Journal of Experimental and Clinical Medicine
https://dergipark.org.tr/omujecm

Clinical Research

J. Exp. Clin. Med., 2020; 37(3): 61-65
doi: 10.5835/jecm.omu.37.03.001

The effects of treatment on nutrition in children with cancer

Müberra Tanrıverdi[a*], Melikenur Vural[b], Fatma Betül Çakır[c]

[a] *Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Bezmialem Vakıf University, İstanbul, Turkey*
[b] *Faculty of Medicine, Bezmialem Vakıf University, İstanbul, Turkey*
[c] *Department of Pediatric Hematology-Oncology, Faculty of Medicine, Bezmialem Vakıf University, İstanbul, Turkey*

ARTICLE INFO

Article History
Received 04 / 02 / 2020
Accepted 08 / 03 / 2020
Online Published 30 / 04 / 2020

*** Correspondence to:**
Müberra Tanrıverdi
Department of Physiotherapy and Rehabilitation,
Faculty of Health Sciences,
Bezmialem Vakıf University,
İstanbul, Turkey
e-mail: tanriverdi88@hotmail.com

Keywords:
Body mass index
Chemotheraphy
Children
Nutrition

ABSTRACT

Chemotherapy affects the diet and feeding habits of children with cancer. They experience side effects such as vomiting, diarrhea and constipation. Feeding disorders occur during treatment period of chronic illnesses such as during the chemotherapy and radiotherapy. The purpose of this study was to determine their feeding habits of the children with cancer. We applied a questionnaire concerning the feeding habits of 21 patients with cancer who received chemotherapy. The questionnaire included where, how, how often and how much children were fed. Nine (42.9%) female patients and 12 (57.1%) male patients participated in the survey. Six (28.6%) lymphomas, 5 (23.8%) sarcomas, 3 (14.3%) kidney tumors, 3 (14.3%) neuroblastomas, 2 (9.5%) brain tumors, 1 (4.8%) acute leukemia and 1 (4.8%) bone tumor were diagnosed. There was a positive statistically significant relationship between regular vegetable consumption and the measurement of body mass indexes ($r=-0.601$; $p<0.05$). Fast food consumption at least once a week was inversely correlated with the measurements of weight and height of the patients ($r=0.683$; $p<0.05$). Body mass index was found to decrease during the acute gastroenteritis periods ($r=-0.470$; $p<0.05$). There was a positive statistically significant relationship between constipation periods and the skinfold thickness measurements ($r=0.714$; $p<0.05$). Healthy feeding is especially important for every child in this patient group. Fast food consumption is one of the factors that negatively affects the health, which adversely affects the patients in the treatment process even more adversely. In the literature, there is no protocol established for the feeding of children with cancer and no guideline has been developed as a result of these studies. Our study is planned to determine this need and it might shed light on the literature with the results.

1. Introduction

Chemotherapy has effects on diet of the children diagnosed with cancer after they were treated with chemotherapy. Children live through various changes on their diet caused by chemotherapy. Because of early feeling of fullness, nausea, vomiting, diarrhea, changes in tastes in mouth, skipping meal, and reasons similar to these, they fall behind of their peers in case of nutrition. Children see various effects on their gastrointestinal system during chemotherapy treatment. During chemotherapy treatment, children do not consume some foods because of change of their taste, skipping meals, nausea-vomiting and diarrhea-constipation problems because of early felling of fullness. Whether main and snack meals provide qualified and sufficient nutrition determines the effectiveness of the treatment (Sala et al., 2004; Moyer-Mileur et al., 2009).

Mechanisms of intense chemotherapy which cause bone loss and effective treatments are unclear. This is an important topic for childhood cancers, because after chemotherapy treatment the healing rate is over 75%, thus the number of people who live with chronic bone deficit is increasing. Researches show that these defects are result of bone loss caused by increased bone marrow generation and bone resorption after chemotherapy. These changes probably were caused by regulatory molecules or changed expression and/or activation of pathways responsible for skeletal cell generation and activity. Recently, there are some preclinical studies that show mechanism of actions and potential health benefits, in some cases decreasing the bone defects caused by chemotherapy, of nutraceuticals including: Resveratrol, genistein, icariin and inflamed fatty acids (Su et al., 2017). Survivors of childhood cancer are at higher risk in terms of developmental conditions such as osteoporosis and cardiovascular diseases. Health promoting behaviors such as healthy diet may decrease this chronic problems. Targeted nutrition interventions may prevent or decrease these chronic diseases (Cohen et al., 2016). Pediatric nutrition and cancer discussions are generally focused on sufficient nutrition intake (enteral and parenteral) on early stages of treatment and after the treatment. However, there are some information that show the vitamins may have additive roles in the care of the children with cancer. In the last decade, researchers showed that maternal bias and perinatal vitamin intake alters the cancer risk of the baby and the children. It's been reported that there is a correlation between prevalence and severity of the side effects of vitamin and antioxidant on children treated with chemotherapy. Vitamin D has a potential anti-cancer activity and many children in North America have low vitamin D values (Stallings, 2008).

In our study, we assessed whether children with various cancers who treated with chemotherapy, received qualified and sufficient nutrition and if they suffered any side effects on their gastrointestinal system. The purpose of our study is to examine children's diet and dietary habits, provide qualified and sufficient nutrition intake and determine the side effects, such as vomiting, diarrhea, during chemotherapy treatment.

2. Material and methods

Study design

Our study is a lifestyle habits examining assessment questionnaire. Our study conducted in our university, Pediatrics Department, Pediatric Hematology and Oncology Division.

Participants

Children and their parent are informed thoroughly and signed informed consent form.

Inclusion criteria

1. Diagnosed with cancer
2. Voluntary attendance
3. Not having any musculoskeletal problems that may prevent assessment

Exclusion criteria

1. Coexistence of a neurologic or orthopedic disorder
2. Lack of cognitive function that prevents communication
3. Lack of mental and physical ability

Outcome measure

Hospital records that contains children's and their parents' personal and clinical information has been scanned and the questionnaire was conducted with those who accepted voluntary attendance. The answers for the questions regarding what kind of snacks they consume, how often they go to fast food restaurants and other similiar subjects were received from the childen diagnosed with cancer. With these results we compared the results from children who was being treated with chemotherapy.

Assessment form

Diagnosis, diagnosis date, treatment, which cure, anthropometric measurements, personal and family history of the person who completed the questionnaire, are recorded. Birthday, gender, place of residence, height, weight, body mass index, upper arm circumference, triceps skin thickness, cancer type, cancer stage, diagnosis date, treatment, which cure of chemotherapy, family history, siblings count, parent education status, school success, personal and family history are the information included in this form.

Diet form

This form has the information about main and snack meal consumptions of children who was undergoing treatment, what they prefer for their meals, the side effects they encountered on their gastrointestinal system during treatment. We found the answers for the following questions; do they consume fruits every day, do they eat fish twice a week, consume vegetable twice a week, do they go fast-food restaurant more than once, do they eat legume more than once a week, do they consume two glass of milk every day, do they consume dessert and sugar several times every day, do they drink energy drink, do they eat egg more than four times a week. How often they consume fruit, vegetable, milk, yoghurt, cheese, cereal, rice and pasta questions are answered. We get information concerning if they experience any gastrointestinal problems during the treatment and if so, whether constipation, diarrhea, early feeling of fullness, nausea or vomiting are present. The questions regarding how many main and

snack meal are consumed and whether they do skip the meals if they skip what they consume instead, what do they drink between meals, why do they skip meals, how often they eat outside are also answered.

Statistical method

Statistical Package for Social Sciences (SPSS) Version 20.0 (SPSS Inc. Chicago. IL. USA) statistics software has been used. Demographic and clinical features of patients analyzed by calculating descriptive statics with minimum, maximum values, average and standard deviation. In all analysis $p<0.05$ (two-sided) values accepted statistically significant. To select the advance statistical analysis which was suitable for the data analysis of this study, it's been checked with "Shapiro-Wilks" test whether data groups have normal distribution. Demographic features of children (gender, age, etc.), diet regimen result's correlation observed with "Spearman Correlation Analysis".

3. Results

Results of the demographic and clinical features of children and diet, has been shown in Table 1. Inter-correlation of results has been shown in Table 2. Results show that nine of them (42.9%) eat fruit everyday regularly, six of them (28.6%) eat fish at least twice a week regularly, 12 of them (57.1%) eat legume more than once a week, nine of them (42.9%) eat vegetables or salads twice a week regularly, 10 of them (47.6%) consume more than 2-3 portions of meat every week 12 of them (57.1%) consume 2 glass of milk every day, 4 of them (19%) consume carbonated drinks, none of them consumes energy drinks, 12 of them (57.1%) eat more than four eggs in a week, three of them (14.3%) consume sugar and dessert several times a day, one of them (4.8%) go to fast-food restaurant more than once a week has been found. When daily dietary habit has been questioned, according most given answers; it has been reported that bread, cereal, rice and pasta consumption as sometimes (n=10, 47.6%), fruit consumption as sometimes (n=12, 57.1%), vegetable consumption as sometimes (n=10, 47.6%), milk, yoghurt or cheese consumption as sometimes (n=7, 33.3%), meat, chicken, fish, legume, egg, appetizers like foods consumption as sometimes (n=10, 47.6%). It has been learnt that children very rarely eat outside (n=15, 71.4%). It's been detected that children have breakfast regularly (n=14, 66.7%), be full very fast frequently (n=8, 38.1%), sometimes have nausea (n=9, 42.9%), sometimes have constipation problems (n=10, 47.6%), most of them have no diarrhea (n=14, 66.4%). It has been found that 12 of children (57.1%) skips meals, most skipped meal is breakfast (n=7, 33.3%), skipping reasons are lack of time (n=7, 33.3%), lack of appetite (n=5, 23.8%), uneasiness about health problems (n=14, 66.7%). It has been determined that fruit is the most preferred snack food (n=14, 66.7%), ayran is the most preferred drink (n=7, 33.3%). It has been found that there is a statistically significant correlation between children's age and eating more than 2-3 portion meat in a week (r=-0.625; p=0.002), between Z-score normal/abnormal status and going fast-food restaurant more than once a week (r=0.683; p=0.004), between going fast-food restaurant more than

Table 1. Demographical and clinical characteristics of children with cancer.

	N	%
Gender (Girl/Boy)	9/12	42.9/57.1
Z-Score (Normal/Abnormal)	3/18	14.28/85.72
Tumor Type		
Leukemia	1	4.8
Lymphoma	6	28.6
Brain tumor	3	14.3
Wilms tumor	3	14.3
Neuroblastoma	3	14.3
Sarcoma	5	23.8
Treatment type		
Chemotherapy	11	52.4
Chemotherapy + Radiotherapy	3	14.3
Chemotherapy + Surgery	2	9.5
Chemotherapy + Radiotherapy + Surgery	5	23.8

	Mean	SD	Min.	Max.
Age (years)	**9.52**	**5.212**	**3**	**18**
Age at diagnosis (years)	7.52	4.844	1	16
BMI (kg/m2)	17.47	4.240	12.2	28.3
Z-Score	48.47	30.824	4	96
Arm circumference	19.58	5.189	14	31
Fat tissue	6.55	1.739	5	9
Chemotherapy cure number	5.16	2.292	1	10
Academic achievement	8.60	1.897	5	10
Number of main meal	2.55	1.099	0	4
Number of snacks	2.47	1.646	0	7

Table 2. The relationship between demographical/physical and related with cancer and treatment characteristics.

		Related with cancer and treatment characteristics					
		Tumor type		Treatment		Chemotherapy cure number	
		z	p	z	p	z	p
Demographical and physical characteristics	Age	-.029	.902	-.005	.982	.160	.512
	Age at diagnosis	-.081	.727	-.137	.553	-.114	.642
	Gender	-.089	.700	-.017	.941	-.335	.161
	Z-Score	.403	.109	.097	.710	.676	.006
	Arm circuference	-.088	.719	.115	.641	.266	.286
	BMI	.128	.613	.203	.419	.461	.072
	Fat tissue	-.062	.866	.047	.898	.056	.886

once a week and consumption of carbonated drinks (r=0.481; p=0.035), between going fast-food restaurant and eating outside (r=0.465; p=0.049), between eating 6-11 meals of bread, cereal, rice and pasta, and BMI (r=-0.470; p=0.049), between eating 6-11 meals of bread, cereal, rice and pasta, and Z-score category (r=0.633; p=0.008), between constipation and skinfold (r=0.714; p=0.020), between early feeling of fullness while eating and treatment (r=-0.568; p=0.007).

4. Discussion

According to our study results, it has been shown that chemotherapy has an effect on nutrition, it has to be assessed in detail during treatment process (diagnosis, treatment and after treatment) and that there is a need for multidiciplinary consultations. Survivors of childhood cancers generally come up against excessive weight gain during early stages of treatment. To prevent obesity and cardiovascular diseases in early stages, it is important to start lifestyle changes early. Studies which focus on lifestyle changes are quite low in number. According to results of studies, the lifestyle changes related cancer are both safe and applicable (Zhang et al., 2017).

In a review which includes 616 participants in total; 275 participants have ALL, all studies have different intervention methods and weak results. There is no clear evidence about bone health related to calcium intake (mean difference (MD) 111.60, 95% confidence interval (CI) -258.97 to 482.17;p=0.56, low quality evidence). Milk consumption (MD 0.43, 95% CI 0.07 to 0.79; p = 0.02, low quality evidence), is meaningful when it's used with calcium supplement day count (MD 11.42, 95% CI 7.11 to 15.73; p<0.00001, low quality evidence), and any calcium supplement (risk ratio (RR) 3.35, 95% CI 1.86 to 6.04; p<0.0001, low quality evidence). It has been reported that there is no significant difference between bone density z-scores in X-Ray DEXA, calcium and vitamin D supplement, and diet and dietary education; at the beginning, during treatment at 12^{th}, 24^{th}, 36^{th} month assessments there was no difference with control group. Multifactorial health behavior had changes even with one behavior change on patients who focused on healthy dietary principals and follow-up phone interviews showed differences when compared with control grouop (MD -0.05, 95% CI -0.24 to 0.14; p=0.60, low quality evidence). There is no clear evidence whether there is a difference between the group who developed healthy dietary behavior, and other. Even though health behavior changes had minor improvement on health behaviors, there is no clear evidence whether it also improves diet. There is no clear evidence about dietary regimen possessing positive or negative effects on cardiovascular and metabolic disorders (Cohen et al., 2016).

Cancer diagnosis and treatment may affect diet Methods which is used to assess dietary intake has not been validated. There is not any specific scale for this topic, and general scales used to collect data are considered not valid (EI-TEE)/TEE × 100%, was 22% for FFQ and 1% for repeated 24HRs.) (Zhang et al., 2015). In the studies which assessed patients diagnosed with cancer and their parents, it was shown that there has to be a support team which is especially important while dealing with side effects of cancer treatment. Adequate management of side effects faced by children treated for cancer, significantly affects their life quality (Bryant, 2003).

Recently, survival rate of childhood cancers has been increased. Increasing survival rates also increased the focus on supportive care for these patients. The regulation of the diet is a supportive method which helps to increase tolerance to chemotherapy included in the anticancer treatment, to increase survival rates, to increase quality of life and to decrease infection risk. Guides and evaluation criteria for care management that includes diet, pharmacology and psychosocial hardships considered in diet regimen of children with cancer, has been suggested, but no applicable guides with high quality evidence is available (Ladas et al., 2005).

Anthropometric measurements are being used while assessing diet status (Sacks et al., 2014). There is a correlation between dietary and infection rate on leukemia patients, thus supplementary diet is suggested during chemotherapy to reduce infection rates (Taj et al., 1993). Children with ALL have a higher risk because of unhealthy weight gain. Weight measurements are regularly repeated for weight management. Early weight management is important (Folta et al., 2017).

Acute and chronic hunger are mostly correlated with chilhood cancer. Despite gastrointestinal complications that interrupts chemotherapy and radiotherapy treatments, supplamentary diet should be maintained (Filler et al., 1977). Children treated with chemotherapy and/or radiotherapy are under the risk of malnutrition because of nausea, vomiting, lack of appetite and mouth ulcer-like side effects. Malnutrition during treatment increases the infection risk, decrease the tolerance to the treatment and even effects general survival rates. Personal risk factors should also be examined (Robinson et al., 2012).

Having more survivors of chilhood cancer, revealed that central nervous system treatment may have serious long term consequences on cognitive and endocrine functions. Most common endocrinopathies related to radiation are hypothyroidism and lack of growth hormone. The effects of the treatment on the rate of growth are multifactorial and includes lack of growth hormone, spinal shrinking, early puberty, undetermined

and malnutrition. It is essential to maximize long term impact assessment until non-neurotoxic treatment completed (Duffner, 2004). Chemotherapy often causes intestinal damage (mucositis). There is no clinical evidence whether mucositis caused by chemotherapy endangers absorption. After chemotherapy, mucositis and/or diarrhea toxicity scores increase (De Koning et al., 2007). After chemotherapy, tibia and femur fracture risk increases because of the bending stiffness decreases. These are caused by malnutrition and accompanied by weight loss and direct effects of chemotherapeutic agents on skeletal system. Signs and symptoms suggestive of these complications should be looked out during the follow-up of children treated with chemotherapy (Van Leeuwen et al., 2003). Increasing the survival rates of chilhood cancer, long-term effects become crucial. Oral health during cancer treatment process is important for general health, nutrition level, quality of life and holistic care. Oral health is especially important for neuroblastoma patients treated with chemotherapy (Hutton et al., 2010).

Limitations of our study are the small number of participants included in our study, the lack of the ability to divide into subgroups according to their appropriate demographic and clinical characteristics, the disease progression and survival rates of different cancer types, and the presence of different eating culture habits, even if experienced in the same society.

Acknowledgements
We thank patients for participating the study.

REFERENCES

Bryant, R., 2003. Managing side effects of childhood cancer treatment. J. Pediatr. Nurs. 18, 113-125.

Cohen, J.E., Wakefield, C.E., Cohn, R.J., 2016. Nutritional interventions for survivors of childhood cancer. Cochrane Db. Syst. Rev. 22, CD009678.

De Koning, B.A., Van Der Schoor, S.R., Wattimena, D.L., De Laat, P.C., Pieters, R., Van Goudoever, J.B., 2007. Chemotherapy does not influence intestinal amino acid uptake in children. Pediatr. Res. 62, 195.

Duffner, P.K., 2004. Long-term effects of radiation therapy on cognitive and endocrine function in children with leukemia and brain tumors. Neurologist. 10, 293-310.

Filler, R.M., Jaffe, N., Cassady, J.R., Traggis, D.G., Das, J.B., 1977. Parenteral nutritional support in children with cancer. Cancer. 39, 2665-2669.

Folta, S.C., Chang, W., Hill, R., Kelly, M.J., Meagher, S., Bowman, W.P., Zhang, F.F., 2017. Parent and health care provider perceptions for development of a web-based weight management program for survivors of pediatric acute lymphoblastic leukemia: A mixed methods study. J. Med. Internet. Res. 3, e2.

Hutton, A., Bradwell, M., English, M., Chapple, I., 2010. The oral health needs of children after treatment for a solid tumour or lymphoma. Int. J. Paediatr. Dentist. 20, 15-23.

Ladas, E.J., Sacks, N., Meacham, L., Henry, D., Enriquez, L., Lowry, G., Hawkes, R., Dadd, G., Rogers, P., 2005. A multidisciplinary review of nutrition considerations in the pediatric oncology population: A perspective from children's oncology group. Nutr. Clin. Pract. 20, 377-393.

Moyer-Mileur, L.J., Ransdell, L., Bruggers, C.S., 2009. Fitness of children with standard-risk acute lymphoblastic leukemia during maintenance therapy: Response to a home-based exercise and nutrition program. J. Pediat. Hematol. Onc. 31, 259-266.

Robinson, D.L., Loman, D.G., Balakas, K., Flowers, M., 2012. Nutritional screening and early intervention in children, adolescents, and young adults with cancer. J. Pediatr. Onc. Nurs. 29, 346-355.

Sacks, N., Hwang, W.T., Lange, B.J., Tan, K.S., Sandler, E.S., Rogers, P.C., Womer, R.B., Pietsch, J.B., Rheingold, S.R., 2014. Proactive enteral tube feeding in pediatric patients undergoing chemotherapy. Pediatr. Blood Cancer. 61, 281-285.

Sala, A., Pencharz, P., Barr, RD., 2004. Children, cancer and nutrition: A dynamic triangle in review. Cancer. 100, 677-687.

Stallings, V.A., 2008. Childhood cancer and vitamins: Prevention and treatment. Pediatr. Blood Cancer. 50, 442-444.

Su, Y.W., Chen, K.M., Hassanshahi, M., Tang, Q., Howe, P.R., Xian, C.J., 2017. Childhood cancer chemotherapy–induced bone damage: Pathobiology and protective effects of resveratrol and other nutraceuticals. Ann. New York Acad. Sci. 1403, 109-117.

Taj, M.M., Pearson, A.D., Mumford, D.B., Price, L., 1993. Effect of nutritional status on the incidence of infection in childhood cancer. J. Pediat. Hematol. Onc. 10, 283-287.

Van Leeuwen, B.L., Verkerke, G.J., Hartel, R.M., Sluiter, W.J., Kamps, W.A., Jansen, H.W., Hoekstra, H.J., 2003. Chemotherapy decreases epiphyseal strength and increases bone fracture risk. Clin. Orthop. Relat. R. 413, 243-254.

Zhang, F.F., Kelly, M.J., Must, A., 2017. Early nutrition and physical activity interventions in childhood cancer survivors. Curr. Obesity Rep. 6, 168-177.

Zhang, F.F., Roberts, S.B., Must, A., Wong, W.W., Gilhooly, C.H., Kelly, M.J., 2015. Assessing dietary intake in childhood cancer survivors: Food frequency questionnaire versus 24-hour diet recalls. J. Pediatr. Gastr. Nutr. 61, 499.