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# Albumin and Total Protein in Cancer Patients at Radiotherapy Clinic, Zimbabwe

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**Original Research Article**

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**Abstract:** Cancer is a major public health problem and a cause of morbidity and mortality in many parts of the world. On the other hand radiotherapy is one of the cancer treatment methods available but it has many side effects. Hypoalbuminaemia and hypoproteinaemia are common effects of radiotherapy and are often used to assess nutritional status of patients but there are few published reports on albumin and total protein levels in cancer patients on radiotherapy in Zimbabwe. Hence this study was carried out to determine the levels of serum albumin and total protein and compare levels in radiotherapy-exposed patients at Parirenyatwa Radiotherapy Clinic by type of cancer. A total of 63 cancer patients took part in this cross-sectional study, 30 had breast cancer while 18 had cervical cancer and 15 had prostate cancer. Samples were analysed using the Beckman Coulter AU680 Chemistry Analyser based on Bromocresol Green (BCG) method for albumin and the Biuret method for total protein, respectively. One way ANOVA was used for comparison of normally distributed data while the Kruskal-Wallis test was used for skewed data. Out of all cancer patients who took part in this study, 18 (28.6%) were hypoalbuminaemic and 3 (4.7%) had hypoproteinaemia. There was no significant difference between albumin and total protein of patients with different types of cancer. Prevalence of patients with hypoalbuminaemia (28.6%) and hypoproteinaemia (4.7%) was comparable to studies from other countries. High prevelance of hypoalbuminaemia is worrying in this context as it worsens prognosis of cancer patients.
**Keywords:** albumin, cancer, radiotherapy, total protein, Zimbabwe.

## INTRODUCTION

Cancer is the uncontrolled growth of cells which can invade and spread to distant sites of the body [1]. It is a potentially fatal disease caused mainly by environmental factors that cause genetic damage to critical cell-regulatory proteins that regulate growth and proliferation of cells in the body [2]. Genetic damage can be caused by three types of carcinogens namely chemicals, radiant energy and microbial agents. Chemical and radiation energy are the most common causes of cancer in humans and they can be found in certain foods, sunlight, alcohol and cigarettes. Some common cancers include breast, cervical, prostate, neck, head and colorectal cancer [1].

Cancer is a major public health concern and cause of death in many parts of the world and the African region is not spared [3, 4]. In Zimbabwe cancer is a major cause of morbidity and mortality with over 5000 new diagnoses and over 1500 deaths per year [5]. Many of the cancer cases in Zimbabwe are related to HIV infection therefore the country is facing a huge double burden of HIV and cancer [6]. In Zimbabwe, cervical cancer is the most common type of cancer in women while prostate cancer is the most common cancer in men [7]. Each year more than 5000 new cases of all types of cancer are diagnosed and this is expected to double in the next twenty years [8]. Reduction in the number of new cancer cases can be achieved by avoiding known risk factors such as the use of tobacco, alcohol use and unhealthy diets [8].

One of the cancer treatment methods used in Zimbabwe is radiotherapy[9].Radiotherapy is the use of high energy X-rays to destroy cancer cells and its use as a central part of curative treatment for several types of cancer has been developed during the last decades [9, 10]. It works by damaging the genes that control cell growth and proliferation causing cell death and shrinkage of the tumour [11]. Unfortunately, radiotherapy kills actively dividing cells including normal cells and this causes unwanted side effects and the most common side effects include tiredness, hair loss, loss of appetite and diarrhoea [9, 11]. Side effects depend on the type of cancer being treated and malnutrition is one of them. Hence albumin and total protein are some of the parameters used to assess the nutritional and health status of cancer patients [12-14].

Hypoalbuminaemia and hypoproteinaemia are common in critically ill cancer patients and have been reported as negative prognostic factors for survival in breast cancer and other types of cancer [15-17].

Hypoalbuminaemia and hypoproteinaemia are expected to be prevalent in cancer patients as prevalence of malnutrition in patients with cancer ranges from 28 to 87% depending on tumour type, stage of disease and therapy applied [18]. The aim of this study was to determine the serum levels of albumin and total protein in cancer patients on radiotherapy and compare levels between patients with cervical, breast and prostate cancer, respectively.

## MATERIALS AND METHODS

**Study Design:** A cross-sectional study

**Study Period:** 2 November 2015 to 30 April 2016.

**Study Site:** The study was carried out at Parirenyatwa Radiotherapy Clinic. Samples used for this study were collected from cancer patients attending the clinic and analysed in the Biochemistry Laboratory. Information on the type of cancer and when patients had started radiotherapy was obtained from the Radiotherapy Clinic records.

**Participants:** Patients recruited had either cervical, breast or prostate cancer.

**Sample Size:** A minimum of 87samples was required for this study; sample size was calculated using the Dobson's formula for descriptive studies.

**Sample Collection:** Samples were collected by vacutainer into plain tubes and separated by centrifuging at 3000rpm for 5 minutes. Serum was aliquoted into serum pots for storage prior to analysis.

**Sample Analysis:** Biochemical analysis was carried out using the Beckman Coulter AU680 Chemistry Analyser in the Biochemistry Laboratory. The analyser was maintained, calibrated and controls were run every day before samples were analysed. The albumin test is based on the ability of albumin to bind to the indicator dye bromocresol green (BCG) under acidic conditions (pH 4.3) to form a blue-green complex while the Biuret biochemical test for total proteins is based on the ability of proteins to form a violet-blue complex with copper salts in an alkaline medium.

**Reference range**: The normal reference range for serum albumin is 3.5 to 5.4g/dl i.e. (35g/L to 50g/L) and that for serum total protein is 6 to 8g/dl (i.e. 60 to 80 g/L) [19, 20].Serum albumin level less than 3.5g/dl or 35g/L is known as hypoalbuminaemia and it may lead to oedema while hypoproteinaemia is defined as serum total protein less than 6g/dl (i.e. 60g/L) [20, 21].

**Ethical Considerations**

The study was approved by the Joint Research Ethics Committee for the University Of Zimbabwe College of Health Sciences and the Parirenyatwa Group of Hospitals (JREC).

## RESULTS

Patients attending the Radiotherapy Clinic came from the capital city, Harare and surrounding towns. A total of 63 cancer patients with either cervical, breast or prostate cancer on radiotherapy were recruited. Patients were aged between 26 and 99 years of age, 30 (47%) had breast cancer, 18 (29%) had cervical cancer and 15 (24%) had prostate cancer. Of all 63 study participants only 15 (24%) were males, 18 (28.6%) hadhypoalbuminaemia (Figure 1) and 4.7% had hypoproteinaemia (Figure 2). There was no difference in average levels of albumin and protein when patients were compared by type of cancer (Table 1) and age (Figures 3 and 4). All mean albumin and total protein levels were normal when patients were grouped by type of cancer (Table 1).

**Table 1: Means, standard deviations and medians for all cancer types**

| Variable | Type of cancer for radiotherapy treated patients | | | p value |
|---|---|---|---|---|
| | **Breast** n=30 | **Cervical** n=18 | **Prostate** n=15 | |
| **Albumin (g/L)** | | | | |
| Mean ± SD | 40.4 ± 19.7 | 36.7 ± 5.2 | 37.4 ± 4.8 | *NS |
| Median (IQR) | 38.5 (32.5–42.5 ) | 38.0 (34.0–40.5) | 39.0 (32.0–42.0) | - |
| *Range* | *Normal* | *Normal* | *Normal* | |
| **Total Protein (g/L)** | | | | |
| Mean ± SD | 74.1 ± 7.37 | 72.9 ± 8.71 | 72.5 ± 5.9 | - |
| Median (IQR) | 74.0 (69.0–80.5) | 74.5 (68.0–78.5) | 73.0 (67.0–78.0) | *NS |
| *Range* | *Normal* | *Normal* | *Normal* | |

SD, standard deviation; IQR, interquartile range; g/L– grams per litre, n- number of participants; NS, not significant, *Difference between groups was tested using one way ANOVA for total protein and the Kruskal-Wallis test for albumin

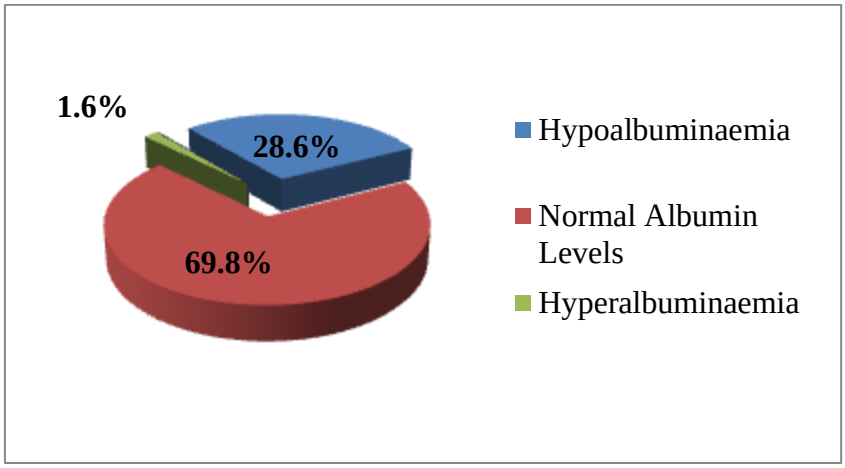


**Fig-1: Showing distribution of serum albumin levels**

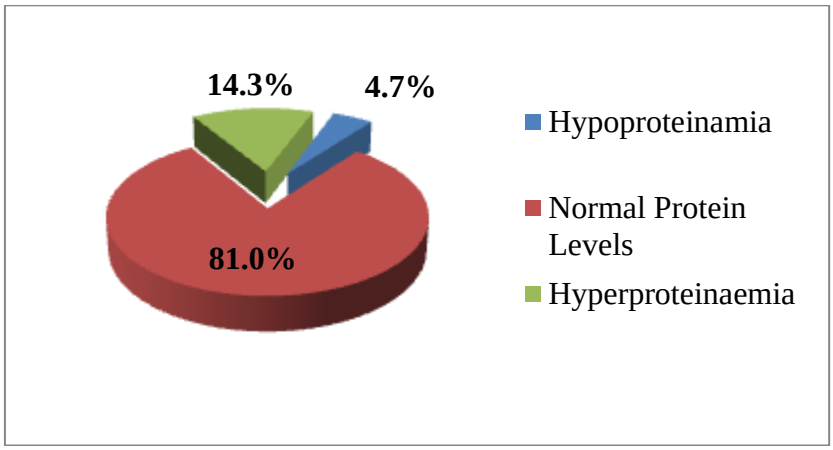


**Fig-2: Showing distribution of serum total protein levels**

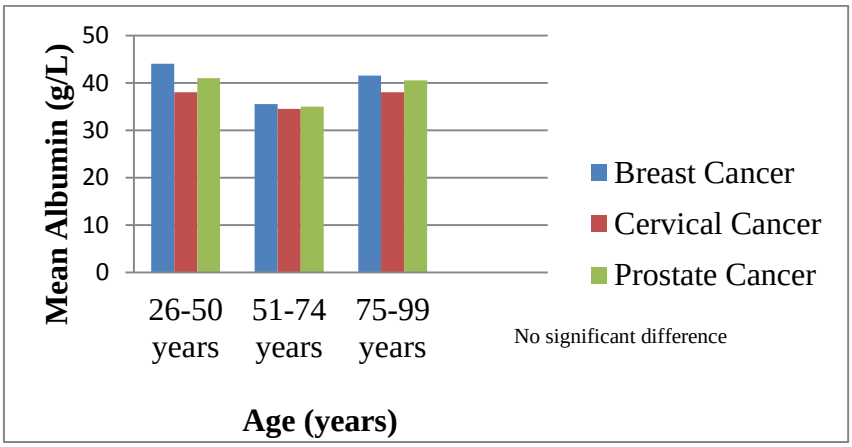


**Fig-3: Age based comparisons of serum albumin**

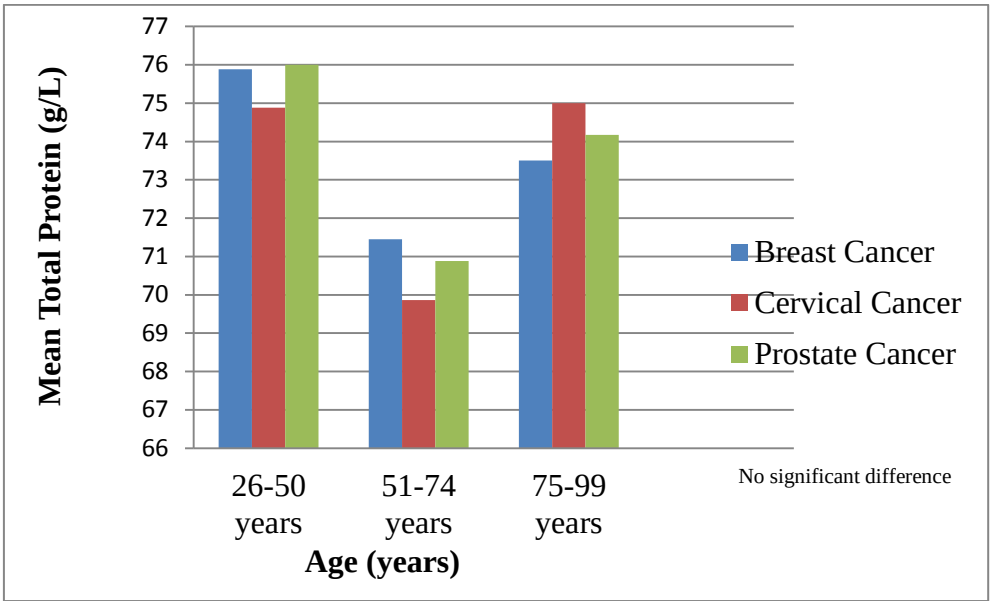


**Fig-4: Age based comparisons of serum total protein**

## DISCUSSION

Of the 63 cancer patients who took part in this study, 18 (28.6%) were hypoalbuminaemic (Figure 1). Ross et al reported that prevalence of malnutrition in cancer patients ranges from 28% to 87% and this agrees well with the finding in the current study for hypoalbuminaemia [18]. However there is need for further study because though hypoalbuminaemia could have been due tomalnutrition, it could also be due to suppression of albumin synthesis by inflammatory mediators such as interleukin-1 (IL-1) and tumour necrosis factor-α (TNF-α) [22]. Another possibility could be increased albumin uptake by tumour cells or due to the function of serum total proteins especially albumin as antioxidants in cancer [16, 23].This could be due to its high content of thiol groups which have a chain breaking effect in the termination of the chain reaction of lipid peroxidation [24]. Another possible pathway for the loss of serum proteins could be increased capillary permeability due to capillary induced changes caused by radiotherapy [25]. Radiotherapy, mainly gamma radiation modifies the protein structure of albumin thereby decreasing its level in blood and this was shown in a study by Gaber et al in 2005 which reported a decrease in bovine serum albumin after exposure to gamma radiation [26].

The number of patients who had hypoproteinaemia in the current study was 4.7% (n=3). This low prevalence is in agreement with earlier studies which reported a significant reduction in plasma albumin after radiotherapy but no significant change in plasma protein [16].This result may need to be explored further as apparently normal levels of protein could be due to acute phase proteins produced by the liver in response to the cancer although reasons for this low prevalence were not researched in this study.

Table 1 also shows comparisons of the means of serum albumin and total protein from all the three groups of cancer patients. All mean levels were normal; there was no significant difference ($p > 0.05$) between the patients in the different cancer groups. Figure 3 and Figure 4 show comparisons of serum albumin levels and total protein levels based on the ages of participants and there was also no significant difference for patients in different age groups. This shows that neither age nor the type of cancer the patient is associated with degree of hypoalbuminaemia or hypoprtenaemiain the cancer patients studied.

## CONCLUSION

In conclusion more than 28% of patients studied had hypoalbuminaemia and 5% had decreased protein levels.. Results from this study show that levels of albumin and protein are sometimes decreased in cancer patients undergoing radiotherapy regardless of the type of cancer the patient has and the prevalence compares well with reports from other countries. The high prevalence of hypoalbuminaemia is of concern as it has prior been associated with a number of clinical consequences, including deteriorated quality of life, decreased response to treatment, increased risk of chemotherapy-induced toxicity and a reduction in cancer survival.

## RECOMMENDATIONS

Based on the findings of this study it is recommended that an experimental or randomised clinical trial on a larger population be carried out to ascertain the cause of the decreased levels of albumin and total protein in some patients. The study design can also be improved by doing a longitudinal study in which preoperative and postoperative serum levels of albumin

and total protein will be measured. This would clearly show if radiotherapy or cancer itself associated with hypoalbuminaemia and hypoproteinaemia. Results of such studies have potential to help clinicians who handle patients with evidence necessary to recommend administration of albumin supplements to patients with severely depleted levels of albumin to avoid complications such as: malnutrition and oedema.

**REFERENCES**


1. Kumar, V., Abbas, A., & Aster, J. (2013*). Robbins-Basic Pathology* 9th Edition. Elsevier Saunders, Philadelphia.
2. Priyanga, A., & Prakasam, S. (2013). Effectiveness of Data Mining-based Cancer Prediction System. *International Journal of Computer Applications*, *83*(10), 0975–8887.
3. Ferlay, J., Shin, H., Bray, F., Forman, D., Mathers, C. (2010). Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *International Journal of Cancer*, *127*(12)**,** 2893-2917.
4. von Lilienfeld-Toal, M., Berger, A., Christopeit, M., Hentrich, M., Heussel, C. P., Kalkreuth, J., Klein, M., Kochanek, M. (2016). Community acquired respiratory virus infections in cancer patients: Guideline on diagnosis and management by the Infectious Diseases Working Party of the German Society for haematology and Medical Oncology, Review. *European Journal of Cancer*, *67*(200e212).
5. Nyakabau, A. M. (2014). Priorities for cancer prevention and control in Zimbabwe. *Cancer Control*, 126-130.
6. Awolude, O. A., Morhason-Bello, I., O. Denny, L. A., & Adewole, I. F. (2013). Human papillomavirus infection and related cancers in sub-Saharan Africa: burden and tools for prevention. *Vaccine*, *31*, vii-vix.
7. Bruni, L., Barrionuevo-Rosas, L., Albero, G., Aldea, M., & Serrano, B. (2015). Information Centre on HPV and Cancer (HP*V Information Centre),Human Papillomavirus and Related Diseases in Zimbabwe*. Summary Report 2014.
8. Zimbabwe Ministry of Health and Childcare. (2014). *National Cancer Prevention & Control Strategy for Zimbabwe*, 2013-2017, Available @ http://www.iccp-portal.org/sites/default/files/plans/CANCER%20STRATEGY%20FINAL%202013%202017.pdf, downloaded 7 August 2017.
9. Cox, J., & Ang, K. K. (2010). *Radiation Oncology*, 9th edition, Mosby Elsevier.
10. Owen, J. B., Coia, L. R., & Hauks, G. E. (1992). Recent patterns of growth in radiation therapy facilities in USA. *International Journal of Radiation Oncology, Biology, Physics*, *24*(5), 983-986.
11. Hofman M., Ryan, J. L., Figueroa-Moseley, C. D., Jean-Pierre, P., & Morrow G. R. (2007). Cancer-Related Fatigue: The Scale of the Problem. *The Oncologist*, *12*(S1), 4-10.
12. Mahdavi, R., Faramarzi, E., Mohammad-Zadeh, M., Ghaeammaghami, J., & Jabbari, M. V. (2007). Consequences of radiotherapy on nutritional status, dietary intake, serum zinc and copper levels in patients with gastrointestinal tract and head and neck cancer. *Saudi Medical Journal*, *28*(3), 435-440.
13. Bozzetti, F., Migliavacca, S., Scotti, A., Bonalumi, M. G., Scarpa, D., Baticci, F., Ammatuna, M., Pupa, A., Terno, G., Sequeira, C., & Masserini, C. (1982). Impact of cancer, type, site, stage and treatment on the nutritional status of patients. *Annals of surgery*, *196*(2), 17.
14. Nicholson, J. P., Wolmarans, M. R., & Park, G. R. (2000). The role of albumin in critical illness. *British Journal of Anaesthesia*, *85* (4), 599-610.
15. Walker, S., Beckett, G., Rae, P., & Ashby, P. (2013).*Clinical Biochemistry Lecture Notes*, 9th Edition, John Wiley & Sons Ltd, West Sussex.
16. Abulkassim, R. A. R., Ismael, D. K., Numan, N. A. M., Al-Shawi, N. N., & Hussain, S. A. R. (2012). The Effect of Radiotherapy on Oxidative Stress, Biochemical and Hematological Parameters in women with Breast Cancer. *AJPS*, *14*(2), 1-9.
17. Jin, Y., Zhao, L., & Peng, F. (2013). Prognostic impact of serum albumin levels on the recurrence of stage I non-small cell lung cancer. *Clinics (Sao Paulo)*, *68*(5), 686-693.
18. Ross, P. J., Ashley, S., Norton, A., Priest, K., Waters, J. S., Eisen, T., Smith, I. E., & O'Brien, M. E. (2004). Do patients with weight loss have a worse outcome when undergoing chemotherapy for lung cancers? *British Journal of Cancer*, *90*(10), 1905–1911.
19. Walker, S., Beckett, G., Rae, P., & Ashby, P. (2013). *Clinical Biochemistry Lecture Notes*, 9th Edition, John Wiley & Sons Ltd, West Sussex.
20. Chamberlain, R. S., Atkins, S., Saini, N., & White, J. C. (2000). Ileal perforation caused by cytomegalovirus infection in a critically ill adult. *Journal of clinical gastroenterology*, *30*(4), 432-435.
21. Heys, S. D., Walker, L. G., Deehan, D. I., & Eremin, E. (1998). Serum albumin: a prognostic indicator in patients with colorectal cancer. *J R CollSurg Edinb*, *43*(3), 163-8.
22. Richter, E., Connelly, R. R., & Moul, J. W. (2000). The role of pre-treatment serum albumin to predict pathological stage and recurrence among radical prostatectomy cases. *Prostate Cancer and Prostatic Diseases*, *3*(3), 186-190.
23. Wunder, A., Stehle, G., Sinn, H., & Heene, D. L. (1997). Enhanced albumin uptake by rat tumors. *International Journal of Oncology*, *11*(3), 497-507.

24. Halliwell, B. (1988). Albumin- an important extracellular antioxidant? *Biochem. Pharmacol, 37*, 569-571
25. Gatti, R. M., Radi, R., & Augusto, O. (1994). Peroxy nitrite mediated oxidation of albumin to the protein thiyl free radicals. *FEBS Letters*, 348, 90.
26. Gaber, M. (2005). Effect of gamma irradiation on the molecular properties of bovine serum albumin. *J BiosciBioeng, 100*(2), 203-6.