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BMI and Cancer Risk in Basrah Oncology and Haematology Centre Patients: A Case-Control Study

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Abstract

Introduction. Worldwide, overweight and obesity are epidemics, and there is mounting evidence that a high body mass index increases the risk of cancer. The risk of developing colon, kidney, breast, endometrial, and gallbladder cancers is increased by obesity. There is no quantification of community-wide risk for both general and site-specific cancers. The dose-response relationship between cancer and body mass index is still not fully understood.

Purpose. To evaluate the association between body weight and risk of site-specific cancers.

Materials and methods. The Basrah Oncology and Hematology Center (BOHC) in southern Iraq conducted a case-control study. Four hundred fifty-four cancer patients were either inpatients or outpatients, as well as 197 healthy controls. Study participants were randomized into case or control groups. Complete demographic information (age, sex, profession, weight, height, smoking status, and medical history) was gathered through a questionnaire.

Results. Obesity was found to be significantly associated with breast and endometrial cancer ($p<0.0001$). Nonetheless, there was no correlation between body mass index

and cervical cancer (p=0.099). The prostate cancer risk was unaffected by the body mass index categories (p=0.315). Statistical evidence did not indicate a relationship between body mass index and acute or chronic myelogenous leukemia (p-values 0.703 and 0.623, respectively), although there was a skewed risk of chronic lymphoblastic leukemia (p-value 0.018). There was a strong correlation between obesity and both colorectal and gastrointestinal stromal tumors (p-value <0.0001), as well as a positive correlation between stomach cancer (p-value =0.025). A substantial correlation exists between body mass index and hepatobiliary malignancies (p<0.0001), but not pancreatic cancer (p=0.135). There is a significant inverse relationship between obesity and lung cancer (p<0.0001) and bladder cancer (p=0.009).

Conclusion. While obesity is associated with a greater likelihood of endometrial and breast cancers, it has no such effect on cervical or prostate cancers. Body mass index has a connection to a higher risk of chronic lymphoblastic leukemia, but there is no association with myelogenous leukemia. Cancers of the eosophagus, stomach, biliary tract, lungs, and bladder are highly associated with obesity.

Keywords: BMI, cancer, ВОНС, chronic myelogenous leukemia, obesity

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Индекс массы тела и риск рака у пациентов онкологического и гематологического центра Басры: исследование «случай – контроль»

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Резюме

Введение. Во всем мире избыточный вес и ожирение приобретают характер эпидемий. Появляется все больше доказательств того, что высокий индекс массы тела увеличивает риск развития рака. Риск развития рака толстой кишки, почек, молочной железы, эндометрия и желчного пузыря увеличивается при ожирении. Количественная оценка риска возникновения рака в масштабах всего сообщества, как общего, так и локально-специфического, не проводится. Зависимость между раком и индексом массы тела до сих пор полностью не изучена.
Цель. Оценить связь между массой тела и риском развития рака определенной локализации.
Материалы и методы. В Центре онкологии и гематологии Басры (BOHC), на юге Ирака, проведено исследование «случай – контроль». В исследовании приняли участие 454 онкологических пациента, которые находились на стационарном или амбулаторном лечении, а также 197 здоровых лиц контрольной группы. Участники исследования были рандомизированы в группы «случай» и «контроль». Полная

демографическая информация (возраст, пол, профессия, вес, рост, статус курения и анамнез) была собрана с помощью анкетирования.

Результаты. Было обнаружено, что ожирение достоверно связано с раком молочной железы и эндометрия (p<0,0001). Тем не менее не было корреляции между индексом массы тела и раком шейки матки (p=0,099). Риск рака предстательной железы не был затронут категориями индекса массы тела (p=0,315). Статистические данные не указали на связь между индексом массы тела и острым или хроническим миелоидным лейкозом (p-значения 0,703 и 0,623 соответственно), хотя наблюдался смещенный риск хронического лимфобластного лейкоза (p-значение 0,018). Была выявлена сильная корреляция между ожирением и колоректальными и желудочно-кишечными стромальными опухолями (p-значение <0,0001), а также положительная корреляция с раком желудка (p-значение =0,025). Существует значимая корреляция между индексом массы тела и злокачественными новообразованиями гепатобилиарной системы (p<0,0001), но не раком поджелудочной железы (p=0,135). Существует значимая обратная связь между ожирением и раком легких (p<0,0001) и раком мочевого пузыря (p=0,009).

Заключение. Несмотря на то что ожирение связано с повышенной вероятностью развития рака эндометрия и молочной железы, оно не оказывает подобного влияния на рак шейки матки или предстательной железы. Индекс массы тела связан с повышенным риском хронического лимфобластного лейкоза, но не связан с миелоидным лейкозом. Рак пищевода, желудка, желчных путей, легкого и мочевого пузыря тесно связан с ожирением.

Ключевые слова: ИМТ, рак, ВОНС, хронический миелоидный лейкоз, ожирение

■ INTRODUCTION

Overweight and obesity (BMI 25–29.9 kg/m^2 or higher) can cause cancer. High BMI increases esophagus (adenocarcinoma), pancreatic, colorectum, breast, endometrial, and kidney cancer risk [1–3].

Rising obesity and overweight rates worldwide are health issues. Recent estimates show that 35% of people worldwide are overweight and 12% obese [4]. Southeast Asians had the lowest overweight and obesity rates (14% and 3%), while Americans had 62% and 26%. African, East Mediterranean, and South East Asian women were twice as obese as men [5].

The WHO warns that obesity may increase the risk of non-communicable diseases in several countries. Eastern Mediterranean research demonstrates alarming child and adult obesity rates. Approximately 50% of Eastern Mediterranean and North African mortality is due to NCD [6, 7]. Obesity and cancer risk factor research in Iraq is scant or regional [8].

Basrah, in southern Iraq, has been 31.3% overweight and 23.8% obese over the past decade [9]. Although cancer causation differs by type, physiological pathways may link fat to cancer risk. Four main systems may promote obesity-related cancer: insulin, sex hormones, and adipokines. New ways include long-lasting inflammation, oxidative stress, hypoxia caused by obesity, the interaction between cancer cells and adipocytes and migratory adipose stromal cells, genetic vulnerability, and problems with immune function [10].

We now know that an excessive BMI can cause cancer. Esophageal, colorectal, renal, pancreas, gallbladder, postmenopausal breast, endometrial, and ovarian adenocarcinomas are high BMI-related [11].

■ MATERIALS AND METHODS

This study employs retrospective case-control. Basrah oncology and hematology center (BOHC) accepted both inpatients and outpatients from Basrah City and nearby governorates who had cancers confirmed by histopathology or immunohistochemistry in different parts of their bodies.

Also, age- and sex-matched controls were randomly chosen from outpatient clinic patients at Al-Sader Teaching Hospital and Al-Basrah General Hospital for various non-neoplastic disorders. All questionnaires included personal, occupational, anthropometric, and medical components (height, weight, smoking, diabetes history).

The study comprised 521 cancer patients aged 18–85 and 197 controls aged 15–82. Because of our exclusion criteria, only 454 cancer patients (16 types) were eligible for our study.

Exclusion criteria: under 1.35 m or 16 kg/m^2, aggressive cancer or metastases at diagnosis. Cancerous types with too few cases to be statistically significant can wait three months for BOHC registration after histological results. Hepatic, renal, or eating disorder patients Working with radiation, chemicals, or industrial cancer hazards. A close family member, BOHC patient case document, or self-reported BMI was used to acquire data by telephone interview if patients were deceased, too ill, or otherwise unavailable.

Upon diagnosis or appointment, cancer patients' height and weight were recorded at the Basrah Oncology Centre. After measuring weight and height in light clothing and without shoes, BMI was calculated as kilograms divided by meters squared.

The WHO BMI classifications are 18.5–24.9 kg/m^2 (normal weight), 25–29.9 (overweight), 30–34.9 (obese class I), and >35 (obese classes II and III) [12].

Those with 16–18.5 kg/m^2 were of normal weight. Few cases and controls had obesity grades II and III, so they were consolidated into obese class I. All analyses utilized a normal BMI.

Statistical analysis

The International Classification of Diseases for Oncology (ICDOM) [13] classified 454 cancer patients and 197 controls as having 16 different types of cancer. Age, gender (continuous variables), smoking status (never smokers, former smokers, and current smokers), and a history of diabetes mellitus (diabetic or not) were all recorded as covariates. Using the median age of menopause across Iraqi provinces (48) as a cutoff point, SPSS version 22 was used to analyze the data. Chi-square analysis compared groups using predetermined criteria. Trend tests were done on BMI categorical variables (normal, overweight, and obese). All analyses are considered significant if the p-value is less than 0.05.

■ RESULTS

Table 1 displays the age and sex distributions of both the control group and the group consisting of individuals diagnosed with cancer. The study had a cohort of 454 individuals, 184 males and 270 females, diagnosed with 16 malignancies. The participants had a mean

Table 1
The age and sex distributions of both the control group and the group consisting of individuals diagnosed with cancer

Cancer and control	Total	Men	Women	Age mean (SD)
Controls	197	77	120	41.9 (18.8)
Breast	82	–	82	49.8 (11.5)
Cervix	16	–	16	45.7 (8.9)
Endometrium	16	–	16	51.9 (8.5)
Prostate	21	21	–	71.5 (6.7)
AML	32	7	25	36.2 (14.3)
CLL	24	9	15	68.7 (10)
CML	49	11	38	44.1 (13.9)
Colorectum	28	12	16	50.7 (14.3)
GIST	19	9	10	59.6 (8.3)
Stomach	20	9	11	56.3 (12.8)
Hepatobiliary	18	5	13	57.7 (7)
Hodgkin lymphoma	28	20	8	41.1 (14.7)
Non-Hodgkin lymphoma	21	14	7	57.3 (17.8)
Lung	38	32	6	57.9 (10.6)
Pancreas	20	16	4	66.1 (7.9)
Urinary bladder	22	20	2	65.4 (10.5)
All cancer cases	454	185	269	53 (23)

age of 53±23 years. The control group comprises 77 male and 120 female participants, with a mean age of 41.9±18.8 years (Table 1).

Table 2 presents the average body mass index (BMI) with the specific kind of cancer and the presence or absence of potential confounding factors such as smoking and diabetes. People with a body mass index (BMI) above 30 kg/m^2 were more likely to get cancers of the endometrium, gastrointestinal stromal tumors (GIST), hepatobiliary system, breast, and colorectum. The average BMI of patients with stomach cancer (29.9±7.8 kg/m^2) was higher than the mean BMI of the control group (26.7±5.9 kg/m^2). The body mass index (BMI) of patients diagnosed with lung cancer, urinary bladder cancer, pancreatic cancer, Hodgkin's and non-Hodgkin's lymphomas, chronic lymphocytic leukemia (CLL), chronic myeloid leukemia (CML), acute myeloid leukemia (AML), prostate cancer, and cervical cancer was found to be lower compared to the control group. In contrast, the control group exhibited a frequency percentage of 22.8% for smoking and 22.3% for diabetes. The patient population with the highest prevalence of smoking was observed among individuals diagnosed with lung cancer (81.6%), urinary bladder cancer (63.6%), pancreatic cancer (60%), and prostate cancer (57.1%). Conversely, the lowest rates of smoking were found among patients with female-specific tumors. Compared to the control group, people with pancreatic cancer (65%), hepatobiliary cancer (44.4%), chronic lymphocytic leukemia (37.5%), gastrointestinal stromal tumors (36.8%), endometrial cancer (37.5%), cervical cancer (31.2%), and prostate cancer (33.3%) were more likely to have diabetes.

Each type of cancer's correlation with BMI was studied after being compared to a control group of similar ages and sexes. Table 3 displays the malignancies affecting the female reproductive system and the breast. Obesity was linked to an increased risk of

Table 2
The average body mass index (BMI) with the specific kind of cancer and the presence or absence of potential confounding factors

Group	Smoking		Diabetes		BMI
	Never, %	Ever, %	Yes, %	No, %	Mean (SD)
Controls	77.2	22.8	22.3	77.7	26.7 (5.9)
Breast	93.3	3.7	23.2	76.8	32.6 (6.4)
Cervix	87.5	12.5	31.2	68.8	24.8 (4.8)
Endometrium	93.8	6.2	37.5	62.5	33.9 (7)
Prostate	42.9	57.1	33.3	66.7	25.2 (6.1)
AML	93.7	6.3	18.8	81.2	25.3 (5.5)
CLL	83.3	16.7	37.5	62.5	24.4 (3.3)
CML	89.8	10.2	18.4	81.6	25.2 (4.5)
Colorectum	85.7	14.3	14.3	85.7	32.3 (5.6)
GIST	84.2	15.8	36.8	63.2	33.7 (7.7)
Stomach	70	30	31	69	29.9 (7.8)
Hepatobiliary	66.7	33.3	44.4	55.6	33 (6.3)
Hodgkin lymphoma	71.4	28.6	17.9	82.1	24.3 (5.1)
Non-Hodgkin Lymphoma	61.9	38.1	9.5	90.5	26.5 (5.7)
Lung	18.4	81.6	13.2	86.8	23 (3.4)
Pancreas	40	60	65	35	23.6 (3.8)
Urinary bladder	36.4	63.6	9.1	90.9	23 (3.6)

Table 3
The malignancies affecting the female reproductive system and the breast in relation to BMI

BMI Category	Control, N (%)	Breast cancer, N (%)	Cervical cancer, N (%)	Endometrial cancer, N (%)
≤16–24.9 kg/m^2	47 (39.2)	10 (12.2)	10 (62.5)	1 (6.3)
25–29.9 kg/m^2	45 (37.5)	16 (19.5)	4 (25)	4 (25)
≥30 kg/m^2	28 (23.3)	56 (68.3)	2 (12.5)	11 (68.8)
P trend across categories[1]		<0.0001	0.099	<0.0001

developing both breast and endometrial cancers (p=0.0001), both of which are extremely deadly. However, a correlation between cervical cancer and body mass index was not found (p=0.099).

The risk of getting prostate cancer (table 4; p-value 0.315) or myeloid leukemias (table 5; p-values 0.703 for AML and 0.623 for CML) was not linked to having a high BMI. However, the risk of getting CLL was linked to having a high BMI (p-value 0.018).

There was no statistically significant link between BMI and Hodgkin's or non-Hodgkin's lymphoma (p values =0.121 and 0.734, respectively; Table 6).

Table 7 examines the link between obesity and gastrointestinal cancers, finding a significant positive correlation between the two in the case of colorectal and GIST cancers (p=0.0001) and a non-significant one between stomach cancer and obesity (p=0.025).

Table 4
BMI in relation to prostate cancer

BMI Categories	Control, N (%)	Prostate Cancer, N (%)
≤16–24.9 kg/m²	41 (53.2)	15 (71.4)
25–29.9 kg/m²	20 (26)	2 (9.5)
≥30 kg/m²	16 (20.8)	4 (19)

Table 5
BMI in relation to leukemias

BMI Categories	Controls, N (%)	AML, N (%)	CLL, N (%)	CML, N (%)
≤16–24.9 kg/m²	88 (44.7)	17 (53.1)	17 (70.8)	25 (51)
25–29.9 kg/m²	65 (33)	7 (21.9)	5 (20.8)	13 (26.5)
≥30 kg/m²	44 (22.3)	8 (25)	2 (8.3)	11 (22.4)
P trend across categories[1]		0.703	0.018	0.623

Table 6
BMI and Hodgkin's or non-Hodgkin's lymphoma

BMI Categories	Control, N (%)	Hodgkin lymphoma, N (%)	Non-Hodgkin lymphoma, N (%)
≤16–24.9 kg/m²	88 (44.7)	14 (50)	12 (57.1)
25–29.9 kg/m²	65 (33)	13 (46.4)	3 (14.3)
≥30 kg/m²	44 (22.3)	1 (3.6)	6 (28.6)
P trend across categories[1]		0.121	0.734

Table 7
Obesity and gastrointestinal cancers

BMI Categories	Controls, N (%)	Colorectal cancer, N (%)	GIST, N (%)	Stomach cancer, N (%)
≤16–24.9 kg/m²	88 (44.7)	4 (14.3)	2 (10.5)	6 (30)
25–29.9 kg/m²	65 (33)	6 (21.4)	6 (31.6)	4 (20)
≥30 kg/m²	44 (22.3)	18 (64.3)	11 (57.9)	10 (50)
P trend across categories[1]		<0.0001	<0.0001	0.025

Table 8
BMI and hepatobiliary malignancies

BMI Categories	Controls, N (%)	Hepatobiliary cancer#, N (%)	Lung cancer, N (%)	Pancreas, N (%)	Urinary bladder, N (%)
≤16–24.9 kg/m²	88 (44.7)	1 (5.6)	27 (71.1)	13 (65)	16 (72.7)
25–29.9 kg/m²	65 (33)	6 (33.3)	11 (28.9)	4 (20)	5 (22.7)
≥30 kg/m²	44 (22.3)	11 (61.1)	0 (0)	3 (15)	1 (4.5)
P trend across categories[1]		<0.0001	<0.0001	0.135	0.009

Table 8 shows a high link between BMI and hepatobiliary malignancies, with obesity strongly associated ($p<0.0001$), but pancreatic cancer was not associated ($p=0.135$). Conversely, obesity was significantly inversely related to lung cancer ($p<0.0001$) and bladder cancer ($p=0.009$).

■ DISCUSSION

Breast cancer and BMI

Basrah had an incidence rate of 22.94 per 100,000 women, making breast cancer the most common malignancy in females worldwide [14, 15]. The current study found strong evidence linking obesity and breast cancer, although the correlation held for both premenopausal and postmenopausal women.

Two meta-analyses (mixed case-control and cohort studies) found positive relationships between the waist-to-hip ratio and the risk of premenopausal breast cancer [16–18]. It is known that a higher body mass index (BMI) increases the risk of postmenopausal breast cancer [3, 16]. Body mass index is not the only anthropometric measure of obesity; waist-to-hip ratio and waist circumference may be more accurate predictors of cancer risk [19]. Possible confounding factors include HRT usage [20] and mammographic density [21]. This study may not have had as much research power for the link between BMI and breast cancer after menopause because it did not look at other valid body size variables, such as waist-to-hip ratio (WHR) and waist circumference. Since 23.2% of breast cancer patients have diabetes, it is important to investigate how insulin and metformin affect body weight and cancer incidence [22, 23].

Endometrial cancer and BMI

The present study investigates the relationship between obesity and endometrial carcinoma. The findings suggest a strong association between these two factors, which can be attributed to the significant influence of circulating estrogens on the development of endometrial cancer. These results align with previous research conducted in this field [3]. There is a link between obesity and endometrial cancer, particularly for estrogen-driven endometrial malignancies [24]. Because aromatase is active, androgenic precursors are quickly changed into estradiol in adipose tissues. This makes more endometrial cells divide. This process also hinders apoptosis and encourages the local production of IGF-1 [25].

Cervical cancer and BMI

When this study looked at the link between body weight and cervical cancer, it found inconsistent data [26, 27], data that showed a link between obesity and the risk of getting cervical cancer [28, 29], and data that showed no such link [30]. Possible causes of inconsistency include:

- studies' varying methods of classifying body weight;
- researchers' failure to account for all possible confounders;
- a lack of studies (particularly prospective cohorts).

Prostate cancer and BMI

Few risk factors for prostate cancer exist, but IGF1 is modestly linked [31]. Obesity protects against localized prostate cancer but is related to aggressive variants [32]. Despite obesity being a key risk factor for type 2 diabetes, men with it had reduced prostate cancer risk [33]. Like other conflicting research, this study found no connection between prostatic carcinoma and BMI [34, 35]. Careful examination of prostate cancer clinical kinds, diabetes, and race/ethnicity [36] may alter outcomes.

BMI and gastrointestinal system cancer

Obesity is connected with colon cancer more than rectal cancer [37, 38], according to various research studies [3]. According to a meta-analysis, bariatric surgery reduced colon cancer risk by 27% [39]. Our data analysis showed a substantial connection with obesity, although putting colon and rectal cancer patients into one anatomical region may impact the results. Gastrointestinal stromal tumor GIST is a digestive mesenchymal neoplasm. Smooth muscle pacemaker interstitial cells of Cajal or related cells cause GISTs. These tumors can be anywhere from the esophagus to the anus, although 60% are stomach-based [40]. The obesity risk for GIST is rarely studied, save for one recent study [41]. This connection may explain the greater GIST diagnostic rate during sleeve gastrectomy [42]. GIST's connection with obesity in our study is intriguing and warrants additional study. BMI and stomach cancer This study demonstrated substantial evidence linking stomach cancer and obesity, similar to Yang et al.'s meta-analysis [43]. Other studies find that obesity does not increase gastric tumor risk, whereas gastric cardia may [44]. Potential variables include Helicobacter pylori illness, alcohol use, and nutrition.

In recent years, the World Cancer Research Foundation (WCRF) has uncovered compelling evidence linking liver cancer to obesity [45–47]. Alcohol, chemicals, and viral hepatitis can cause damage to the liver. However, metabolic syndrome and persistent local inflammation cause changes in the fatty liver [48], which are not factors that threw this study off track. In this study, 44.4% of hepatobiliary cancer patients had diabetes, which may increase their liver cancer risk. Obesity is a risk factor for gallstones, which induce chronic inflammation and cancer [49]. Due to the few liver and gallbladder cancer cases, we combined them into one group with a statistically significant obesity connection.

BMI and lung cancer

This investigation shows a clear inverse relationship between obesity and lung cancer. Lung cancer risk was highest in low-BMI people. Many studies show that being overweight may help prevent lung cancer. Some studies found a link with certain types of lung cancer tissue [50–52], and others found a link between being overweight and getting lung cancer [53, 54]. Failure to adjust data for smoking intensity, duration, and smoking-related lung illnesses causing preclinical weight loss may explain outcome differences.

BMI and pancreatic cancer

BMI has been linked to pancreatic cancer risk in men and women [3, 55, 56], but this investigation found no connection. This study includes 60% of current or former smokers, which is a risk factor for pancreatic cancer [57, 58]. Failure to control for this potential confounder may impact the results. DM may cause or precede pancreatic cancer [59, 60]. Pancreatic cancer is often identified in advanced stages with severe weight loss; hence, follow-up studies are indicated to eliminate prediagnostic weight loss. Our findings are supported by a multicenter Italian investigation [61].

Bladder cancer and BMI

This study found an inverse connection between bladder cancer and BMI, suggesting fat protects against it. Adiposity and bladder cancer epidemiologic investigations found no statistically significant connection with body weight [2, 3, 62]. Obesity increases bladder cancer risk in a meta-analysis of cohort studies [63]. Smoking, occupational carcinogen

exposure, schistosomiasis, arsenic-tainted tap water, medications, and family history are risk factors [62]. 14/22 (63.6%) bladder cancer The majority of this study's patients are elderly and current or ex-smokers, which may impact results because of accidental weight loss [64].

Hematological malignancies

In Sweden, comprehensive cohort research was undertaken, encompassing 336,381 individuals. The mean age of the cohort was 34.3 years, ranging from 14 to 82 years. It is important to note that the study did not investigate the occurrence of chronic lymphocytic leukemia. The study found no significant correlation between BMI and the risk of the specific leukemia subtypes examined [65]. Additionally, epidemiological evidence indicates that increased adipose tissue may contribute to developing hematologic malignancies, such as non-Hodgkin's lymphoma [66] and acute myeloid leukemia (AML). Multiple studies have identified a statistically significant positive correlation between obesity and the occurrence of lymphoma [2, 67], as well as its associated mortality [27].

Conversely, several additional studies have reported no discernible link between body mass index (BMI) and non-Hodgkin lymphoma [68–70]. The current study found no significant link between body size, lymphoma subtypes, or leukemia. However, a statistically significant link existed between a higher BMI and a lower risk of CLL. This finding is consistent with a previous study conducted among the Scandinavian population [71]. Some types of lymphoma were not included in this study, like follicular lymphoma and diffuse large B-cell lymphoma, which comprise more than 30% of all non-Hodgkin lymphoma cases. The absence of these subtypes in our observations may contribute to variations in the association between obesity and lymphoma across different studies [72]. Several investigations have documented a positive correlation between leukemia and obesity. However, it is important to note that these studies had limitations due to the small sample size of cancer cases (less than 75) and the relatively short follow-up period [73, 74]. The potential omission of examining several leukemia and lymphoma subtypes could significantly impact the outcomes.

■ CONCLUSION

Obesity is linked to various cancers, including breast, endometrial, colorectal, and stomach cancers. However, it does not show a significant association with cervical, AML, CML, or other cancers. Weight loss does not seem to reduce cancer risk, but various therapeutic approaches have shown efficacy.

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