

Inverse correlation between feverish infections and the likelihood to develop cancer

Observation	Effect	Year of publication	Pathogen	Ref.
Lower risk of cancer in syphilitic prostitutes	prophylactic	1725	<i>Treponema pallidum</i>	[1]
Collection of 302 cases of spontaneous regression (44 complete remissions) 27/302 cases accompanied by infection (9%), 69 cases where "incomplete operation [was] often accompanied by post-operative fever" (28%)	therapeutic	1918	diverse	[2]
Low risk of cancer in tuberculosis patients	prophylactic	1929	<i>Mycobacterium tuberculosis</i>	[3]
Lower risk of cancer in malaria patients	prophylactic	1929	<i>Plasmodium falc., malariae, vivax</i>	[4, 5]
Of 300 cancer patients 113 had no febrile infectious childhood diseases (FICD), while in 300 controls 16 lacked FICD	prophylactic	1934	diverse	[6]
Fewer childhood diseases, higher cancer risk in adults	prophylactic	1936	diverse	[7]
In a cohort of 300 cases of childhood leucemia, 26 spontaneous remissions were observed. 21/26 (80%) were accompanied by infection	therapeutic	1951	diverse	[8]
"...according to the Cancer Centre in Sao Paulo (Brazil), among tens of thousands of cancer patients only two gave a positive Machado reaction [indicating chronic or recovered trypanosoma infection], whereas among the remaining population the number suffering from this infection varies from 10 to 20 percent.", anecdotal remark	prophylactic	1963	<i>Trypanosoma cruzi</i>	[9]
Higher likelihood for malignant vs. benign ovarian cancers in patients with a history of mumps (78 age matched cases, p=0.007)	prophylactic	1966	<i>Paramyxovirus parotitis</i>	[10]
Lower cancer mortality in 5460 survivors of typhoid fever	prophylactic	1970	<i>Salmonella typhi</i>	[11]
Fewer physician visits, secondary illnesses and hospital referrals in 150 controls vs. 150 cancer patients	prophylactic	1970	diverse	[12]
In 62/224 cases of spontaneous regression (28%) either an infection or a persistent temperature elevation was observed prior to regression	therapeutic	1971	diverse	[13]
Occasional remissions in Hodgkin's lymphoma after measles attack	therapeutic	1971	<i>Morbillivirus</i>	[14]
Patients developing empyema after lung cancer surgery have improved 5-year survival (50% (n=18) vs 22% (n=411))	therapeutic	1972	diverse	[15]
Lower risk for ovarian cancer in about 400 patients with a history of pneumonia or influenza vs. age matched controls	prophylactic	1974	diverse	[16]
Lower incidence of mumps, measles, rubella in 300 patients with cancer of the ovary compared to control group	prophylactic	1977	MMR-viruses	[17]
Lower incidence of mumps in patients with cancer of the ovary compared to control group	prophylactic	1979	<i>Paramyxovirus parotitis</i>	[18] [19]

Increased cancer risk with an odds ratio of 2.6 for missing history of infectious organ diseases, 5.7 for missing history of common colds and 15.1 for missing history of fever	prophylactic	1983	diverse	[20]
Out of 353 individuals with a negative history of measles 21 developed cancer versus 1 case in 230 controls with a positive history of measles (p 0.001)	prophylactic	1985	diverse	[21]
Much lower cancer rate in wool and hemp factories; wool or hemp dust can carry bacterial endotoxins.	prophylactic	1985	diverse	[22]
Lower frequency of infections in the first year of life for children with leukemia	prophylactic	1986	diverse	[23]
Lower cancer incidence after Herpes infections	prophylactic	1987	<i>Herpes simplex</i>	[24]
Post-transfusional hepatitis in patients with acute myelogenous leukemia doubles survival rate	therapeutic	1982, 1992	<i>Hepatitis viruses</i>	[25, 26]
A history of common colds or gastroenteric influenza was found to be associated with a decreased cancer risk (odds ratio 0.18 and 0.23 vs. population and hospital controls, resp.)	prophylactic	1991	Common cold viruses	[27]
Lower melanoma risk (139 patients, 271 controls) for reported chronic infectious diseases (OR=0.32), wound infections (OR=0.21), herpes infections (OR=0.45) and influenza/common cold (OR=0.32)	prophylactic	1992		[28]
Inverse correlation between number of infections and mortality from tumors in Italy in the period 1890-1960: each 2% reduction in number of infectious diseases was followed by a 2% increase in tumours about 10 years later	prophylactic	1998	diverse	[29]
Inverse association between number of carcinoma (but not breast cancer) and febrile infectious childhood diseases (FICD); association stronger for higher numbers of FICD and childhood in pre-antibiotic times; strongest protection by rubella (379 cancer cases vs. 379 office matched controls)	prophylactic	1998	diverse	[30]
68 well documented cases of spontaneous regression from melanoma, preceded in 21 (31%) cases by a febrile infection	therapeutic	1998	<i>Streptococcus pyogenes</i>	[31]
Statistically significant inverse association between a reported history of infections and glioma, meningioma (RR=0.72, age and gender matched population control of 1509 cases)	prophylactic	1999	diverse	[32]
Inverse correlation between melanoma risk and number of recorded infections on one hand and between melanoma risk and fever height on the other hand, leading to a combined reduction of melanoma risk of about 40% for people with a history of three or more infections with high fever above 38.5°C (age and gender matched population control)	prophylactic	1999	diverse	[33]
More than two-fold higher incidence of cancer in Europe, GUS and US compared to Africa and Asia of 381 vs 156 (ten most prominent cancer forms, age standardized rate per 100000 population; in Africa and Asia a significant higher rate of infections is assumed here)	prophylactic	2003	diverse	[34]
Neuroblastoma in children (538 vs 504 age matched controls): decreased risk associated with day care attendance (OR=0.81), childhood diseases like chickenpox, mumps, measles (OR=0.6) and allergies (OR=0.68)	prophylactic	2004	diverse	[35]

Prior immunisation of melanoma patients with vaccinia or BCG is associated with better survival (age matched controls)	prophylactic	2005	Vaccinia, BCG vaccine	[36]
Dairy farmers, but not crop and orchard farmers, report one third less cancers than the average population; protection diminishes over time after exposure is removed; dust in cattle houses can carry bacterial endotoxins which frequently lead to unspecific "day fever"	prophylactic	2005	diverse	[37]
The 10-year survival for patients with osteosarcoma with infection within one year after surgery (n=41) was 84.5% compared to 62.3% in the non-infected group (n=371)	therapeutic	2007	diverse	[38]
After allogeneic stem cell transplantation, patients who had a febrile infection (FI) before post-transplant day 21 (FI group) had a lower probability of leukemic relapse (P < 0.001) and a higher relapse-free survival rate (P = 0.012) than those patients who did not have a FI before post-transplant day 21 (non-FI group)		2008		[39]
Never fever during childhood reported by 83% of 355 patients vs 57% of 244 controls	prophylactic	2009	diverse	[40]
4-fold higher risk for Hodgkin-lymphoma if tonsils are removed at age < 15 years	prophylactic	2010	diverse	[41]
Reduced ALL (acute lymphoblastic leukemia) risk in kindergarten children (frequent mutual infectious contaminations presumed), OR 0.8) or children with repeated common infections (OR 0.7)	prophylactic	2010	diverse	[42]
Reduced risk for ALL in children visiting kindergarten	prophylactic	2010,2011	diverse	[43], [44]
Reduced HL risk (Hodgkin lymphoma, 128 cases aged 5-14) and NHL (non-Hodgkin lymphoma, 164 cases aged 2-15 Jahre) vs. 1312 controls. HL+kindergarten: OR 0.5; HL+common infections+non-breast-feeding; OR 0.3; NHL+birth order 3: OR 0.7; NHL+prolonged breast feeding: OR 0.5; NHL+frequent farm visits in early life: OR 0.5; NHL+asthma: OR 0.6	prophylactic	2011	diverse	[45]

Table 1: Anti-correlation between acute, cured infections and the likelihood to develop cancer. Contradictory findings: Two publications were found which could not confirm inverse association between infection and cancer [46],[47], one, in a low impact journal not listed in PubMed [48], reported an increased risk with mumps and whooping cough. All three publications are based on less than 200 cases. In one study an inverse correlation between childhood mumps and ovary cancer could not be confirmed [49]. One study reported an increased risk of childhood ALL in the first 2-5 years after infections within the first year of life, when the immune system is not yet established (425 patients vs 1031 controls, average number of general practitioner visits with clinically diagnosed infection 3.6 vs 3.1, confidence intervals hardly gap separated, alleged confidence >95%) [50]. Attie et al. reported that 86 infectious events in 106 colon cancer patients during or until one year after cancer therapy lead to decreased survival compared to non-infected patients, however, they excluded infectious events treated in ambulatory setting, introducing a strong bias towards severe infections in hospitalized patients, which might be life threatening by themselves [51]

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