

# Zinc in Cancer Therapy

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**Abstract** This study aims to prove that Zinc supplementation can be an effective treatment against Cancer according to the immunotherapeutic theory and in accordance with the results of several recent and older studies. It would show proof of Zinc Supplementation to enable significant improvement in treated patients as tested by different parameters [2] and to reduce tumor burden in mice [3], review Plasma Zinc level testings that show reduced zinc levels in correlation with the advancement stages of the disease [4], General public data that shows dietary intake of Zinc to reduce the risk of lung cancer [5] and of other types of cancer [6] and show evidence of reduced zinc levels in all forms of malignant tissue [7].

**Keywords:** cancer, cancer therapy, Zinc, Zn, Zinc supplementation

**Cite This Article:** Amos Gelbard, "Zinc in Cancer Therapy." *American Journal of Food and Nutrition*, vol. 4, no. 4 (2016): 112-114. doi: 10.12691/ajfn-4-4-4.

## 1. Hypothesis

The Immunotherapeutic theory suggests that by enhancement of the immune system's function it by itself could overcome any type of Cancer and it's symptoms.

The immune system operates through the entire body, therefore igniting it could supposedly cure any Cancer regardless of it's location.

Zinc Deficiency is a condition in which lack of Zinc leads to weakness of the immune system. On the other hand, high levels of Zinc are known to cause auto-immune conditions in which the immune system is enhanced to the point it attacks it's own body.

Therefore, it's plausible to assume the role of Zinc as an enhancer of the immune system, a substance that, in compliance with the said theory, can lead to an ignited immune activity and enable the body to overcome any type of cancer. [1]

## 2. Methods

The 1st clinical study referenced, [2] examines cancer patients who were given oral administration of Zinc and Selenium and then were tested by multiple parameters.

The 2nd study [3] tested tumor burden and size in cancerous mice treated with zinc supplementation. The next research [4] examined plasma levels of Zinc, among other parameters, in young patients suffering from leukemia, through different stages of the disease. The following researches [5,6] examined accumulated public dietary data and another study examined zinc levels in malignant tissue cells in-situ [7].

## 3. Results

The idea that Zinc can be used as an immunotherapeutic substance and be useful in battling Cancer, has been

hypothesized before, specifically in a research from 2009, 'Zinc in cancer prevention' (by Prasad AS1, Beck FW, Snell DC, Kucuk O). It explains Zinc's role in the immune system and advocates further studies to test Zinc's possible effectiveness in cancer therapy based on this assumption.

According to the immunotherapeutic theory such enhancement of the immune system is supposed to be effective against any type of cancer because of the immune system whole-body mechanism.

A study made in the University of Naples, Italy, in 2001, Examined the 'Effects of selenium and zinc supplementation on nutritional status in patients with cancer of digestive tract' (by Federico A1, Iodice P, Federico P, Del Rio A, Mellone MC, Catalano G, Federico P.). [2] This study evaluated the effect of oral administration of selenium and zinc tablets in patients with cancer of the digestive tract during chemotherapy.

The subjects were a total of 60 patients (median age 55 y, range 46-61 y) with diagnosis of gut cancer who were randomized in 1999. Patients were at the same time treated with chemotherapy.

Trace elements were measured by atomic absorption spectroscopy. The nutritional status of the patients was assessed, by biochemical and bio-impedance analysis parameters, in basal condition and after 60 days of treatment.

Patients were treated with oral administration of selenium and zinc, in oral tablet form, for 50 days. Selenium 200 microg/day (50 microg/tablet) and Zn 21 mg/day (7 mg/tablet).

The results after 60 days were that 21/30 (70%) of those treated with Se and Zn did not show a further worsening of nutritional status and experienced a significant decrease of asthenia with an increase of appetite. On the other hand, 24/30 (80%) untreated patients had a significant decline of all parameters studied after 60 days.

Another study, conducted in 2016, shows 'Reduction in squamous cell carcinomas in mouse skin by dietary zinc

supplementation' (by Sun J1, Shen R2, Schrock MS1,3, Liu J1, Pan X4, Quimby D1, Zanasi N1, Druck T1, Fong LY5, Huebner K1). [3]

The researchers tested two types of mice, wild-life and Fhit (murine fragile histidine triad gene) for 30 weeks, using zinc supplementation.

They've found Zn supplementation to significantly reduce tumor burdens in Fhit-/- mice (males and females combined, 16.2 unsupplemented versus 10.3 supplemented,  $P = 0.001$ ) and the SCC (squamous cell carcinomas) burden was reduced after Zn supplementation in both strains and genders of mice, most significantly in the wild-type males ( $P = 0.035$ ). According to this research the Zn-supplemented tumors also showed evidence of reduced DNA damage and some cohorts showed reduced inflammation scores.

A study from 1994 by The American Society of Hematology, 'Plasma Zinc Level and Thymic Hormone Activity in Young Cancer Patients' (By Eugenio Mocchegiani, Paolo Paolucci, Donatella Granchi, Laura Cavallazzi, Lory Santarelli, and Nicola Fabris) [4] also suggested zinc's immune function as a possible explanation for their findings - alterations in blood plasma zinc levels in various stages of the disease.

They investigated the blood plasma level of zinc in 91 young patients affected by acute lymphoblastic leukemia and discovered that the zinc levels were reduced at the onset and relapse, whereas in complete remission and in off-therapy they were in the normal range.

Their results were conclusive: The average Zn levels of fully healed patients and of healthy subjects at the same age was between 107.5-112 whereas the average Zn level for Patients at disease onset was 59.6, patients in complete remission had average Zinc levels of 90.8 and patients during a relapse stage tested for average of 72.8.

This shows an exact correlation between the severity and advancement of the disease and a decrease in patient's Plasma Zinc levels and proves at least a connection between advancement of cancer and low blood plasma zinc levels.

A research from 2016, examined the issue from a different perspective. 'Dietary mineral intake and lung cancer risk: the Rotterdam Study' [5] examined the role of mineral intake in the development of lung cancer (LC), relying on public dietary data and statistics. They investigated whether dietary calcium, copper, iron, magnesium, selenium and zinc intake were associated with LC risk. They analyzed data from 5435 participants of the Rotterdam Study, a prospective population-based cohort study among subjects aged 55 years and older.

At baseline (1990-1993), diet was measured by a validated food frequency questionnaire. LC events were diagnosed on the basis of pathology data and medical records.

During a follow-up period of 22 years, they identified 211 incident cases of LC. They've found higher zinc intake to be associated with 42 % reduction in risk of LC. They also found a connection between reduced LC risk and Iron intake but no evidence of correlation regarding the other trace elements.

Another study, made in 1977, 'Cancer mortality correlation studies-IV: Associations with dietary intakes and blood levels of certain trace elements, notably se-antagonists' [6] used the same scientific tools. The

researchers estimated the per-capita intakes of zinc, cadmium, copper and chromium from food consumption data in 28 countries and found them to "correlate directly with the age-corrected mortalities from cancers of intestine, prostate, breast, leukemia, skin and of other organs".

Regarding zinc, specifically, they found that "zinc concentrations in whole blood collected from healthy donors in the U.S. correlate directly with regional mortalities from cancers of intestine, breast and of other sites."

Another research from April 2016 offers 'In situ clinical evidence that zinc levels are decreased in breast invasive ductal carcinoma' (by Leslie C. Costello, Jing Zou, Renty B. Franklin). [7]

The researchers based their study on prior studies that claim "Altered zinc levels in malignant cells versus their normal cells have important implications in the development and progression of several cancers."

"Prostate, pancreatic, and hepatocellular carcinomas exhibit consistent marked zinc decrease in situ in the malignant cells, and other cancers (such as kidney, lung, and thyroid) also exhibit decreased tissue zinc levels."

This specific research was to confirm or challenge the contemporary view that zinc levels are however increased in breast cancer tissue compared to breast normal tissue, and that zinc is increased in invasive ductal carcinoma.

The results revealed the zinc levels to be consistently and markedly decreased in the ductal malignant cells as compared with higher prominent zinc levels in the normal ductal epithelium. Among the twenty-five cancer cases in this study, none exhibited increased zinc in the invasive ductal carcinoma compared to the zinc level in the normal ductal epithelium.

According to their results, the decreased zinc levels in breast invasive ductal carcinoma is consistent with prostate, pancreatic, and liver carcinomas, in which the decrease in zinc is a required event in the development of malignancy.

## 4. Conclusions

These findings brought together show definite connection between Cancer and Zinc. It brings evidence of zinc supplementation possibly being an effective treatment to different forms of Cancer. It proves Zinc levels in blood and tissue to be significantly decreased during the disease and shows proof that higher dietary zinc intake reduces cancer risk. It also shows proof that zinc supplementation can reduce tumor size and tumor burden, at least in mice.

I strongly recommend further examination of these findings in order to find out if Zinc supplementation can in fact enable reduction of tumor size, increase survival rates and serve as an effective treatment for any type of Cancer

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