting | up | enhance | chemotherapy |
| 14 | Hu,[14] | 2019 | Toxicology and Applied Pharmacology | up | enhance | chemotherapy |
| 15 | Sun,[15] | 2019 | Pathology-Research and Practice | up | enhance | chemotherapy |
| 16 | Liu,[16] | 2021 | Cancer Management and Research | up | enhance | chemotherapy |
| 17 | Pu,[17] | 2021 | Cell Death and Disease | down | reduce | chemotherapy |
| 18 | Shen,[18] | 2020 | Cell Death & Disease | up | enhance | chemotherapy |
| 19 | Wang,[19] | 2020 | Biology Direct | up | enhance | chemotherapy |
| 20 | Zhu,[20] | 2019 | Molecular Therapy | up (lnc MEG3) | enhance | chemotherapy |
| down (has\_circ\_0001258) | reduce |
| 21 | Fu,[21] | 2019 | Aging (Albany NY) | up | enhance | chemotherapy |
| 22 | Zhang,[22] | 2020 | Medical Science Monitor | up | enhance | chemotherapy |
| 23 | Liu,[23] | 2020 | OncoTargets and Therapy | up | enhance | chemotherapy |
| 24 | Gu,[24] | 2020 | Biomedicine&Pharmacotherapy | up | enhance | chemotherapy |
| 25 | Sun,[25] | 2020 | Biomedicine&Pharmacotherapy | up | enhance | chemotherapy |
| 26 | Meng,[26] | 2020 | Biochemical and Biophysical Research Communications | up | enhance | chemotherapy |
| 27 | Liang,[27] | 2018 | Cancer Medicine | up | enhance | chemotherapy |
| 28 | Shi,[28] | 2020 | IUBMB Life | down | reduce | chemotherapy |
| 29 | Zhu,[29] | 2020 | Aging (Albany NY) | up | enhance | chemotherapy |
| 30 | Wen,[30] | 2020 | Cancer Biomarkers | down | reduce | chemotherapy |
| 31 | Wang,[31] | 2017 | Oncotarget | down | reduce | chemotherapy |
| 32 | Guo,[32] | 2020 | Cell Transplantation | up | enhance | chemotherapy |
| 33 | Zhou,[33] | 2018 | Biomedicine&Pharmacotherapy | up | enhance | chemotherapy |
| 34 | Zhang,[34] | 2016 | Tumor Biology | up | enhance | chemotherapy |
| 35 | Cheng,[35] | 2019 | European Review for Medical and Pharmacological Sciences | up | enhance | chemotherapy |
| 36 | Zhang,[36] | 2017 | Cancer Letters | up | enhance | chemotherapy |
| 37 | Zhu,[37] | 2019 | Journal of Cellular Physiology | up | enhance | chemotherapy |
| 38 | Li,[38] | 2018 | Cell Proliferation | up | enhance | chemotherapy |
| 39 | Hu,[39] | 2018 | Bioscience Reports | up | enhance | chemotherapy |
| 40 | Li,[40] | 2016 | American Journal of Translational Research | up | enhance | chemotherapy |
| 41 | Chen,[41] | 2018 | Oncotarget | down | reduce | chemotherapy |
| 42 | Zhu,[42] | 2017 | Oncotarget | down | reduce | chemotherapy |
| 43 | Zhang,[43] | 2020 | Open Life Sciences | up | enhance | chemotherapy |
| 44 | Tang,[44] | 2022 | Bioengineered | up | enhance | chemotherapy |
| 45 | Liu,[45] | 2020 | Journal of BUON | down | reduce | chemotherapy |
| 46 | Patil,[46] | 2019 | Scientific Reports | down | reduce | chemotherapy |
| 47 | Wang,[47] | 2020 | Life Sciences | down | reduce | chemotherapy |
| 48 | Lou,[48] | 2019 | European Review for Medical and Pharmacological Sciences | down | reduce | chemotherapy |
| 49 | Li,[49] | 2020 | ACS Biomaterials Science & Engineering | down | reduce | chemotherapy |
| 50 | Vanas,[50] | 2016 | PLoS One | up | reduce | chemotherapy |
| 51 | Ziyan,[51] | 2014 | Medical Science | up | enhance | chemotherapy |
| 52 | Bazavar,[52] | 2020 | Pathology-Research and Practice | down | reduce | chemotherapy |
| 53 | Xu,[53] | 2016 | Oncology Reports | down | reduce | chemotherapy |
| 54 | Wang,[54] | 2019 | Orthopaedic Surgery | down | reduce | chemotherapy |
| 55 | Li,[55] | 2014 | Tumour Biology | down | reduce | chemotherapy |
| 56 | Zhu,[56] | 2020 | DNA and Cell Biology | - | reduce | chemotherapy |
| 57 | Zhang,[57] | 2015 | Molecules and Cells | down | reduce | chemotherapy |
| 58 | Song,[58] | 2017 | Brazilian Journal of Medical and Biological Research | down | reduce | chemotherapy |
| 59 | Song,[59] | 2017 | Cellular and Molecular Biology | up | enhance | chemotherapy |
| 60 | FIORE,[60] | 2016 | Journal of Cellular Physiology | down | enhance | chemotherapy |
| 61 | Zhang,[61] | 2015 | Biochemical and Biophysical Research Communications | up | enhance | chemotherapy |
| 62 | Meng,[62] | 2020 | Molecular Medicine Reports | down | reduce | chemotherapy |
| 63 | Meng,[63] | 2020 | Oncology Repport | down | reduce | chemotherapy |
| 64 | Yuan,[64] | 2018 | Future Oncology | down | reduce | chemotherapy |
| 65 | Lin,[65] | 2016 | Medical Science Monitor | up | enhance | chemotherapy |
| 66 | Lei,[66] | 2018 | BMC Cancer | up | enhance | chemotherapy |
| 67 | Pu,[67] | 2016 | Oncotarget | up | enhance | chemotherapy |
| 68 | Song,[68] | 2010 | Molecular Cancer | up | enhance | chemotherapy |
| 69 | Li,[69] | 2017 | Cancer Biomarkers | down | reduce | chemotherapy |
| 70 | Zhou,[70] | 2016 | Acta Pharmacologic Sinica | down | reduce | chemotherapy |
| 71 | Chang,[71] | 2014 | ScientificWorldJournal | down | reduce | chemotherapy |
| 72 | Gao,[72] | 2015 | Scientific Reports | down | reduce | chemotherapy |
| 73 | Fiore,[73] | 2014 | International Journal of Oncology | down | reduce | chemotherapy |
| 74 | Wei,[74] | 2016 | Bioscience Reports | up | enhance | chemotherapy |
| 75 | Xie,[75] | 2018 | Biotechnology Letters | up | enhance | chemotherapy |
| 76 | Novello,[76] | 2014 | PLoS One | down | reduce | chemotherapy |
| 77 | Chen,[77] | 2014 | Experimental and Therapeutic Medicine | up | enhance | chemotherapy |
| 78 | Li,[78] | 2015 | Oncology Letters | down | reduce | chemotherapy |
| 79 | Huang,[79] | 2021 | Journal of Chemotherapy | down | reduce | chemotherapy |
| 80 | Zou,[80] | 2018 | Oncology Letters | up | enhance | chemotherapy |
| 81 | Zhu,[81] | 2021 | Oncology Letters | up | enhance | chemotherapy |
| 82 | Zhang,[82] | 2019 | Oncology Letters | up | enhance | chemotherapy |
| 83 | Jiang,[83] | 2015 | Oncology Letters | down | reduce | chemotherapy |
| 84 | Chen,[84] | 2016 | Journal of Cancer | down | reduce | chemotherapy |
| 85 | Yu,[85] | 2019 | OncoTargets and Therapy | up | enhance | chemotherapy |
| 86 | Pu,[86] | 2017 | Scientific Reports | up | enhance | chemotherapy |
| 87 | Song,[87] | 2009 | Oncogene | up | enhance | chemotherapy |
| 88 | Pu,[88] | 2017 | BMC Cancer | up | enhance | chemotherapy |
| 89 | Osaki,[89] | 2016 | Scientific Reports | down | reduce | chemotherapy |
| 90 | Zhang,[90] | 2021 | Aging (Albany NY) | down | reduce | chemotherapy |
| 91 | Zhao,[91] | 2017 | Cancer cell international | down | reduce | chemotherapy |
| 92 | Wang,[92] | 2019 | Journal of Bone Oncology | down | reduce | chemotherapy |
| 93 | Gao,[93] | 2017 | Cancer cell international | down | reduce | chemotherapy |
| 94 | Cheng,[94] | 2020 | Oncology Report | down | reduce | chemotherapy |
| 95 | Yu,[95] | 2019 | Bioscience Reports | up | enhance | chemotherapy |
| 96 | Tsai,[96] | 2018 | Journal of Cellular Physiology | down | reduce | chemotherapy |
| 97 | Meng,[97] | 2017 | Scientific Reports | down | reduce | chemotherapy |
| 98 | Zhang,[98] | 2020 | Biomed Research International | down | reduce | chemotherapy |
| 99 | Liu,[99] | 2019 | Biochemical and Biophysical Research Communications | down | reduce | chemotherapy |
| 100 | Keremu,[100] | 2019 | Bioscience Reports | down | reduce | chemotherapy |
| 101 | Yan,[101] | 2018 | Anti-Cancer Drugs | down | reduce | chemotherapy |
| 102 | Xiao,[102] | 2017 | Oncotarget | down | reduce | chemotherapy |
| 103 | Wang, [103] | 2017 | Molecular Therapy | down | reduce | chemotherapy |
| 104 | Zhou,[104] | 2018 | Molecular Medicine Reports | down | reduce | chemotherapy |
| 105 | Zhang,[105] | 2020 | Neoplasma | down | reduce | chemotherapy |
| 106 | Xu,[106] | 2014 | Medical Oncology | down | reduce | chemotherapy |
| 107 | Duan,[107] | 2016 | Molecular Oncology | down | reduce | chemotherapy |
| 108 | Maximov,[108] | 2019 | International Journal of Cancer | down | reduce | chemotherapy |
| 109 | Chen,[109] | 2017 | Molecular Medicine Reports | down | reduce | chemotherapy |
| 110 | Lin,[110] | 2015 | Journal of Cancer Research and Clinical Oncology | up | enhance | chemotherapy |
| 111 | Zhao,[111] | 2013 | PLoS One | up | enhance | chemotherapy |
| 112 | Zhou,[112] | 2016 | Cell Oncol (Dordr) | up | enhance | chemotherapy |
| 113 | Wang,[113] | 2021 | Bosnian Journal of Basic Medical Sciences | down | reduce | chemotherapy |
| 114 | Yang,[114] | 2020 | Journal of Experimental & Clinical Cancer Research | down | reduce | chemotherapy |
| 115 | Xu,[115] | 2018 | Medical Science Monitor | down | reduce | chemotherapy |
| 116 | Zhou,[116] | 2015 | Experimental Biology and Medicine (Maywood) | down | reduce | chemotherapy |
| 117 | Liu,[117] | 2015 | Technology in Cancer Research & Treatment | down | reduce | chemotherapy |
| 118 | Shao,[118] | 2015 | Cellular Physiology Biochemistry | down | reduce | chemotherapy |
| 119 | Xu,[119] | 2016 | Oncology Report | up | enhance | chemotherapy |
| 120 | Zhou,[120] | 2014 | Journal of experimental & clinical cancer research : CR | up | enhance | chemotherapy |
| 121 | Liu,[121] | 2019 | Cell Cycle | down | reduce | chemotherapy |
| 122 | Liu,[122] | 2018 | Biomed Research International | down | reduce | chemotherapy |
| 123 | Li,[123] | 2021 | Cell Biology International | down | reduce | chemotherapy |
| 124 | Tang,[124] | 2018 | Biochemical and Biophysical Research Communications | down | reduce | chemotherapy |
| 125 | Xu,[125] | 2014 | Oncotarget | down | reduce | chemotherapy |
| 126 | Liu,[126] | 2018 | European Review for Medical and Pharmacological Sciences | down | reduce | chemotherapy |
| 127 | Liu,[127] | 2017 | Scientific Reports | down | reduce | chemotherapy |
| 128 | Zhu,[128] | 2016 | PLoS One | down | reduce | chemotherapy |
| 129 | Long,[129] | 2018 | Journal of Cellular Biochemistry | down | reduce | chemotherapy |
| 130 | Li,[130] | 2016 | Oncotarget | up | enhance | chemotherapy |
| 131 | Wang,[131] | 2016 | Journal of Bone Oncology | up | enhance | chemotherapy |
| 132 | Li,[132] | 2021 | Frontiers in Cell and Developmental Biology | down | reduce | chemotherapy |
| 133 | Jin,[133] | 2017 | Oncotarget | down | reduce | chemotherapy |
| 134 | Li,[134] | 2020 | Cancer Management and Research | down | reduce | chemotherapy |
| 135 | Chen,[135] | 2019 | Oncology Letters | up | enhance | chemotherapy |
| 136 | Zhou,[136] | 2018 | Oncology Letters | down | reduce | chemotherapy |
| 137 | Ling,[137] | 2020 | Experimental and Therapeutic Medicine | down | reduce | chemotherapy |
| 138 | Sun,[138] | 2016 | Scientific Reports | up | enhance | chemotherapy |
| 139 | Zhi,[139] | 2022 | Cellular and Molecular Biology | down | reduce | chemotherapy |
| 140 | Zhou,[140] | 2021 | Current Molecular Medicine | down | reduce | chemotherapy |
| 141 | Liang,[141] | 2019 | OncoTargets and Therapy | down | reduce | chemotherapy |
| 142 | Gao, [142] | 2020 | Neoplasma | down | reduce | chemotherapy |
| 143 | Wang,[143] | 2021 | Molecular Carcinogenesis | down | reduce | chemotherapy |
| 144 | Wang,[144] | 2022 | Bioengineered | up | enhance | chemotherapy |
| 145 | Zhan,[145] | 2022 | Journal of Oncology | down | reduce | chemotherapy |
| 146 | Zhang,[146] | 2021 | Human Cell | up | enhance | chemotherapy |
| 147 | Zhang,[147] | 2020 | OncoTargets and Therapy | up | enhance | chemotherapy |
| 148 | Feng,[148] | 2021 | Cell Death Discovery | up | enhance | chemotherapy |
| 149 | Dong,[149] | 2020 | Journal of Molecular Histology | up | enhance | chemotherapy |
| 150 | Wei,[150] | 2021 | Journal of Orthopaedic Surgery and Research | up | enhance | chemotherapy |
| 151 | Hu,[151] | 2019 | Journal of Clinical Laboratory Analysis | down | reduce | chemotherapy |
| 152 | Li,[152] | 2020 | Aging (Albany NY) | up | enhance | chemotherapy |
| 153 | Li,[153] | 2021 | BioMed Research International | up | enhance | chemotherapy |
| 154 | Zhu,[154] | 2018 | International Journal of Biological Sciences | up | enhance | chemotherapy |
| 155 | Wang,[155] | 2022 | International Journal of Clinical Oncology | up | enhance | chemotherapy |
| 156 | Pan,[156] | 2021 | Cell Biology International | up | enhance | chemotherapy |
| 157 | Zhang,[157] | 2018 | Oncology Letters | up | enhance | chemotherapy |
| 158 | Xie,[158] | 2020 | Cancer Management and Research | up | enhance | chemotherapy |
| 159 | Lin,[159] | 2022 | Journal of Laboratory Analysis | up | enhance | chemotherapy |
| 160 | Ma,[160] | 2021 | Cell Death Discovery | up | enhance | chemotherapy |
| 161 | Yuan,[161] | 2021 | Cancer Management and Research | up | enhance | chemotherapy |
| 162 | Wei,[162] | 2020 | Open Life Sciences | up | enhance | chemotherapy |
| 163 | Zhou,[163] | 2021 | Journal of Gene Medicine | down | reduce | chemotherapy |
| 164 | Bai,[164] | 2021 | Journal of Orthopaedic Surgery and Research | up | enhance | chemotherapy |
| 165 | Li,[165] | 2021 | Molecular Cancer | up | enhance | chemotherapy |
| 166 | Tang,[166] | 2022 | Bioengineered | up | enhance | chemotherapy |
| 167 | Jacques,[167] | 2016 | Oncotarget | up (in OS) | reduce | chemotherapy |
| down (in EWS) |
| 168 | Nakatani,[168] | 2012 | The Journal of Pathology | down | reduce | chemotherapy |
| 169 | Robin,[169] | 2012 | Molecular Cancer Research | down | reduce | chemotherapy |
| 170 | Iida,[170] | 2013 | Cancer Cell International | up | enhance | chemotherapy |
| 171 | Zhu,[171] | 2014 | Asian Pacific Journal Cancer Prevention | down | reduce | chemotherapy |
| 172 | Huang,[172] | 2017 | Cancer Biomark | down | reduce | chemotherapy |
| 173 | Tang,[173] | 2016 | Drug Design Development and Therapy | down | reduce | chemotherapy |
| 174 | Bharathy,[174] | 2019 | Science Signaling | down | reduce | chemotherapy |
| 175 | Minami,[175] | 2014 | Cancer Science | up | enhance | chemotherapy |
| 176 | Xu,[176] | 2018 | Iranian Journal of Allergy Asthma and Immunology | down | reduce | chemotherapy |
| 177 | Zhang,[177] | 2020 | Frontiers in Oncology | down | reduce | chemotherapy |
| 178 | Jain,[178] | 2022 | DNA repair | down | reduce | chemotherapy |
| 179 | Li,[179] | 2021 | Frontiers in Cell and Developmental Biology | down | reduce | chemotherapy |
| 180 | Wang,[180] | 2021 | Pharmacological Research | down | reduce | targeted therapy |
| 181 | Wang,[181] | 2019 | OncoTargets and Therapy | down | reduce | targeted therapy |
| 182 | Wang,[182] | 2019 | Journal of Experimental & Clinical Cancer Research | down | reduce | targeted therapy |
| 183 | Cao,[183] | 2018 | American Journal of Translational Research | down | reduce | targeted therapy |
| 184 | Yan,[184] | 2019 | Brazilian Journal of Medical Biological Research | down | reduce | targeted therapy |
| 185 | Zhang,[185] | 2021 | Cell Death Discovery | up | enhance | targeted therapy |
| 186 | Shao,[186] | 2021 | Molecular Therapy Nucleic Acids | up | enhance | targeted therapy |
| 187 | Fan,[187] | 2014 | Clinical and Experimental Medicine | down | reduce | targeted therapy |
| 188 | Chen,[188] | 2020 | Cell Death & Disease | down | reduce | targeted therapy |
| 189 | Shi,[189] | 2015 | Laboratory Investigation | down | reduce | targeted therapy |
| 190 | Huang,[190] | 2018 | Experimental Cell Research | up | enhance | targeted therapy |
| 191 | Akcakaya,[191] | 2014 | British Journal of Cancer | up | enhance | targeted therapy |
| 192 | Cao,[192] | 2016 | European Review for Medical and Pharmacological Sciences | down | reduce | targeted therapy |
| 193 | Shiozawa,[193] | 2017 | Biochemical and Biophysical Research Communications | up | enhance | targeted therapy |
| 194 | Pang,[194] | 2021 | Frontiers in oncology | up | enhance | Immune checkpoint inhibitor |
| 195 | He,[195] | 2020 | Journal of Clinical Laboratory Analysis | up | enhance | Radiotherapy |
| 196 | Yang,[196] | 2018 | Oncology Report | down | reduce | Radiotherapy |
| 197 | Li,[197] | 2019 | Frontiers in oncology | up | enhance | Radiotherapy |
| 198 | Dai,[198] | 2018 | Oncotarget | down | reduce | Radiotherapy |
| 199 | Vares,[199] | 2020 | Radiotherapy and Oncology | down | reduce | Radiotherapy |
| 200 | Lee,[200] | 2014 | Cell Transplantation | down | reduce | Radiotherapy |
| 201 | Polvani,[201] | 2022 | Anti-Cancer Drug | down | biomarker | chemotherapy |
| 202 | Zhu,[202] | 2015 | International Journal of Clinical and Experimental Pathology | up | biomarker | chemotherapy |
| 203 | Yuan,[203] | 2012 | Journal of International Medical Research | up | biomarker | chemotherapy |
| 204 | Lou,[204] | 2016 | Journal of Bone Oncology | down | biomarker | chemotherapy |
| 205 | Han,[205] | 2020 | Translational Cancer Research | up | biomarker | chemotherapy |
| 206 | Zhu,[206] | 2018 | Epigenomics | up | biomarker | chemotherapy |
| 207 | YAMADA,[207] | 2021 | Oncology Letters | - | biomarker | targeted therapy |
| 208 | Yan,[208] | 2017 | Oncology Letters | - | biomarker | targeted therapy |
| 209 | Amirnasr,[209] | 2019 | Cancers (Basel) | - | biomarker | targeted therapy |
| 210 | Kou,[210] | 2018 | Journal of biosciences | - | biomarker | targeted therapy |
| 211 | Gao,[211] | 2013 | Acta Biochimica ET Biophysica Sinica (Shanghai) | - | biomarker | targeted therapy |
| 212 | Zhang,[212] | 2018 | Neoplasma | - | biomarker | targeted therapy |

The relative expression levels of non-coding RNAs were measured in tumor tissues/cells compared to normal/adjacent tissues/cells or in drug sensitive tissues/cells compared to drug resistant tissues/cells. MiR-193a-5p was up-regulated in osteosarcoma and down-regulated in Ewing’s sarcoma that compared to head and neck squamous cell carcinoma.

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RNA PWRN1

is lowly expressed in osteosarcoma and modulates cancer proliferation and migration by targeting

hsa‐miR

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