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Impact of Applying Dietary Pattern on Nutritional Status of Patients with Leukemia Undergoing Chemotherapy

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Abstract

Leukemia is common neoplastic disease accounting 40-55% worldwide. Malnutrition in cancer patients has been reported occurrence 36% of patients in USA and in 50 % of patients in Netherlands. Patients' nutritional needs must include energy requirement to support the patient during the disease and its treatment. **Aim:** To evaluate the impact of applying dietary pattern on the nutritional status of patients with leukemia undergoing chemotherapy. **Design:** Quasi/experimental research design was utilized in this study. Sample: A purposive sample of 120 patients with leukemia was included in the study. **Tools:** Data was collected by using two tools. Patients were interviewed to collect socio-demographic data and medical history of the disease. The subjects were undergone a comprehensive nutritional assessment and application of dietary pattern. Data was collected during a period of 6 months. **Results:** The results showed that impact of dietary pattern during chemotherapy was significantly effective in improving the ` nutritional status, the chemotherapy side effects and their management. It also showed improvement in the leukemic patients` anthropometric measurements and laboratory investigations. **Conclusion:** Impact of a dietary pattern during chemotherapy was significantly effective in improving the patients 'nutritional status and their knowledge about nutrition and treatment Recommendations: Emphasizing the importance of nutritional assessment and management process in the medical settings are mandatory. Educating and training the nursing staff to be familiar with how and when to apply such process and improving the food services in medical setting are highly recommended.

Key words: Dietary pattern, Nutritional status, leukemia, chemotherapy.

Introduction

Leukemia refers to a cancers of white blood cells, in which large numbers of abnormal white blood cells are produced in bone marrow. These abnormal white blood cells crowd the bone marrow and flood the blood stream, but they cannot perform their proper role of protecting the body against disease because they are defective**(Lewis,2018**).As leukemia progresses, the cancer interferes with the body production of other types of blood cells, including red cells and platelets.

About 245,000 people in the United States are affected with some form of leukemia, including those that have achieved remission or cure. Rates from 1975 to 2011 have increased by 0.7% per year among patients Approximately 44,270 new cases of leukemia were diagnosed in the year 2018 in the US. This represents 2.9% of all cancers (excluding simple basal cell and squamous cell skin cancers) in the United States, and 30.4% of all blood cancers**(Cancer Health center, 2017).**

Malnutrition in oncology population has been reported to occur in 32% of patients in USA and in 50% of patients in Netherlands. Fundamental to managing the malnutrition problem is to detect it. In-depth nutritional assessment should provide the opportunity to identify malnutrition or patients at high nutritional risk at an early stage of medical care, establish nutritional needs and care plans, and to assess the appropriate route of nutrition (**Cancer Health Center, 2019)**.

Routine assessment of patients to identify risk of malnutrition has been recommended by many national, international and specialized organizations**.** The patient's weight and height are among the simplest anthropometric measures. Moreover, when measured accurately and regularly, weight changes are valuable indicators of nutritional risk. Body Mass Index is an indirect measure of lean body mass and fat stores **(Crist, Pui, Arvin, 2017).**

Treatment of leukemia involves chemotherapy only or in combination with radiotherapy and/or surgery. Chemotherapy is the most effective treatment. Other hand, it causes several side effects which interfere with the quality of life and daily habits. Some of these side effects are anorexia, vomiting, dry mouth, taste and smell changes, fatigue, pallor, weight loss, infection, alopecia, bone and joint pain, fever, easy bruising, Epistaxis or other hemorrhage, hepatomegaly, splenomegaly and lymphadenopathy **(Crist, 2017)**

The link between the good nutrition and the disease prevention is similarly strong. The good nutritional support and advice can achieve significant improvements in the nutritional status and reductions in morbidity and mortality. It prevents or treats malnutrition or deficiencies in specific nutrients and potentially hinders progression of the disease. Also, it decreases the rate and incidence of complications of the disease **(Hoffman, Benz, Shattil, 2017)**.

For those reasons nutrient care and support should be a component part of the total health care provided specially for patients with leukemia. An appropriate diet is a part of the overall treatment that can help the patient cope with the symptoms of the disease. It may enhance the response to the treatment and lessen its side effects, maintaining or adopting a healthy eating pattern provides benefits that go beyond immediate wellbeing to ensure a better

health status later in life and potentially slow the progression of cancer**(linshner, 2018)**.

The disease progresses slowly; subtle nutritional deficits are not always obvious at early stages. Therefore, it is vitally important that the patients with leukemia try to maintain a balanced diet with an adequate energy, protein, carbohydrate, fat, vitamins, minerals and fluids. Eating well can become more challenge as the leukemia cancer progresses**(van Lieshout et al, 2020).**

So, the nutritional assessment and support is very important to reduce or stop the incidence of complications, stability of the complete blood count, and prepare the patient for the treatment phase to be able to cope with its different side effects. **(American Dietetic Association, 2019).**

Aims of the Study

The present study aims to evaluate impact of applying dietary pattern on the nutritional status of patients with leukemia undergoing chemotherapy. This can be achieved through:

- Assess eating habits according to nutritional requirements
- Identify nutritional complications for patients undergoing chemotherapy
- Determine signs and symptoms of malnutrition.
- Compare results of lab investigations.

Research Hypothesis:

Patients undergoing chemotherapy who exposed to dietary pattern exhibited improvement in the nutritional status than those who do not use.

Method

Research Design:

Quasi/experimental research design was utilized in this study.

Setting:

This study was conducted at the outpatient clinics of oncology center at Mansoura University Hospital.

Subject:

- A Purposive sample of 120 adult patients of both sexes with the diagnosis of leukemia.

Criteria for selection of the subjects:

Inclusion criteria:

- Leukemia patients
- Aged from 20 to 60 years old.
- Receiving chemotherapy for first time.
- Free from communication, vision, and hearing disorder.
- Available for telephone follow-up.
- Willing to participate in the study and have the ability to learn.
- Post the 1st induction cycle of chemotherapy.

Exclusion criteria:

- Free from any other chronic conditions that affect the nutritional status such as Diabetes and kidney failure.

Tools:

Tools: Two tools were used in this study:

Tool I:Patients' Knowledge aboutNutritional Needs during ChemotherapyStructured Interview Schedule:

The tool was developed by the researcher to assess the patients' knowledge about nutritional needs during chemotherapy. It consists of:

Part 1:

- Demographic data such as age, sex.
- Medical history of the disease such as date of diagnosis, time of starting treatment, number of chemotherapy sessions per month.

Part 2: patients' knowledge about nutritional requirements during chemotherapy and nutritional patterns such as likes and dislikes number of meals per day, snacks…etc.

Part 3: Chemotherapy Nutritional Side Effects: It assessed the type and frequency of the side effects induced by chemotherapy such as nausea, vomiting, diarrhea, and stomatitis…etc.

ToolII: Patients' utritionalAssessment Tool

The tool was developed by the researcher. For the purpose of assessing the patients' nutritional status, the following data was collected:

PartA:Anthropometric asurements included the weight, height, Body Mass Index (BMI), mid-arm circumference, and skin fold thickness.

Part B: Biochemical Data included hemoglobin, hematocrit, total serum albumin, total lymphocytic, red blood count, glucose levels, and blood urea.

Part C: Clinical Data included vital signs, general condition, patient's activity level, face, eyes, skin, and gastrointestinal problems.

Method

Data collection

This study will be conducted in three phases; preparation, implementation, and evaluation phase.

Preparation Phase

- Permission to carry out the study was obtained from the responsible authorities of the Outpatient oncology center at Mansoura University Hospital after an explanation of the aim of the study.
- Development of tools was done after thorough review of literature.
- All tools were tested for content validity and clarity by 5 experts (jury) in the field of the study (validity =0.89%).
- Suggestions of the jury members will be followed and tool will be modified as indicated.
- All tools were tested for reliability using Cronbach's coefficient alpha test (r= 0.89)
- Verbal consent of the patients sharing in the study was obtained.
- ***The frame work of the study will be carried out according to 4 phases: -***

Assessment phase*:* Patients who will be agreed to participate in the study and fulfilled the inclusion criteria was included in the study. They All patients was assessed immediately on the first visit to the outpatient to collect base line data using the tool I, II.

- The patients were interviewed individually to collect the sociodemographic data about the sample and medical history of the disease (Tool I).
- The subjects were undergone a comprehensive nutritional assessment that included:
- Assessing the knowledge about proper nutrition during chemotherapy (Tool I). Patients were interviewed in relation to patient's nutritional needs during chemotherapy at the beginning and at the end of the study.
- Assessing chemotherapy related nutritional problems in the relation to type and frequency (tool I) Patients were asked about side effects of chemotherapy that have an effect on their nutritional status (nausea, vomiting, loss of appetite, and diarrhea… etc) at the beginning and at the end of the study.
- Assessing patients' nutritional status (Tool I) the patient was done

three times: pre dietary pattern application, after 2 months and, post dietary pattern application:

- Weight, height, mid-arm circumference, and skin fold thickness were measured and recorded.
- Body Mass index (BMI) was calculated and recorded.
- All laboratory investigations were taken from the patients' medical record.

They included hemoglobin, hematocrit, total lymphocytic, red blood count, glucose levels, and blood urea.

Planning phase: Based on the finding of the assessment phase goals, priorities, and expected outcomes will be formulated. In this phase three sessions were planned by researcher for studied group.

Implementation phase:

The dietary Pattern for Patients with Leukemia:

It contained information related to leukemia, chemotherapy and its nutritional side effects and how to prevent or manage them. It also included nutritional requirements needed during chemotherapy and how to prevent poor nutrition.

Objectives

By the end of implementation of the dietary pattern, patients were able toList the side effects of chemotherapy that have an effect on the nutritional status,

- Explain how to manage each nutritional problem related to chemotherapy
- Recognize the signs of poor nutritional status.
- Comprehend the importance of good nutrition during chemotherapy
- Colored booklet was developed about the allowed and prohibited, foods examples, how to deal with side effect of chemotherapy that affect on dietary intake. It was distributed to the patients.
- Audio-visual materials and a laptop were used. Arabic booklet was distributed for each patient.
- The instructions about the diet were presented in form of sessions for all study group patients as the following:
- ***The first session*:** at the second day of the first visit to the outpatient clinic. It covered the following (the definition of leukemia and its treatment, side effects of chemotherapy and made nutritional assessment to the patients.
- ***The second session*:** after three days from the first visit. It covered the goal of the nutritional support, what to be considered when preparing the diet and allowed and prohibited food.
- ***The third session*:** after five days from the first visit for instructing the patients on how to deal with side effects of chemotherapy that affect the nutritional status.
- The time of the sessions was arranged with the same time of the patient attendance to the outpatient chemotherapy unit to complete the investigation to save the patient time, decrease patient overload for attendance to the unit especially for the researcher and give the patient chance to be adherence for the attendance to the clinic in the correct time.
- The patients were divided into small groups; each group consists of 5patients. The researcher was interviewing each patient in the group separately for explaining the nutritional diet, using question and discussion throughout the interview.

- Each interview was lasted for 30-45 minutes. In each interview the researcher reinforced and guides the patient about nutritional support.

The evaluation phase: Compare between the results of studied group pre and post dietary pattern application to determine impact of dietary pattern on nutritional status for patients with leukemia undergoing chemotherapy.

Patients were evaluated and assessed for three times using developed and adopted tools:

First time*:* immediately on the first visit to the clinic.

Second time: two months after the first visit to the clinic.

Third time: six months from the beginning of the first visit.

Ethical considerations:

Verbal consent was obtained after explaining the purpose of the study. Privacy was maintained during the process of data collection. Confidentiality of collected data and anonymity were guaranteed.

Statistical Analysis

After data was collected it was revised, coded and fed to statistical software SPSS version 20. The given graphs were constructed using Microsoft excel software.

All statistical analysis was done using two tailed tests and alpha error of 0.05 P value.

Results

Part I: The socio-demographic and the medical data of leukemic patients:

This table shows that, no significant difference between study and control groups as regard sociodemographic characteristics. In addition, the study and control groups are matched as regard to age, gender, and the level of education, marital status, occupation, income, family size, and living status.

Regarding the age, this table revealed that, 36.7of the patients in the study group were in the age group of 41-years with mean age39. In relation to sex half of the study subjects were females. They constituted 50% of the study group were males and females.

Concerning level of education, the illiterate and university education were constituted approximately 26.7 of the study group. In addition, private occupation was found that the most prevailing job 40.0 and 33.3 among patients in study groups.

As regard to income the majority of patient in the study group and control groups (73.3) had low income. As regard to the family member it was noticed that, the majority of patient in the study groups had 4 – 6 member in his family. Approximately (70.0) living with their family.

In relation to activity, the majority of patient in study groups (61.7%) were performing moderate activity.

Table (I1)shows the relationship between chemotherapy side effects pre and post the dietary application and number of chemotherapy sessions.Pre the dietary pattern application, mouth ulcers were detected in all numbers of sessions. However, ulcers were significantly higher in patients who had two sessions (83.3) than those who had one session (31.8) and three sessions (71.4). Differences are statistically significant at 0.05 ($p = 0.001$). Furthermore, all patients who had 3 sessions have diarrhea compared to 54.5% of them who had one session and to 41.7% of them who had two sessions. A statistical significant difference is found at 0.05 ($p = 0.002$).

Post the application of dietary pattern, vomiting was found in all leukemic patients who had one session compared to 41.7% of those who had two sessions and 85.7% of those who Statistically significant differences are found at 0.05 (p = 0.000). Moreover, loss of appetite and diarrhea prevalence was significantly higher in those who had three sessions (85.7% and 100% respectively) when matched to those who had two (41.7 and 54.2 consecutively) and one session (68.2 and 4.5 respectively). The differences are statistically significant at 0.05 (p =0.019 for loss of appetite and p= .000 for diarrhea). On the other hand, constipation was only detected in those who had one chemotherapy session (27.3%). Differences are statistically significant at 0.05 (p = 0.003).

Table (III) shows the relationship between, chemotherapy stage and number of chemotherapy sessions and total energy intake at the beginning of the study.Energy intake differs between males and females where females consumed more energy intake than males. No statistical significant difference is found. Moreover, residence shows a difference in energy intake between rural and urban areas but it is not statistically significant.

Concerning the chemotherapy stage, patients in the consolidation phase consumed less than patients in other phases. Differences are not statistically significant. Regarding number of chemotherapy sessions, the more sessions the patients have the less energy intake they consume. Differences are statistically significant at 0.05 (p = 0.000).

In **table (IV)**, illustrates the relationship between chemotherapy stage and number of chemotherapy sessions and BMI at the beginning of the study, post 2months, and at the end of the study. At the beginning of the study, patients in the maintenance phase had higher mean BMI (26.2±4.0) than those in consolidation phase (23.1±2.2) and delay intensification phase (24.0±1.6). Differences are statistically significant 0.05 (p = 0.003). Moreover and post 2months, patients in the maintenance phase had higher mean BMI (26.5±4.1) than those in consolidation phase (23.7±2.0) and delay intensification phase (24.5±1.5).

Differences are statistically significant at 0.05 (p = 0.011). At the end of the study, patients in the maintenance phase had higher mean BMI (27.4±4.3) than those in consolidation phase (23.0±1.9) and delay intensification phase (25.2±1.5). Differences are statistically significant at 0.05 (p =0.000).Regarding number of chemotherapy sessions, although there are differences of mean BMI between patients who has one session, two sessions, and three sessions of chemotherapy, but those differences are not statistically significant.

Table (V)shows the relationship between chemotherapy stage and number of chemotherapy sessions and protein intake at the beginning of the study. Patients who had one chemotherapy session consumed more protein (30.1g) than those who had two (18.3g) or three sessions (25.6g). Differences are statistically significant at 0.05 (p= 0.004).

Table(VI)illustrate the relationship between chemotherapy stage and chemotherapy sessions and carbohydrates intake at the beginning of the study. Regarding number of chemotherapy sessions, patients who had one session consumed more

carbohydrates (105.2) than those who had two and three sessions (57.9 and 33.7respectively).Astatistically ignificant difference is found at 0.05 (p=0. 0.001).

As **table (VII)** presents the relationship between chemotherapy stage and number of chemotherapy sessions and total energy intake at the end of the study. Patients in the delay intensification stage had the highest energy intake with 972.1Kcal compared to 487.5 in the consolidation stage and 358.7 in maintenance stage. Differences are statistically significant at 0.05 (p = 0.033). Regarding number of chemotherapy sessions, patients who had one session had more energy intake (992.7kcal) than those who had two (358.7) and three sessions (5 18.3). Differences are statistically significant at 0.05 (p = 0.000).

Table (VIII) presents the relationship between, chemotherapy stage and number of chemotherapy sessions and protein intake at the end of the study. Concerning chemotherapy stage, patients in the delay intensification phase consumed higher protein intake (39.2g) compared to those in consolidation (27.1) and maintenance (20.2) phases. The differences are statistically significant at 0.05(p = 0.047).

Patients who had one chemotherapy session had higher protein intake (42.0g) than those who had two sessions (20.2g) and those who had three (28.5g). A statistically significant difference is found at 0.05 (p = 0.000).

Table (IX) presents the comparison between the mean value and SD of some of biochemical data. Concerning the mean value of Hb levels, they increased from 8.8±2.7g/dl. at the beginning of the study to 9.3±1.8 post 2 months to 9.6±1.7 at the end of the study. Differences are statistically significant at 0.05 (p= .003). Furthermore, mean value of Hct levels differences are statistically significant at 0.05 (p= .000) when these levels increased from 27.8±9.6 at the beginning of the study to 30.7±6.2 at the end of the study. On the other hand, although serum albumin levels are increased from 3.0±0.7 to 3.1±0.4 both post 2 months and at the end of the study, no statistically significant difference is found.

Mean value of WBC and RBC at the beginning of the study are $6.6x10^3$±5.6 and $2.8x10^6$±0.6 respectively. They are increased to $8.7x10^3$±4.5 and $3.0x10^6$±0.6 consecutively post 2 months and to $9.0x10^3$±3.0 and $2.9x10^6$±0.4 at the end of the study. Differences are statistically significant at 0.05 (p= .000 and p= .000 respectively).

An increase in the mean value of serum urea is observed post 2 months of the study (24.8±5.5mg/dl). However it decreased to 22.9±3.9 at the end of the study and the difference is statistically significant at 0.05 (p = .000).

Discussion

The present study shows the impact of a dietary pattern on the nutritional status ofleukemic patients undergoing chemotherapy. Patients went through a comprehensive nutritional assessment and evaluation throughout different stages during the study pre and post the application of the dietary pattern. **Therefore;** this study was aimed to evaluate effect of applying dietary pattern on the nutritional status of patients with leukemia undergoing chemotherapy.**:**

leukemia is one of the 10 most common malignancies and the major form of cancer in most of Arab countries. With a prevalence rate of 8, 2 and 4, 8

per 100,000 inhabitants in Egypt and Syria respectively, those two countries are internationally ranked as number 30 and 44 consecutively **(Haward and Lins, 2019)**

The current study involved 120 leukemic patient, About half of them were males, a finding that goes in line with the generally reported higher frequency of cancer among males compared with females andthe present study findings revealed that, more than half of the study groups were in middle adult. This result is in agreement with **Cherry (2017)** report that, leukemic patients are in the age group of 30 to 39 and may become affected by complications of the disease over the next 10 to 20 yearsa finding that goes in line with the generally reported higher frequency of cancer among males compared with females Moreover, incongruent with the current study, mentioned that males were affected more often by the result of the present study is contradicting withwho clarified that, the prevalence of leukemia was higher in males due to exposure to numerous risk factors as compared to females which is in conformity with another local study. According to our cultural environment, females are only negligibly exposed to some of the risk factors.

The theory is known as **Population Mixing** Theory **Kinlen(2016)**. Susceptible individuals who live in rural areas in which the population suddenly increases, or for which the composition changes regularly, mayexposed to infectious agents that are brought into the area by new residents. This possiblytriggers a cluster of cases of ALL. An excess of leukemic patients have been found in ruralpopulations that have undergone an influx of permanent residents.

Kinlen's theory implies that the differences 1n rates of leukemia in rural areas are due to differences in population of immunity in these areas However, **Rybojad(2016)** disagrees with the result ofthe present study. **Rybojad** reported that there were no differences in prevalence and overall survival between rural and urban areas among adults with lung cancer.

Agriculture pesticides are widely used in rural areas and rural patients are may exposed to this kind of pesticides than urban patients. Clothes may spread the residues to the patient's clothes. Patients are likely to be exposed toShort-range drift and ambient levels of residues in the air, and their drinking water may Contain greater levels of residues than those to which urban patients are exposed, especially if using well-water. They may also eat food directly from fields that have recently been sprayed, Furthermore; many have studies have suggested a link between pedicide exposure and leukemia.Agriculture pesticides are widely used in rural areas and rural patients are may exposed to this kind of pesticides than urban patients. The current study reported that the less the number of siblings, the higher the incidence of leukemia (**Bevier, 2019)** contradicted the previous results and reported the higher number of sibling, the higher the incidence of leukemia. Genetic diseases or cancer may shorten the reproduction.

As regard to **level of education**, the result of the present study showed that, the majority of the study group was in university and illiterate level. In fact this may be related to that, most of the study group came from rural area with low socioeconomic level and interested in manual and farmer work. This is in harmony with; **Hamayun et al**

(2015)who reported that, the prevalence of leukemia was more in illiterate subjects and increased with decreasing monthly income.

Moreover, the present study illustrated that the majority of study group were housewives, this may be related to the high prevalence of the females in the present study. Moreover private occupation accounted the highest percentage in the finding of the study group. This may be related to the majority of the study group came from rural areas with a low socioeconomic level. Also most of the students do not work in accordance with their educational level due to decreased chance of workin governmental hospital but they are working in private.

The present study emphasized that, the majority of study group **family member**ranged from 4 to 6 and **living with family**. This finding may be as low socioeconomic status of family; poor housing condition; absence of good eating habits; absence of family planning; living in rural areas and inability to reach to health insurance systems; cost and side effect of the treatment; and lack of access to screening, care, and treatment limit the use of these therapies for most patients with leukemia.

The present study showed different distributions concerning the stages of chemotherapy treatment, the duration of the treatment, and the number of chemotherapysessions. This variability in stages of anti-leukemic treatment is considered a positive pointfor the present study, which shows that the efficacy of the suggested dietary pattern applied in the current study is tested under different aspects of the malignancy stages and not restricted to a single item or phase.

There are many symptoms that result from the chemotherapy treatment that can affect the oral intake in patients with cancer. The most common symptoms are nausea and vomiting accompanied with anorexia caused by GIT mucosal cells damage due to the cancer chemotherapeutic agents. Furthermore, salivary gland damage and decreased saliva production can result in taste changes and inability to chew and swallow. These side-effects result in decreased oral intake as well as fluid and electrolytes imbalance. Therefore, the low oral intake in the present study can be associated with high percentage of patients who suffered from the chemotherapy side effects at the beginning of the study **Rodgers and Walsh(2018).**

In the present study, educating and teaching patients about their nutritional needs during chemotherapy turned to have an effect on their knowledge about the chemotherapy side effects and ways to manage them. Number patients who didn't know what cause the chemotherapy side effects decreased significantly and the number of them who were able to manage these side effects significantly increased.

This finding was documented when studying the efficacy of proactive information on self-care in chemotherapy patients. Patients receiving side effect management information proactively performed significantly higher scores on all of the self-care behavior scale and had fewer side effects. **Mooreet al (2017)** contradicted this finding.

In the current study, post application of the dietary pattern, most of the chemotherapy side effects were significantly reduced except nausea. Vomiting, loss of appetite, and mouth ulcers had a 26.7%, 21.6%, and 58.3%

reduction respectively. A small study in adults with prostate cancer found that preventative nutrition counseling which included supplementation and nutritional medical education and management resulted in a statistically significant decrease in therapy delays, hospitalizations, and complications of therapy**Hoffman(2018).** The same study also found that the intervention group was able to receive more dose-intense therapy.

Although energy, protein, carbohydrates, and fat intakes were significantly increased post application of the dietary pattern, they are still less than the recommended daily allowance for control patients suggested by the **Huhmamn et al (2019**). Assessing nutritional status of patients with hematological malignancies, **Linga et al (2017)** reported that 79% of patients had deficit caloric intake and 74%of them had deficit protein intake. A contradicting result reported by **Bond (2017**) who found that the study group energy intake was similar to healthy groups and was below the recommended dietary allowance (RDA) in both groups.

In the present study, the means weight for-age percentile have shown a significant rise post 2 months of starting the dietary pattern and at the end of the study. Considering the low energy intake of the patients in the current study, the means percentiles at the beginning, post 2 months, and at the end of study were ranged between > 50^{th} percentile and < 75^{th} percentile. Weight may further be altered by hydration status during chemotherapy**Owens (2017**). Studying the effect of glucocorticoid therapy on energy intake in patients post for ALL, **Reillyet al (2019**) reported that Glucocorticoid treatment in acute lymphoblastic leukemia increases energy intake markedly, and this effect contributes to the excess weight gain and obesity characteristic of patients being treated for acute lymphoblastic leukemia.

The other anthropometric measurements in the present study also showed a significant increase post application of the dietary pattern. Of course BMI value is largely dependent on the weight value of the patient. Moreover, **Murphy (2019**) reported that there was no significant difference in the height, weight, and BMI between the patients with cancer when the raw measurements were examined.

In the present study, all laboratory investigation has shown a significant increase post application of the dietary pattern. One study reported that anemia was one of the most common manifestations in 59% of patients with cancer having Hb level < 8gm/dl and 32% having Hb level 8-10gm/dl**Jain et al (2017).**A findingthat is similar to the results of the present study. At the beginning of the present study, Blood urea showed lowest grade of normal, then rising after 2 months to drop again at the end of the study. Acute or chronic chemotherapy induced nephrotoxicity may result from the direct effect of the chemotherapy drugs on kidney or on the glomerular distal tubule pathways or indirectly cause renal toxicity by the tumor cells releasing large volumes of ions and metabolites as they die this cellular debris can result in a blockage of the tubes resulting in impaired renal function and toxicity. Non-steroidal anti-inflammatory drugs used to treat cancer pain may cause acute kidney injury in patients with a reduced effective circulating volume. A study reported that 55% of the patients had low albumin levels and blood urea was increased beyond the reference value in 37% of the

patients. Moreover, the non-statistical slight improvement in the albumin levels might be due to improvement in the protein intake as shown in the results of the present study. However, **Huhmann and Cunningham (2019)** reported that serum albumin is not a sensitive indicator of nutritional status as it has a 14- to 20-day half-life and might be affected by other factors. Therefore, serum albumin doesn't clearly reflect the nutritional status among patients with leukemia.

Low levels of physical activity, musculoskeletal morbidity are commonly reported problems in patients with cancer. In the present study, activity level has significantly improved. Patients were encouraged to increase their physical activity explaining the benefit of physical activity on their health and nutritional status. Many studies reported that patients with malignancies have a decreased physical activity after starting their chemotherapy treatment**Fuemmeler(2017).** Moreover, intensive medical treatment and a decline in physical activity cancer patients result in reduced motor functioning. A study conducted by **Florin et al (2019)** reported that long-term survivors of ALL are less likely to meet physical activity recommendations and more likely to report no leisure-time physical activity in the past month.

Conclusion

The present study concluded that the impact of a dietary pattern of leukemic patients undergoing chemotherapy was significantly effective in improving the patients' nutritional style, their knowledge about their proper nutrition, and their treatment. It also effective in increasing the leukemic patients' anthropometric measurements, all laboratory investigations except serum albumin and improving general condition.

Recommendations

- Emphasizing the necessity of nutritional assessment and management throughout their disease and treatment course.
- Improve the food service and its quality in cancer medical setting to ensure proper nutrition to cancer patients.

- **Table (I): Percentage Distribution of Sociodemographic Characteristics of Leukemic Patients**

Sociodemographic data	No (120)	%
Age group		
20-	26	21.6
31-	28	31.7
41-	44	36.7
51- 60	12	10.0
Mean	39	
Gender		
Male	60	50.0
Female	60	50.0
Level of education		
Illiterate	32	26.7
Read &write	28	23.3
Secondary	28	23.3
University	32	26.7
Marital status		
Single	12	10.0
Married	104	86.7

Widow	2	1.7
Divored	2	1.7
Occupation		
Governmental	26	21.7
Private	48	40.0
Student	6	5.0
House wife	40	33.3
Reteirment	0.0	0.0
Income		
Low	88	73.3
Moderate	32	26.7
High	0.0	0.0
Family member		
1-3	34	28.3
4-6	70	58.3
7 or more	16	13.3
Living status		
Alone	6	5.0
With family	84	70.0
With other	30	25.0
Dialy activities		
Mild	26	21.7
Moderate	74	61.7
Sever	20	16.7

Chemotherapy side effects	**No. of chemotherapy sessions**						**MCP**
	Once		Twice		3+		
	No.	%	No.	%	No.	%	
• **Side effects Pre dietary pattern**							
• Nausea	44	100	42	87.5	28	100	0.094
• Vomiting	44	100	48	100	28	100	NA
• Mouth Ulcers	14	31.8	40	83.3	20	71.4	0.001*
• Appetit loss	44	100	40	83.3	22	78.6	0.092
• Diarrhea	24	54.5	20	41.7	28	100	0.002*
• Constipation	14	31.8	12	25	0	0.0	0.068
• Taste change	2	4.5	4	8.3	0	0.0	0.520
• Difficulty in swallowing	24	54.5	26	54.2	22	78.6	0.269
Side effects post dietary pattern							
• Nausea	44	100	48	100	28	100	NA
• Vomiting	44	100	20	41.7	24	85.7	0.000*
• Mouth Ulcers	0	0.0	6	12.5	0	0.0	0.094
• Appetit loss	30	68.2	20	41.7	24	85.7	0.019*
• Diarrhea	2	4.5	26	54.2	28	100	0.000*
• Constipation	12	27.3	0	0.0	0	0.0	0.003*
• Difficulty in swallowing	22	50.0	16	33.3	8	28.6	0.353

*** P < 0.05 (significant)**

MCP:Pvalue based on mont Carlo exact probability

Table (1I): The relationship between chemotherapy side effects pre and post the dietary application and number of chemotherapy sessions.

Chemotherapy stage, No. of chemotherapy sessions	Energy intake (Kcal) at the beginning of the study			Test	P
	Minimum	Maximum	Median		
Chemotherapy stage					
• Maintenance	135.4	1873.0	472.0		
• Consolidation	279.5	1539.8	399.5	2.1	0.351
• Delay intensification	65.7	1635.3	754.7		
No.ofchemotherapy sessions					
• Once	135.4	1873.0	792.1		
• Twice	135.4	1635.3	433.8	18.1	0.000*
• 3 times	65.7	1031.5	399.5		

Table (III): The Relationship between Gender, Residence, Chemotherapy Stage and Number of Chemotherapy Sessions and Total Energy Intake at the Beginning of The Study

* P < 0.05 (significant)

Z : Mann Whitney

X: Kruskal Wallis test

Table (IV)The Relationship Between Chemotherapy Stage And Number Of Chemotherapy Sessions And Protein Intake At The Beginning Of The Study

Chemotherapy stage, No. of chemotherapy sessions	Protein intake (g) at the beginning of the study			Test	P
	Minimum	Maximum	Median		
Chemotherapy stage					
• **Maintenance**	1.6	83.9	27.5		
• **Consolidation**	13.6	127.1	26.9	0.03	**0.984**
• **Delay intensification**	1.4	71.0	25.9		
No. of chemotherapy sessions					
• **Once**	2.4	127.1	30.1		
• **Twice**	2.4	81.8	18.3	10.8	**0.000***
• **3+**	1.4	37.3	25.9		

* P < 0.05 (significant)

Z : Mann Whitney

X: Kruskal Wallis test

Table (V) The Relationship Between Chemotherapy Stage And Chemotherapy Sessions And Carbohydrates Intake At The Beginning Of The Study.

Chemotherapy stage, No. of chemotherapy sessions	CHO intake (g) at the beginning of the study			Test	P
	Minimum	Maximum	Median		
Chemotherapy stage					
• Maintenance	31.0	254.2	60.3		
• Consolidation	33.7	208.6	56.8	0.57	0.751
• Delay intensification	11.0	184.3	58.0		
No. of chemotherapy sessions	31.0	254.2	105.2		
• Once	31.0	208.6	57.9	13.2	0.001*
• Twice	11.0	142.6	33.7		
• 3+					

* P < 0.05 (significant)

Z : Mann Whitney

X: Kruskal Wallis test

Table (VI) Presents the Relationship between Chemotherapy Stage and Number of Chemotherapy Sessions and Total Energy Intake at the End of The Study

Chemotherapy stage, No. of chemotherapy sessions	Energy intake (Kcal) at the end of the study			Test	P
	Minimum	Maximum	Median		
Chemotherapy stage • Maintenance • Consolidation • Delay intensification	279.5 234.5 268.0	1657.0 1423.9 1462.0	358.7 487.5 972.1	6.8	**0.003***
No. of chemotherapy sessions • Once • Twice • 3+	279.5 234.5 459.0	1462.0 1105.5 1657.0	992.7 358.7 518.3	21.1	**0.000***

* P < 0.05 (significant)
Z : Mann Whitney
X: Kruskal Wallis test

Table (VII): The Relationship Between, Chemotherapy Stage and Number of Chemotherapy Sessions and Protein Intake at the End of the Study

Chemotherapy stage, No. of chemotherapy sessions	Protein intake (g) at the End of the study			Test	P
	Minimum	Maximum	Median		
Chemotherapy stage • Maintenance • Consolidation • Delay intensification	9.0 9.9 6.1	91.0 113.4 129.0	20.2 27.1 39.2	6.1	0.047*
No. of chemotherapy sessions • Once • Twice • 3+	19.9 6.1 24.5	129.0 44.7 78.2	42.0 20.2 28.5	21.4	0.000*

* P < 0.05 (significant)
Z : Mann Whitney
X: Kruskal Wallis test

Table (VII) The Relationship Between Chemotherapy Stage And Number Of Chemotherapy Sessions And Carbohydrates Intake At The End Of The Study.

Chemotherapy stage, No. of chemotherapy sessions	CHO intake (g) at the End of the study			Test	P
	Minimum	Maximum	median		
Chemotherapy stage • Maintenance • Consolidation • Delay intensification	31.6 29.6 45.7	240.5 205.2 220.2	65.0 48.4 183.1	7.8	**0.021***
No. of chemotherapy sessions • Once • Twice • 3+	46.7 29.6 46.0	220.2 170.8 240.5	184.3 65.0 50.6	16.7	**0.000***

- P < 0.05 (significant)

Table (VIII): Comparison of means of BMI, Mid-arm circumference, and Skin fold thickness of the leukemic patients

		tudy phase			
nthropometric measurements				F	P
	Pre	ost 2 months	Post		
	Mean SD	Mean SD	Mean SD		
BMI (kg/m^2)	24.6 3.1	25.1 3.1	25.4 3.5	**16.9**	**0.000***
Mid-arm circumference (cm)	25.8 3.6	26.2 3.2	26.8 3.3	**10.7**	**0.000***
Skin fold thickness (mm)	12.2 2.8	12.9 2.7	13.5 2.7	**12.2**	**0.000***

Table (IX): Comparison between different laboratory investigations throughout the study phases.

Lab investigations			Study phase				F	P
	Pre		post ٢ months		Post			
	Mean	SD	Mean	SD	Mean	SD		
Hb)g/dl(	٨.٨	٢.٧	٩.٣	١.٨	٩.٦	١.٧	**٦.٥**	***٠.٠٠٣**
Hct(%)	٢٧.٨	٩.٦	٢٩.٥	٧.٦	٣٠.٧	٦.٢	**١٢.١**	***٠.٠٠٠**
Serum albumin)g/dl(	٣.٠	٠.٧	٣.١	٠.٤	٣.١	٠.٤	١.٨	٠.١٧٢
WBC (١٠٣)	٦.٦	٥.٦	٨.٧	٤.٥	٩.٠	٣.٠	**٢٠.٣**	***٠.٠٠٠**
RBC (١٠٦)	٢.٨	٠.٦	٣.٠	٠.٦	٢.٩	٠.٤	**٨.٨**	***٠.٠٠٠**
Serum urea)mg(	٢٣.٣	٤.٥	٢٤.٨	٥.٥	٢٢.٩	٣.٩	**١٢.٩**	***٠.٠٠٠**

* P < 0.05 (significant)

F:Repeated measures ANOVA

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