Article

Some correlations between eight types of malignant neoplasms: A hint from cancer dynamics of 31 European countries in 20 years

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Abstract

In present study, the data of standardised death rates of malignant neoplasms per 100000 inhabitants in 31 European countries during 1994~2013 were used to analyze linear correlations between eight types of cancers in terms of induced death rates. The results showed that most pairs of cancers closely correlate to each other. The malignant neoplasm of cervix uteri (women) and the malignant neoplasm of trachea, bronchus and lung correlate most closely (r=0.5915), followed by the malignant neoplasms (r=0.4832) of colon, rectosigmoid junction, rectum, anus and anal canal and lymphatic/haematopoietic tissue, the malignant neoplasms (r=-0.483) of stomach, and trachea, bronchus and lung, the malignant neoplasms (r=0.4605) of skin and prostate (men), the malignant neoplasms (r=0.4344) of colon, rectosigmoid junction, rectum, anus and anal canal and trachea, bronchus and lung, etc. These correlations are likely caused by common or adverse environmental, social, medical or even genetic / molecular factors.

Keywords Pearson linear correlation; malignant neoplasms; death rates; countries.

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1 Introduction

Cancer is a leading cause of death worldwide. It accounted for around 13% of all deaths worldwide in 2007. It is not a single disease. It is a phrase used to identify immense number of similar diseases resulting from the interplay of gene(s) and environmental factors (Reya et al., 2001; Goldthwaite, 2006; Emilsson et al., 2008; Iqbal et al., 2014). One of its defining features is the rapid proliferation of abnormal cells that grow beyond their usual boundaries, invade adjoining parts of the body, and subsequently spread through blood and lymphatic vessels to form metastases in other organs which can lead to secondary tumors (Ibrahim et al., 2011). Malignant tumours and neoplasms arise from one single cell in a multistage process, typically involving progression from a pre-cancerous lesion to a malignant tumor. The changes leading to cancer are the result of the interaction between a person's genetic predisposition and external factors such as chemicals (Ibrahim et al.,

2011; Zhang et al., 2011; Su and Zhang, 2014). Some cancers may share common or reverse incentive factors and will show a certain correlation. In present study, I used the data of standardised death rates of malignant neoplasms per 100000 inhabitants in 31 European countries during 1994~2013 to analyze Pearson linear correlations between eight types of malignant neoplasms in terms of induced death rates, aiming to provide some hints for practice and management of public health.

2 Materials and Methods

Data of standardised death rates of malignant neoplasms per 100000 inhabitants in 31 European countries were collected from EUROSTAT (European Commission, 2017; http://ec.europa.eu/health/home_en). Data range was generally from 1994 to 2013 (in total of 20 years), but data for some countries and years were absent. Eight types of cancers include malignant neoplasms of (I) skin (i.e., malignant melanoma; total population), (II) breast (women), (III) cervix uteri (women), (IV) colon, rectosigmoid junction, rectum, anus and anal canal (total population), (V) lymphatic/haematopoietic tissue (total population), (VI) prostate (men), (VII) stomach (total population), and (VIII) trachea, bronchus and lung (total population).

Pearson linear correlation measure (Zhang, 2012, 2015a-b, 2016; Zhang and Li, 2015) was used to calculate the linear correlation between two malignant melanomas. In this situation, a significant correlation usually represents an indirect correlation, caused by common or reverse incentives in respect to public health. Maximally 620 datasets for each pair of cancers (i.e., 20*31 datasets) were used in the calculation. In a dataset (i.e., a pair of values), the two values are standardised death rates per 100000 inhabitants of two cancers being calculated for the same country and the same year.

3 Results and Analysis

Tables 1-3 show that most pairs of malignant neoplasms closely correlate each other in terms of induced death rates. Of which the malignant neoplasm of cervix uteri (women) and the malignant neoplasm of trachea, bronchus and lung (total population) correlate most closely (r=0.5915), followed by the malignant neoplasms (r=0.4832) of colon, rectosigmoid junction, rectum, anus and anal canal (total population) and lymphatic/haematopoietic tissue (total population), the malignant neoplasms (r=-0.483) of stomach (total population), and trachea, bronchus and lung (total population), the malignant neoplasms (r=0.4605) of skin (total population) and prostate (men), the malignant neoplasms (r=0.4344) of colon, rectosigmoid junction, rectum, anus and anal canal (total population) and trachea, bronchus and lung (total population), etc (Fig. 1).

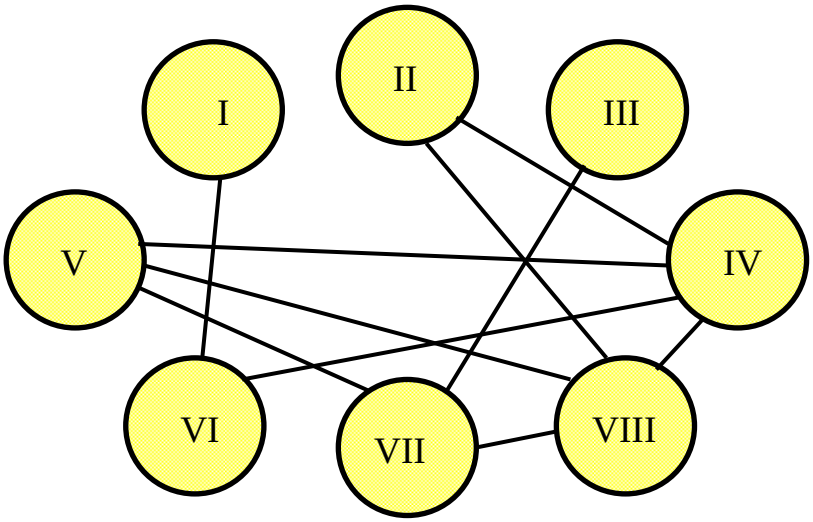

Fig. 1 Graph for the most significant correlations between cancers. Meanings of I~VIII are indicated in Materials and Methods.

Table 1 Pearson linear correlation between malignant neoplasms.

	I	II	III	IV	V	VI	VII	VIII
I	1	0.0191	-0.0544	0.2818	0.2502	0.4605	-0.1623	0.0456
II	0.0191	1	-0.1178	0.3971	0.2113	0.2895	-0.0683	0.432
III	0.0191	-0.1178	1	0.2856	-0.2245	-0.0828	0.5915	0.1413
IV	0.2818	0.3971	0.2856	1	0.4832	0.3313	0.278	0.4344
V	0.2502	0.2113	-0.2245	0.4832	1	-0.1386	-0.3025	-0.3254
VI	0.4605	0.2895	-0.0828	0.3313	-0.1386	1	-0.0468	0.1696
VII	-0.1623	-0.0683	0.5915	0.278	-0.3025	-0.0468	1	-0.483
VIII	0.0456	0.432	0.1413	0.4344	-0.3254	0.1696	-0.483	1

I-VIII represent malignant neoplasms of (I) skin (i.e., malignant melanoma; total population), (II) breast (women), (III) cervix uteri (women), (IV) colon, rectosigmoid junction, rectum, anus and anal canal (total population), (V) lymphatic/haematopoietic tissue (total population), (VI) prostate (men), (VII) stomach (total population), and (VIII) trachea, bronchus and lung (total population). The same interpretation for Tables 2 and 3.

Table 2 Number of datasets for pairs of malignant neoplasms.

	I	II	III	IV	V	VI	VII	VIII
I	0	575	575	575	520	572	575	520
II	575	0	575	575	520	572	575	520
III	575	575	0	575	520	572	575	520
IV	575	575	575	0	520	572	575	520
V	520	520	520	520	0	517	520	520
VI	572	572	572	572	517	0	572	517
VII	575	575	575	575	520	572	0	520
VIII	520	520	520	520	520	517	520	0

Table 3 Statistic *p* values for pairs of malignant neoplasms.

	I	II	III	IV	V	VI	VII	VIII
I	0	0.6479	0.1927	**0**	**0**	**0**	**0.0001**	0.2994
II	0.6479	0	**0.0047**	**0**	**0**	**0**	0.1018	**0**
III	0.1927	0.0047	0	0	0	**0.0477**	**0**	**0.0012**
IV	0	0	0	0	0	**0**	**0**	**0**
V	0	0	0	0	0	**0.0016**	**0**	**0**
VI	0	0	0.0477	0	0.0016	0	0.2638	**0.0001**
VII	0.0001	0.1018	0	0	0	0.2638	0	**0**
VIII	0.2994	0	0.0012	0	0	0.0001	0	0

Bold values represent $p<0.01$, and mean that the correlations are statistically significant.

4 Discussion

It should be noted that the above correlation do not certainly mean the direct interactions between cancers. These correlations are mostly resulted from common or adverse environmental, social, medical or even genetic / molecular factors between cancers.

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