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Editorial

Epidemiology of Cancer in Adults in Relation to Childhood Infectious Burden of the Country

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During our investigations [1], it was noted that a developing country such as India, whose population is subjected to very heavy infectious burdens, shows surprisingly low incidence of some major cancers [1, 2]. Further explorations [3-5] indicated that when all (or at least major) cancers are considered together, lowest incidence is indicated in countries such as Thailand, Honduras, Dominican Republic, Philippines and Mexico [3], or, Senegal and India [4]; much higher incidence of cancer is observed in U.S.A., Canada, Australia, New Zealand and Western European countries (Table I). The reasons for these variations are complex and many and depend on the type of cancer, and, the specific area within a large country, and, involve a host of factors many of which are not yet completely understood.

The common feature of countries such as India, Thailand, Philippines, Senegal, Honduras, China etc. is that they are all poor countries with over-crowding, bad sanitation (due both to nearly non-existing sanitation facilities and poor education in personal hygiene), relative inaccessibility to medical infrastructure and modern medicines (*e.g.*, antibiotics), and, very heavy and frequent infectious attacks at an early age: many of the children, sadly, die but those who survive have a strong immune system. The robustness of the adaptive immune system develops an immunological memory that gears the system for future challenges down the road, *e.g.,* cancer.

We had defined some indicators of the infectious burdens: basically, poverty creates the conditions for these infectious attacks and we had chosen Gross Domestic Product (GDP) per capita as a crude indicator of the level of infectious burden - low GDP means high infectious burden and vice versa. We then explored whether low GDP (cf. high infectious load) heralds how cancer incidence in various regions of the world, and vice versa [5]. Also, infantile mortality was taken as another proxy for infectious burden [5].

Within the confines of the approximate nature of the estimates of data used in our work [5] poorer countries subjected to heavy infectious burdens show lower incidence of cancer whereas the richer countries providing more sanitized conditions for its children (and adults) exhibit higher incidence of the occurrence of cancer among adults (Table I). In this sense, the cancer incidence follows the same general trend as the frequency of occurrence of allergies and asthma. The root of this observation would appear to be connected to the strength of the adaptive immune system although many more highly complex factors, some known and some unknown, are no doubt involved. A consideration of several factors becomes particularly important when one examines the frequency of occurrence of cancer in various organs and at various anatomical sites. Peculiarities of heredity, life-style, oxidative burden, nature of trace elements in food and water, level of pollution of air, water, and soil, exposure to U.V. rays and a vast array of other parameters become contributory risks.

	NEOPLASMS (all sites)					
	MALE			FEMALE		
REGIONS	DEATHS	A.A.D.R.	R.O.	DEATHS	A.A.D.R.	R.O.
(AFRICA)						
1. Mauritius	180	70.92	45	200	65.72	46
(AMERICA)						
2. Canada	18 803	159.89	24	15 262	111.55	18
3. Chile	5 037	148.36	26	5 382	126.47	8
4. Costa Rica	708	127.24	39	639	111.06	19
5. Cuba	5 600	137.42	30	3 700	99.20	32
6. Dominican Republic	489	37.29	48	493	38.87	50
7. Ecuador	1 205	72.59	44	1 459	79.03	42
8. El Salvador	330	30.92	51	561	47.12	49
9. Honduras	227	36.26	49	393	53.40	47
10. Martinique	163	137.40	31	105	67.68	44
11. Mexico	9 259	60.77	46	12 610	76.88	43
12. Panama	414	82.49	43	327	66.94	45
13. Puerto Rico	1 718	126.32	40	1 196	83.53	39
14. Trinidad & Tobago	306	107.50	41	409	109.53	20
15. United States	199 194	163.53	23	166 338	109.47	21
16. Uruguay	3 312	198.09	7	2 412	126.17	9
17. Venezuela	3 006	102.82	42	3 316	102.65	29
(ASIA)						
18. Hong Kong	2 801	171.27	18	1 909	96.77	33
19. Israel	2 064	136.56	32	1 981	127.66	7
20. Japan	78 907	150.73	25	61 176	94.15	34
21. Philippines	6 861	59.13	47	6 140	49.33	48
22. Singapore	1 223	173.61	16	779	103.46	27
23. Thailand	3 776	34.96	50	2 900	23.44	51
(EUROPE)						
24. Austria	9 912	195.42	9	9 949	129.83	4
25. Belgium	13 986	203.73	3	10 561	117.13	15
26. Bulgaria	7 291	133.22	35	5 108	85.08	38
27. Czechoslovakia	19 585	218.45	1	14 460	121.07	12

	NEOPLASMS (all sites)					
	MALE			FEMALE		
REGIONS	**DEATHS**	**A.A.D.R.**	**R.O.**	**DEATHS**	**A.A.D.R.**	**R.O.**
28. Denmark	6 272	169.57	19	5 500	128.60	5
29. Finland	4 633	186.57	12	3 753	101.44	30
30. France	68 859	202.68	4	50 920	104.13	26
31. Germany, F.R.	77 488	190.12	11	78 279	128.51	6
32. Greece	8 393	138.54	29	5 478	79.35	41
33. Hungary	13 695	199.38	5	11 927	134.08	1
34. Iceland	160	133.58	34	156	120.90	13
35. Ireland	3 261	163.85	22	2 882	133.90	3
36. Italy	61 774	175.09	14	46 354	104.15	25
37. Luxembourg	484	195.42	8	337	107.45	22
38. Netherlands	16 507	198.77	6	12 054	119.08	14
39. Norway	4 076	134.41	33	3 534	101.29	31
40. Poland	27 913	167.35	20	24 128	106.39	23
41. Portugal	6 289	130.96	37	5 628	88.43	37
42. Romania	14 748	131.32	36	12 235	90.43	35
43. Spain	28 275	144.77	28	22 688	89.85	36
44. Sweden	10 316	147.54	27	9 112	114.92	16
45. Switzerland	7 369	178.07	13	5 806	106.08	24
46. England & Wales	66 348	192.45	10	56 674	124.03	11
47. Northern Ireland	1 574	174.23	15	1 336	113.79	17
48. Scotland	7 044	208.89	2	6 246	134.02	2
49. Yugoslavia	13 117	128.98	38	10 505	82.90	40
(**OCEANIA**)						
50. Australia	11 419	166.69	21	8 739	103.30	28
51. New Zealand	2 712	173.22	17	2 308	124.49	10

Table 1. Cancer deaths, age-adjusted death rates, and rank order (1974). After Segi (3).
Notes:

(1) CANCER DEATHS signifies the number of deaths by cancer in each country in 1974 [3].
(2) AGE-ADJUSTED DEATH RATES (A.A.D.R.) are per 100,000 standard population [3].
(3) R.O. means ranking of age-adjusted death rates in descending order [3].

One of the most successful hypotheses has been the inverse correlation between selenium dietary intake and the incidence of cancer [7-9]. Areas of the world in which a moderately high intake of Se (> 100 ug/day, for instance) through food and water takes place, people generally show lower cancer incidence; the best example is Dakar in Senegal which shows the lowest occurrence of cancer among the various areas studied, and also one of the highest (but below the toxic levels) daily intakes of Se [7-9]. The Se hypothesis does not fit, however, the fact that India, which has one of the lowest cancer occurrence rates, also has one of the lowest daily intakes of selenium. The usual low-income diet in India is vegetarian (and over 90 % of India is in this class) and a typical daily selenium in-take is only 27 ug/day [10], which is quite low. Again, Canadians show high incidence of cancer, even though their selenium in-take is quite adequate.

Aside from the high infectious burden and high infantile mortality rates, what are the other characteristic features of people living in low income countries that may be pertinent to the low incidence of cancer? A dominant characteristic is the low caloric intake - this would translate as low accumulated oxidative load due to normal metabolic processes. Also, in poor countries, for economic reasons, there is very low (or none) consumption of meat, animal fats and diary products usually implicated in some cancers such as those of prostate (males) and breast (females). A great deal of food is based on roots (potatoes, sweet potatoes), vegetables (plantains), lentils, whole wheat and rice etc. - all of which, in general, are high fibre materials which sweep away any carcinogens consumed or produced in the gut: little preserved and smoked meats and fish (cf. nitrates and other preservatives) are consumed.

We also wish to make the observation that all countries with very high cancer incidence (Nordic countries, Western Europe, Japan, U.S.A., Canada, Australia, New Zealand, for example) have very bland food, devoid of all spices especially hot chilli; countries which use hot spicy foods as, for example, in East South Asia (Malaysia, Indonesia, Thailand, Vietnam, Philippines) and Middle South Asia (India, Pakistan, Bangladesh, Sri Lanka) tend to have lower cancer occurrence rates. The validity of this observation perhaps could be challenged or modified and there is certainly no scientific basis for it. In fact, there is some contrary evidence that indicates that chilli pepper consumption enhances the risk for gastric cancer [11]; this epidemiological evidence, however, would be merely coincidental (and not causative) if one were to find, on further study (as we speculate), that the chilli consuming Mexicans investigated in this study [11] also had a higher load in their stomach of Helicobacter pylori.

It is perhaps pertinent to mention briefly here the reasons for the patterns of occurrence of cancers of some specific anatomical sites in the various regions of the world, as has been done in details by Howe [4] and others [3,6, 7-9]. Extremely high colon, breast and prostate cancers in North America have been attributed to the high loads of animal fat in the diet; the opposite seems to hold true for the diets in Japan and Thailand. High rates of liver cancer in China, and even Dakar and other Third World countries have been traced down to the heavy loads of aflatoxins and mycotoxins in the foods, and to Hepatitis B virus. Very high occurrence of stomach cancer in Japan has not been explained in a fully convincing manner, although highly salted diets and perhaps bacteria in raw meat (Sushi and Sashimi) may perhaps have something to do with it. The origin of much of the lung cancer in tobacco and other smoke (*e.g.*, coal burning) is generally accepted. In some areas of the world chewing tobacco and/or betel nut etc. has been found to cause enhanced occurrence of cancers of the oral cavity and oesophagus etc. - this is particularly true in India; on the other hand, it has been found that turmeric, heavily used in cooking in India, confers some protection (anti-oxidant?) against the initiation of various forms of cancer. Turmeric contains curcumin, which is a powerful anti-cancer agent [12].

In summary, the factors that seem to minimize the occurrence of cancer are: a "healthy" level of exposure to childhood infections (i.e., do not give antibiotics to children except in extreme situations); calorie restriction and a low BMI index; avoidance of animal fat in meat and dairy products; no exposure to smoke from tobacco or coal/wood burning; generous intake of turmeric, herbs and spices in the diet; selenium as a supplement if the diet is heavily vegetarian [13].

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