

## Article

# A Physically Active Status Affects the Circulating Profile of Cancer-Associated miRNAs

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**Supplementary Table S3.** List of the miRNAs and miRNA signatures associated with diagnosis in Prostate Cancer from literature. Only miRNAs with significant clinical relevance ( $AUC \geq 0.7$ ), and signature with at least one modulated miRNA from our experimental setting were considered.

| Cancer | Sample | miRNAs     | miRNA signatures | Regulation   | AUC               | Reference |
|--------|--------|------------|------------------|--------------|-------------------|-----------|
| PC     | Serum  | miR-106a   |                  | miR-106a ↑   | miR-106a: 0.928   | [1]       |
|        |        | miR-223    |                  | miR-223 ↓    | miR-223: 0.876    |           |
|        |        | miR-24     |                  | miR-24 ↓     | miR-24: 0.778     |           |
|        |        | miR-874    |                  | miR-874 ↑    | miR-874: 0.845    |           |
|        |        | miR-93     |                  | miR-93 ↑     | miR-93: 0.907     |           |
| PC     | Serum  | let-7b     |                  | let-7b ↓     | let-7b: 0.848     | [2]       |
|        |        | miR-141    |                  | miR-141 ↑    | miR-141: 0.929    |           |
|        |        | miR-205    |                  | miR-205 ↓    | miR-205: 0.914    |           |
|        |        | miR-484    |                  | miR-484 ↓    | miR-484: 0.786    |           |
|        |        | miR-106b   |                  | miR-106b ↑   | miR-106b: 0.750   |           |
| PC     | Serum  | miR-141-3p |                  | miR-141-3p ↑ | miR-141-3p: 0.831 | [3]       |
|        |        | miR-21     |                  | miR-21 ↑     | miR-21: 0.856     |           |
| PC     | Serum  | miR-375    |                  | miR-375 ↑    | miR-375: 0.906    | [4]       |
| PC     | Plasma | miR-375    |                  | miR-375 ↑    | miR-375: 0.757    | [5]       |
| PC     | Plasma | miR-145-5p |                  | miR-145-5p ↓ | miR-145-5p: 0.900 | [6]       |
|        |        | miR-152-3p |                  | miR-152-3p ↑ | miR-326: 0.910    |           |
| PC     | Plasma | miR-326    |                  | miR-326 ↑    | miR-152-3p: 0.820 | [7]       |
| PC     | Plasma | miR-141    |                  | miR-141 ↑    | miR-141: 0.800    | [8]       |
| PC     | Plasma | miR-375    |                  | miR-375 ↓    | miR-375: 0.711    | [9]       |
| PC     | Plasma | miR-21     | miR-21           | miR-21 ↑     | miR-21: 0.880     | [10]      |
|        |        | miR-221    | miR-221          | miR-221 ↑    | miR-221: 0.830    |           |
| PC     | Plasma | let-7c     |                  | let-7c ↓     | let-7c: 0.775     | [10]      |
|        |        | let-7e     |                  | let-7e ↓     | let-7e: 0.804     |           |
|        |        | miR-30c    |                  | miR-30c ↓    | miR-30c: 0.818    |           |

PC: prostate cancer; AUC: area under the ROC curve.

## References

- Moltzahn, F.; Olshen, A.B.; Baehner, L.; Peek, A.; Fong, L.; Stoppler, H.; Simko, J.; Hilton, J.F.; Carroll, P.; Blemloch, R. Microfluidic-based multiplex qRT-PCR identifies diagnostic and prognostic microRNA signatures in the sera of prostate cancer patients. *Cancer research* **2011**, *71*, 550-560, doi:10.1158/0008-5472.CAN-10-1229.
- Guo, X.; Han, T.; Hu, P.; Guo, X.; Zhu, C.; Wang, Y.; Chang, S. Five microRNAs in serum as potential biomarkers for prostate cancer risk assessment and therapeutic intervention. *International urology and nephrology* **2018**, *50*, 2193-2200, doi:10.1007/s11255-018-2009-4.
- Porzycki, P.; Ciszakowicz, E.; Semik, M.; Tyrka, M. Combination of three miRNA (miR-141, miR-21, and miR-375) as potential diagnostic tool for prostate cancer recognition. *International urology and nephrology* **2018**, *50*, 1619-1626, doi:10.1007/s11255-018-1938-2.
- Wach, S.; Al-Janabi, O.; Weigelt, K.; Fischer, K.; Greither, T.; Marcou, M.; Theil, G.; Nolte, E.; Holzhausen, H.J.; Stohr, R.; et al. The combined serum levels of miR-375 and urokinase plasminogen activator receptor are suggested as diagnostic and prognostic biomarkers in prostate cancer. *International journal of cancer* **2015**, *137*, 1406-1416, doi:10.1002/ijc.29505.
- Chen, Z.; Zhen, M.; Zhou, J. LncRNA BRE-AS1 interacts with miR-145-5p to regulate cancer cell proliferation and apoptosis in prostate carcinoma and has early diagnostic values. *Bioscience reports* **2019**, *39*, doi:10.1042/BSR20182097.
- Matin, F.; Jeet, V.; Moya, L.; Selth, L.A.; Chambers, S.; Australian Prostate Cancer, B.; Clements, J.A.; Batra, J. A Plasma Biomarker Panel of Four MicroRNAs for the Diagnosis of Prostate Cancer. *Scientific reports* **2018**, *8*, 6653, doi:10.1038/s41598-018-24424-w.
- Osipov, I.D.; Zaporozhchenko, I.A.; Bondar, A.A.; Zaripov, M.M.; Voytsitskiy, V.E.; Vlassov, V.V.; Laktionov, P.P.; Morozkin, E.S. Cell-Free miRNA-141 and miRNA-205 as Prostate Cancer Biomarkers. *Advances in experimental medicine and biology* **2016**, *924*, 9-12, doi:10.1007/978-3-319-42044-8\_2.
- Kachakova, D.; Mitkova, A.; Popov, E.; Popov, I.; Vlahova, A.; Dikov, T.; Christova, S.; Mitev, V.; Slavov, C.; Kaneva, R. Combinations of serum prostate-specific antigen and plasma expression levels of let-7c, miR-30c, miR-141, and miR-375 as potential better diagnostic biomarkers for prostate cancer. *DNA and cell biology* **2015**, *34*, 189-200, doi:10.1089/dna.2014.2663.
- Yaman Agaoglu, F.; Kovancilar, M.; Dizdar, Y.; Darendeliler, E.; Holdenrieder, S.; Dalay, N.; Gezer, U. Investigation of miR-21, miR-141, and miR-221 in blood circulation of patients with prostate cancer. *Tumour biology: the journal of the International Society for Oncodevelopmental Biology and Medicine* **2011**, *32*, 583-588, doi:10.1007/s13277-011-0154-9.
- Chen, Z.H.; Zhang, G.L.; Li, H.R.; Luo, J.D.; Li, Z.X.; Chen, G.M.; Yang, J. A panel of five circulating microRNAs as potential biomarkers for prostate cancer. *The Prostate* **2012**, *72*, 1443-1452, doi:10.1002/pros.22495.