

Summary of Publications Using NK Vue

No	Publication Reference	Description	DOI Link
1	Koo, K. C. <i>et al.</i> Reduction of the CD16(-) CD56bright NK cell subset precedes NK cell dysfunction in prostate cancer. <i>PLoS ONE</i> 8 , e78049 (2013).	NKA test can be used together with PSA test to increase the diagnosis of prostate cancer detection., n=51 (PC), n=54 (controls), performed in South Korea	http://doi.org/10.1371/journal.pone.0078049
2	Lee, S.-B. <i>et al.</i> A high-throughput assay of NK cell activity in whole blood and its clinical application. <i>Biochem. Biophys. Res. Commun.</i> 445 , 584–590 (2014).	NKA could be utilized as a supportive diagnostic marker for microsatellite stable (MSS) colorectal cancer., n=41 (CRC), n=41 (controls), performed in South Korea	http://doi.org/10.1016/j.bbrc.2014.02.040
3	Han, J.-W. <i>et al.</i> The Effects of Forest Therapy on Coping with Chronic Widespread Pain: Physiological and Psychological Differences between Participants in a Forest Therapy Program and a Control Group. <i>International Journal of Environmental Research and Public Health</i> 13 , 255 (2016).	The results indicate that forest therapy can help to improve psychological and physiological symptoms of chronic widespread pain for which clear therapeutic methods have yet to be provided., n=33 (treated), n=28 (controls), performed in South Korea	http://doi.org/10.3390/ijerph13030255
4	Barkin, J., Rodriguez-Suarez, R. & Betito, K. Association between natural killer cell activity and prostate cancer: a pilot study. <i>Can J Urol</i> 24 , 8708–8713 (2017).	This pilot study showed that subjects with low values of NKA were more likely to have a positive outcome at prostate biopsy., n=21 (PC), n=22 (controls), performed in Canada	PubMed PMID: 28436356.
5	Jobin, G., Rodriguez-Suarez, R. & Betito, K. Association Between Natural Killer Cell Activity and Colorectal Cancer in High-Risk Subjects Undergoing Colonoscopy. <i>Gastroenterology</i> 153 , 980–987 (2017).	Subjects with low NK cell activity had a 10-fold higher risk of CRC compared with subjects with high NK cell activity. This test might be used in clinical practice to assess patients for risk of CRC., n=23 (CRC), n=849 (controls), performed in Canada	http://doi.org/10.1053/j.gastro.2017.06.009
6	Lee, J. <i>et al.</i> Natural killer cell activity for IFN-gamma production as a supportive diagnostic marker for gastric cancer. <i>Oncotarget</i> 8 , 70431–70440 (2017).	NK cell activities for IFN-g production could be used as a supportive non-invasive tumor marker for GC diagnosis., n=261 (GC), n=48 (controls), performed in South Korea	http://doi.org/10.18632/oncotarget.19712
7	Angka, L. <i>et al.</i> Natural Killer Cell IFN γ Secretion is Profoundly Suppressed Following Colorectal Cancer Surgery. <i>Annals of Surgical Oncology</i> 25 , 3747–3754 (2018).	NKA is significantly reduced following surgery in CRC surgery patients for 2 months. This study showed that NKA decreased after surgery and may possibly lead to recurrence	http://doi.org/10.1245/s10434-018-6691-3

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		and metastases of cancers., n=42 (CRC), n=27 (controls), performed in Canada	
7.1	Angka, L. & Auer, R. C. ASO Author Reflections: Prolonged Immunoparalysis of NK Cells After Surgery. <i>Ann Surg Oncol</i> 25 , 968–969 (2018).	This ASO Author Reflections is a brief invited commentary on the article “Natural Killer Cell IFN γ Secretion Is Profoundly Suppressed Following Colorectal Cancer Surgery,” <i>Ann Surg Oncol</i> . 2018., performed in Canada	http://doi.org/10.1245/s10434-018-6793-y
8	Jung, Y. S., Kwon, M.-J., Park, D. I., Sohn, C. I. & Park, J. H. Association between natural killer cell activity and the risk of colorectal neoplasia: NK cell activity and colorectal neoplasm. <i>Journal of Gastroenterology and Hepatology</i> 33 , 831–836 (2018).	Natural killer cell activity seemed to decrease along with CRC progression toward the later stages in the adenoma-carcinoma sequence. Its activity may be depressed in relation to progression of neoplasia, even at precancerous stage., n=1 (CRC), n=12 (AA), n=233 (NAA), n=1572 (controls), performed in South Korea	http://doi.org/10.1111/jgh.14028
9	Jung, Y. S. <i>et al.</i> Physical Inactivity and Unhealthy Metabolic Status Are Associated with Decreased Natural Killer Cell Activity. <i>Yonsei Medical Journal</i> 59 , 554 (2018).	Physical inactivity and metabolic abnormalities are associated with reduced NK cell activity. Immune systems may become altered depending on physical activity and metabolic status., n=4607 (inactive), n=5940 (minimally active), n=1267 (active), performed in South Korea	http://doi.org/10.3349/ymj.2018.59.4.554
10	Kang, H.-J., Bae, K., Kim, J.-H., Cho, C.-K. & Yoo, H.-S. Correlation Between Natural Killer Cell Activity and Systemic Inflammatory Markers for Heterogeneous Cancer Patients Treated With Wheel Balance Cancer Therapy. <i>Integrative Cancer Therapies</i> 17 , 322–331 (2018).	Negative correlations were identified between NKA and NLR (neutrophil-to-lymphocyte ratio), NKA and ESR (erythrocyte sedimentation rate), and NKA and fibrinogen in patients with heterogeneous cancer types. n=42, performed in South Korea	http://doi.org/10.1177/1534735417717789
11	Nederby, L., Jakobsen, A., Hokland, M. & Hansen, T. F. Quantification of NK cell activity using whole blood: Methodological aspects of a new test. <i>Journal of Immunological Methods</i> 458 , 21–25 (2018).	Intracellular flow cytometry showed that NK cells, T cells, and Natural Killer T (NKT) cells were producing IFN γ in the assay, however when analyzing the distribution of lymphocytes in the IFN γ -expressing subset, the proportion of NK cells far exceeded the percentage of T-, and NKT cells (p < .0001). The read-out of the test was indicative of the NK cells’ ability to mount a response. N/A, performed in Denmark	http://doi.org/10.1016/j.jim.2018.04.002

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12	Kim, C. K. <i>et al.</i> Reduced NK cell IFN- γ secretion and psychological stress are independently associated with herpes zoster. <i>PLOS ONE</i> 13 , e0193299 (2018).	Patients with a recent diagnosis of herpes zoster display reduced interferon-gamma secretion from natural killer cells and frequent previous psychological stress events compared with controls., n=44 (herpes), n=44 (controls), performed in South Korea	http://doi.org/10.1371/journal.pone.0193299
13	Park, S., Mun, Y. C., Seong, C.-M., Huh, H. J. & Huh, J. Variable Natural Killer Cell Activity in Hematological Malignancies at Diagnosis. <i>Laboratory Medicine Online</i> 8 , 41 (2018).	The measurement of NKA could be useful to evaluate the immunological status in hematological malignancies at diagnosis and during follow-up., n=18 (AML), n=31 (MM), n=62 (lymphoma), n=23 (controls), performed in South Korea	https://synapse.koreamed.org/search.php?where=avi&id=10.3343/lmo.2018.8.2.41&code=0192LMO&vmode=PUBREADER
14	Cho, A. R., Lee, S. Y., Cho, Y. H., Kim, C. M. & Kim, S. G. Effects of 4-Week Intervention with <i>Ulmus macrocarpa</i> Hance Extract on Immune Function Biomarkers in Healthy Adults: A Randomized Controlled Trial. <i>Evidence-Based Complementary and Alternative Medicine</i> 2018 , 1–6 (2018).	Administration of UME for 1 week increased serum TNF-alpha and sustains IL-2 in human, which suggests that UME increases Th1-related immune function in the short-term in healthy people. However, long-term effect of UME was not proven., n=29 (UME), n=29 (placebo), performed in South Korea	https://www.hindawi.com/journals/ecam/2018/5690816/
15	Kim, J. H. <i>et al.</i> Relationship between natural killer cell activity and glucose control in patients with type 2 diabetes and prediabetes. <i>Journal of Diabetes Investigation</i> (2019).	Compared with individuals with normal glucose tolerance or prediabetes, type 2 diabetes patients have a reduced NK cell activity, and it is significantly related to glucose control., n=21 (Type 2 diabetes), n=15 (prediabetes), n=13 (control), performed in South Korea	http://doi.org/10.1111/jdi.13002
16	Hansen, T. F. <i>et al.</i> Correlation Between Natural Killer Cell Activity and Treatment Effect in Patients with Disseminated Cancer. <i>Translational Oncology</i> 12 , 968–972 (2019).	The results suggest a correlation between NK cell activity and treatment effect across different solid tumor types and treatments. Patients lacking the ability to mount an immune response during the first 2 months of treatment have a poor prognosis, and their clinical benefit of the treatment is questionable., n=93, performed in Denmark	DOI: 10.1016/j.tranon.2019.04.002
17	Choi, S. I. <i>et al.</i> Clinical utility of a novel natural killer cell activity assay for diagnosing non-small cell lung cancer: a prospective pilot study. <i>Oncotargets and Therapy</i> Volume 12 , 1661–1669 (2019).	This pilot study showed that patients with low NKA were more likely to have lung cancer. n=71 (NSCLC), n=40 (benign lung disease), n=40 (controls), performed in South Korea	http://doi.org/10.2147/OTT.S194473

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18	Kim, B.-R., Chun, S., Cho, D. & Kim, K.-H. Association of neutrophil-to-lymphocyte ratio and natural killer cell activity revealed by measurement of interferon-gamma levels in a healthy population. <i>Journal of Clinical Laboratory Analysis</i> 33 , e22640 (2019).	Helpful in interpreting or predicting NK cell activity in the clinical environment in association with neutrophil-to-lymphocyte ratio., n=106, performed in South Korea	http://doi.org/10.1002/jcla.22640
19	Vidal, A. C. <i>et al.</i> Natural killer cell activity and prostate cancer risk in veteran men undergoing prostate biopsy. <i>Cancer Epidemiology</i> 62 , 101578 (2019).	Men with a low NKA value had five-times higher odds of PC at biopsy. The implementation of this NKA assay in the clinic together with PSA may help to advise patients with the highest risk of PC whether, or not, to undergo a prostate biopsy., n=62 (PC), n=32 (controls), performed in USA	https://www.sciencedirect.com/science/article/abs/pii/S187778211930089X?via%3Dihub
20	Lee <i>et al.</i> Natural Killer Cell Function Tests by Flowcytometry-Based Cytotoxicity and IFN- γ Production for the Diagnosis of Adult Hemophagocytic Lymphohistiocytosis. <i>International Journal of Molecular Sciences</i> 20 , 5413 (2019).	NK-cytotoxicity and NKA-IFN γ assays predicted HLH with sensitivities of 96.0% and 92.0%, respectively. Both NK-cytotoxicity and NKA-IFN γ could be used for diagnosis of HLH. n=50 (HLH), n=69 (non-HLH), performed in South Korea	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6862274/pdf/ijms-20-05413.pdf
21	Cho, Y.-H. <i>et al.</i> Natural Killer Cells as a Potential Biomarker for Predicting Immunotherapy Efficacy in Patients with Non-Small Cell Lung Cancer. <i>Targeted Oncology</i> 15 , 241–247 (2020).	The overall activity or number of NK cells may be a useful biomarker to predict immunotherapy response in patients with NSCLC, n=9 (NSCLC), performed in South Korea	https://doi.org/10.1007/s11523-020-00712-2
22	Lu, Y.-C. <i>et al.</i> Lower postoperative natural killer cell activity is associated with positive surgical margins after radical prostatectomy. <i>Journal of the Formosan Medical Association</i> (2020).	NKA was significantly higher postoperatively than preoperatively. Patients with positive surgical margins had lower postoperative NKA than those with negative margins. Lower postoperative NKA was also observed in higher-stage PCa. NKA could be used as a supplemental marker for detecting the remaining tumor cells after prostatectomy in combination with PSA., n=51 (PC), n=10 (controls), performed in Taiwan	https://doi.org/10.1016/j.jfma.2019.12.015

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23	Jung, Y. S. <i>et al.</i> Impact of Smoking on Human Natural Killer Cell Activity: A Large Cohort Study. <i>Journal of Cancer Prevention</i> 25 , 13–20 (2020).	NK cell activity was lower in current smokers. It also decreased with an increase in the number of cigarettes smoked, and it was negatively correlated with cotinine levels among current smokers. Findings indicate a clear relationship between smoking and decreased NK cell activity., n=12,249, performed in South Korea	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7113411/
24	Park, K. H. <i>et al.</i> Delayed NK Cell Reconstitution and Reduced NK Activity Increased the Risks of CMV Disease in Allogeneic-Hematopoietic Stem Cell Transplantation. <i>International Journal of Molecular Sciences</i> (2020)	Altogether, our results demonstrate that both NK cells' maturation and cytotoxic/IFN production can contribute to CMV protection, thereby revealing the NK phenotype and functional NK monitoring as biomarkers for CMV risk prediction, especially in CMV disease. As NK cells play a crucial role in mediating early immunity in HSCT, it is hypothesized that the probability to control NK cell reconstitution and function in HSCT recipients may induce important clinical benefits.	https://doi.org/10.3390/ijms21103663
25	M.G. Choi <i>et al.</i> Efficacy of natural killer cell activity as a biomarker for predicting immunotherapy response in non-small cell lung cancer. <i>Thoracic Cancer</i> (2020)	Baseline NK cell activity was related to the response to immunotherapy and the PFS. We suggest that NK cell activity from peripheral blood before immunotherapy is a noninvasive, simple, and novel way to predicting the treatment response in patients with NSCLC.	https://doi.org/10.1111/1759-7714.13677
26	H.S. Lee <i>et al.</i> Peripheral natural killer cell activity is associated with poor clinical outcomes in pancreatic ductal adenocarcinoma. (2020)	In pancreatic cancer patients, NK cell activity decreased as cancer progressed, and decreased NK cell activity was associated with poor clinical outcomes.	https://doi.org/10.1111/jgh.15265

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27	S.Y. Oh <i>et al.</i> Vitamin D and Exercise Are Major Determinants of Natural Killer Cell Activity, Which Is Age- and Gender-Specific (2021)	Physical exercise and vitamin D were associated with NKA in a gender and age-dependent manner. Age was a major risk factor of very low NKA in men but not in women.	https://doi: 10.3389/fimmu.2021.594356
28	Hyungwoo Cho <i>et al.</i> Prognostic value of natural killer cell activity for patients with HER2 + advanced gastric cancer treated with first-line fluoropyrimidine–platinum doublet plus trastuzumab (2021)	Our results demonstrated the prognostic value of baseline NK cell activity for patients with HER2 + AGC treated with fluoropyrimidine–platinum doublet plus trastuzumab. The association between treatment outcomes and dynamic changes in NK cell activity suggests that NK cell treatment may improve treatment outcomes, especially for patients with low baseline NK cell activity.	https://doi.org/10.1007/s00262-021-03035-x
29	Yasha Wang <i>et al.</i> Review: Clinical Detection of Peripheral Blood Natural Killer Cell Activity (2021)	The clinical detection strategies of NK cell activity in circulation mainly grouped into five types: methyl thiazolyl tetrazolium colorimetric, lactate dehydrogenase release, radionuclide labeling, flow cytometry and NK Vue cytokine release method. It has played an important role in different stages of clinical application development. This paper will make a comparative review of the above-mentioned detection strategies for the NK cell activity. “This method is used in the ongoing immune cell therapy project of the oncology department of our hospital to assist in the assessment of the patient’s immune function status, and to provide a reference for clinical treatment as a basis for follow-up”	https://doi.org/10.4236/jbm.2021.95004