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Original Research Article

Neoplasms in Cyprus and the Effect of Predisposing Factors of Tobacco and Air Pollution

Irene Rethemiotaki, Efthimios Zervas

School of Science and Technology, the Hellenic Open University, 18 Parodos Aristotelous St., GR-26335 Patra, Greece

Corresponding Author: Efthimios Zervas

ABSTRACT

Aim: The aim of this work is to study the neoplasms and more specifically the malignant neoplasms (cancer) in Cyprus and their relationship to the predisposing factors of smoking and air pollution.
Methods: The statistical methods were used in this study are Mann-Whitney U test in order to check the statistical significance of the neoplasms in relation to gender, One-Way ANOVA test in order to check the statistical significance of neoplasms in relation to age, and the Pearson correlation coefficient for the relationship between neoplasms with smoking and air pollution.
Results: The results showed that there is a statistically significant difference in the number of neoplasms in relation to gender and, more specifically, they occur more frequently in men, in the total number of tumors, in malignant neoplasms of the liver and intrahepatic bile ducts and in leukemia. It was also found that there is a statistically significant difference in the number of neoplasms in relation to the age with a more frequent occurrence at ages 65 and over. Finally, there is a correlation of the incidence of neoplasms with air pollution while there is no statistically significant correlation with smoking.
Conclusions: This study has shown that neoplasms differ in the incidence in terms of age and gender while air pollution is a significant predisposition.

Keywords: Air pollution, Malignant neoplasms, Tobacco.

I. INTRODUCTION

Neoplasm is an abnormal tissue development resulting from autonomous and abnormal cell proliferation, which, if it forms a mass, is usually referred to as tumor, [1-3] However; neoplasia is not always a mass. [4] Neoplasms differ histologically from the corresponding normal tissues based on a variety of characteristics that are useful in diagnosis, such as loss of cell orientation, loss of cellular cohesion, enlargement of the nucleus and increased mitotic activity. [3] Four of them are their main categories of classification: benign neoplasms, in situ neoplasms, malignant neoplasms and neoplasms of unknown behavior. [5] Malignant neoplasm is synonymous with cancer. The major underlying cause of malignant neoplasms known as cancers is the DNA damage. [6,7] Physical damage to DNA is a common phenomenon (mainly due to cellular metabolism) and occurs in more than 60,000 new lesions, on average per human cell, per day. [6] Exposure to exogenous agents may cause additional damage to DNA. Increased exogenous damage to DNA is caused by tobacco smoke and is a possible cause of lung cancer. [8]

The only major cause of death that can be avoided in developed and developing countries is the use of tobacco and causes about 5.4 million deaths per year. In the future, the number of deaths from tobacco use is expected to nearly double over the next 15 years. [9,10] Apart from smokers, non-smokers exposed to passive smoking (SHS) are also at risk from smoking-related diseases and mortality. [11] The SHS report is among the three largest causes of death worldwide, according to a recent analysis of the global burden of illness. [12] In addition, the SHS report accounts for 10.9 million lost disability (DALYs) in both children and adults. [13] Scientific research over the past few years has drawn attention to the toxicity and health of human exposure to third-hand smoke (THS) exposure. THS includes residual pollutants that remain on surfaces and/or dust, even when there is no active smoking, and are re-emitted to air or react with other compounds to produce secondary environmental pollutants. [14,15]

The acute and chronic effects of short- and long-term exposure to Particulate Matter (PM) on health have been studied by many researchers. [16-27] Epidemiological studies show that these health impacts are based on long-term concentrations of particulate matter in the environment (both indoors and outdoors) and the associated risk factors vary from country to country. [28-32] According to studies, particulate matter, PM2.5 has more consistent and stronger mortality relationships. [33-38, 28] In addition, according to the Global Burden of Disease (GBD) plan of the Institute for Measurement and Health Assessment (IHME) and the Institute of Health Effects (HEI), air pollution is considered a high priority. In particular, atmospheric pollution was responsible for 7.6% of all worldwide deaths in 2015. [39, 40] Studying the trend of particulate matter shows that between 1990 and 2015, global PM2.5 concentrations based on population increased by 11.2% (from 39.7 to 44.2 μg/m^3) and the increase was somewhat faster from 2010. However, it is noted that in 2015 92% of the world's population lived in areas that exceeded the WHO air quality guideline (10 μg/m^3). Due to the highly exposed population, air pollution is the fifth highest risk factor for premature mortality in the world. [41] This work studies neoplasms and, in particular, malignant neoplasms (cancer) on gender and age of onset in Cyprus, as well as their relation to smoking and air pollution.

II. METHODS

The data were used in this work come from the Republic of Cyprus and cover the period 2012-2015.Cyprus is a small island in the Mediterranean and has been a member of the European Union since 2004, with a population of approximately 838,897 inhabitants. Cancer is for this island the second leading cause of death.

The statistical methods used in this study were non-parametric Mann-Whitney U test, One-Way ANOVA test, and Pearson's correlation coefficient r. The Mann-Whitney U test checks whether the median values of a variable vary significantly between two independent samples when the distribution is not normal. The One-Way ANOVA test checks whether the mean values of a variable differ significantly between more than two independent samples. In order to perform the above two tests, data from the hospitals of Cyprus was used in 2015. Finally, the Pearson correlation coefficient r checks whether there is a linear correlation between two quantitative variables. For this control data from the hospitals of Cyprus (Nicosia, Larnaka, Lemesos, Ammochostos and Pafos) was used in the years 2012-2015.ThestudywascarriedoutbyusingIBMSPSS 20 software package for Windows.

III. RESULTS

To check the zero hypothesis that the median of the admitted to hospitals in Cyprus with malignant neoplasms did not differ in gender, the Mann-Whitney U statistical criterion was used. As shown in Table 1, a statistically significant difference in the number of neoplasms relative to gender is noted in the overall number of all neoplasms, with a more frequent occurrence in men

Table 1: Mann-Whitney U test

	Data		
	Males	Females	p value
Neoplasms	**5502**	4674	**<0.05**
Malignant neoplasm of lip, oral cavity and pharynx	18	9	>0.05
Malignant neoplasm of oesophagus	7	2	>0.05
Malignant neoplasm of stomach	114	40	>0.05
Malignant neoplasm of colon	435	250	>0.05
Malignant neoplasm of rectosigmoid junction,rectum, anus and anal canal	45	27	>0.05
Malignant neoplasm of liver and intrahepatic bile ducts	**58**	27	**<0.05**
Malignant neoplasm of pancreas	115	81	>0.05
Malignant neoplasm of digestive organs	49	46	>0.05
Malignant neoplasm of larynx	40	0	>0.05
Malignant neoplasm of trachea, bronchus and lung	401	171	>0.05
Other malignant neoplasms of respiratory and intraholic organs	15	0	>0.05
Malignant neoplasm of bone and articular cartilage	20	16	>0.05
Malignant melanoma of skin	19	16	>0.05
Other malignant neoplasms of skin	20	10	>0.05
Malignant neoplasm of mesothelial and soft tissue	40	11	>0.05
Malignant neoplasm of breast	3	605	>0.05
Malignant neoplasm of bladder	450	63	>0.05
Other malignant neoplasms of urinary tract	47	16	>0.05
Malignant neoplasm of eye and adnexa	14	2	>0.05
Malignant neoplasm of brain	16	28	>0.05
Malignant neoplasm of other parts of central nervous system	15	0	>0.05
Malignant neoplasm of other,ill-defined, secondary,unspecified and multiple sites	136	206	>0.05
Hodgkin´s disease	83	82	>0.05
Non-Hodgkin´s lymphoma	590	461	>0.05
Leukaemia	**979**	422	**<0.05**
Other malignant neoplasms of lymphoid, haematopoietic and related tissue	391	654	>0.05

Table 2:One-way ANOVA

	Mean			
	15-44	45-64	65 and over	p-value
Neoplasms	604	1588,434	**2635,49**	<0.05
Malignant neoplasm of lip, oral cavity and pharynx	0	4,245	**6,653**	<0.05
Malignant neoplasm of oesophagus	0	0,377	**3,516**	<0.05
Malignant neoplasm of stomach	1	18,962	**47,266**	<0.05
Malignant neoplasm of colon	4	105,264	**205,538**	<0.05
Malignant neoplasm of rectosigmoid junction,rectum, anus and anal canal	1	12,396	**20,032**	<0.05
Malignant neoplasm of liver and intrahepatic bile ducts	9	12,547	**17,169**	<0.05
Malignant neoplasm of pancreas	10	22,038	**64,097**	<0.05
Malignant neoplasm of digestive organs	0	18,075	**29,097**	<0.05
Malignant neoplasm of larynx	0	6,415	**8,717**	<0.05
Malignant neoplasm of trachea, bronchus and lung	7	114,83	**138,474**	<0.05
Other malignant neoplasms of respiratory and intraholic organs	0	0,755	**4,169**	<0.05
Malignant neoplasm of bone and articular cartilage	6	1	**4,516**	<0.05
Malignant melanoma of skin	2	**9,132**	6	<0.05
Other malignant neoplasms of skin	0	5,396	**7,621**	<0.05
Malignant neoplasm of mesothelial and soft tissue	1	3,377	**8,927**	<0.05
Malignant neoplasm of breast	63	**183,434**	154,761	<0.05
Malignant neoplasm of bladder	0	39,566	**164,674**	<0.05
Other malignant neoplasms of urinary tract	0	7,623	**18,613**	<0.05
Malignant neoplasm of eye and adnexa	0	**0,623**	0,379	<0.05
Malignant neoplasm of brain	5	5,642	**7,347**	<0.05
Malignant neoplasm of other parts of central nervous system	0	0	**0,379**	<0.05
Malignant neoplasm of other,ill-defined, secondary,unspecified and multiple sites	49	55,585	**76,073**	<0.05
Hodgkin´s disease	**58**	6,642	21,895	<0.05
Non-Hodgkin´s lymphoma	60	199,208	**251,418**	<0.05
Leukaemia	89	154,396	**259,11**	<0.05
Other malignant neoplasms of lymphoid, haematopoietic and related tissue	12	168,566	**378,429**	<0.05

Also, more frequent occurrence in men is seen in malignant neoplasm of the liver and intrahepatic bile ducts as well as in leukemia. In all other malignant neoplasms, there is no statistically significant difference between men and women.

In order to test the zero hypothesis that the mean of the admitted to the hospitals in Cyprus with malignant neoplasms did not differ in age, the one-way ANOVA statistical criterion was used. As can be seen from Table 2, there is a statistically significant difference in the number of neoplasms with age, with a more frequent occurrence of 65 or more. Exceptions are malignant melanoma of the skin, malignant neoplasm of the eye and malignant neoplasm of the chest which occur more often in the ages 45-64. Finally, Hodgkin's disease occurs more often at ages 15-44.

Table 3 shows the Pearson correlation coefficient among the total number of neoplasms, the number of smokers on a daily basis and the PM2.5 suspended particulate matter concentration for the years 2012 to 2015.

Table 3: Pearson correlation coefficient

		Neoplasms	PM2.5	Tobacco
Neoplasms	Pearson correlation r	1	-0,95	-0,75
	p - value		<0.05	>0.05

The Pearson correlation coefficient between the total number of neoplasms and PM2.5 suspended particle concentrations is -0.95, which indicates that there is a strong correlation between air pollution and neoplasms. In contrast, there is no statistically significant relationship between smokers on a daily basis and the number of neoplasms.

IV. DISCUSSION

Increasing attention should be given to the association between air pollution and the number of neoplasms. It is noted that despite the reduction in particulate matter concentrations over the years, the number of patients with tumor and cancer is rising. One possible explanation is that cancer can run subclinically for many years before it is identified. Patients may be asymptomatic for many years, prior to local development or the occurrence of metastases.

It is also noteworthy that no statistically significant relevance was found between daily smokers and patients with tumor and cancer. One possible explanation is the existence of other predisposing factors for the development of cancer such as radiation exposure, carbon burning products, lifestyle, etc.

V. CONCLUSIONS

This study has shown that neoplasms differ in the incidence in terms of age and gender while air pollution is a significant predisposition.

REFERENCES

1. Birbrair A, Zhang T, Wang ZM, Messi ML, Olson JD, Mintz A, Delbono O. Type-2 pericytes participate in normal and tumoral angiogenesis. American Journal of Physiology - Cell Physiology. 2014;307 (1): 25–38. doi:10.1152/ajpcell.00084.2014.
2. Cooper G. Elements of human cancer. Boston: Jones and Bartlett Publishers; 1992.ISBN: 978-0-86720-191-8.
3. Kumar V, Abbas AK, Fausto N. Neoplasia. In Pathologic basis of disease, SL Robbins and RS Cotran (eds), Elsevier Saunders, Philadelphia 2005, pp 269-342.E-Book ISBN: 9780323286046.
4. Stedman T. Stedman's medical dictionary. Philadelphia: Lippincott Williams & Wilkins; 2006. ISBN: 0781733901.
5. World Health Organization."II Neoplasms" [cited 2 December 2017]. Available at: http://apps.who.int/classifications/icd10/browse/2010/en#/II.
6. Bernstein C, Prasad AR, Nfonsam V, Bernstei H. DNA Damage, DNA Repair and Cancer. New Research Directions in DNA Repair.2013; pp. 413–65. ISBN: 978-953-51-1114-6.
7. Kastan MB. DNA damage responses: mechanisms and roles in human disease: G.H.A. Clowes Memorial Award Lecture. Mol. Cancer Res.2007; 6(4):517–24. doi:10.1158/1541-7786.MCR-08-0020.
8. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006;3(11): 442.doi:10.1371/journal.pmed.0030442.
9. World Health Organization WHO report on the global tobacco epidemic, 2009: implementing smoke-free environments. WHO, Geneva; 2009.ISBN: 978 92 4 156391 8.
10. Cunningham FH, Fiebelkorn S, Johnson M, Meredith C. A novel application of the Margin of Exposure approach: segregation of tobacco smoke toxicants. Food Chem. Toxicol. 2011; 49 (11):2921–33. doi:10.1016/j.fct.2011.07.019. PMID 21802474.
11. Laumbach R, Kipen H. Mechanistic data support protecting non-smokers from the

lethal effects of second-hand smoke. Int J Public Health, 2014. doi:10.1007/s00038-014-0550-1.
12. Lim SS, Vos T, Flaxman AD et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet. 2013; 380: 2224-2260. doi:10.1016/S0140-6736(12)61766-8.
13. Oberg M, Jaakkola MS, Woodward A, Peruga A, Pruss-Ustun A. Worldwide burden of disease from exposure to secondhand smoke: a retrospective analysis of data from 192 countries. Lancet. 2011; 377: 139–146. doi:10.1016/S0140-6736(10)61388-8.
14. Hang B, Sarker AH, Havel C et al .Third hand smoke causes DNA damage in human cells. Mutagenesis.2013;28:381-391.doi:10.1093/mutage/get01.
15. Matt GE, Quintana PGE, Destaillats H et al.Third hand tobacco smoke: emerging evidence and arguments for a multidisciplinary research agenda. Environ Health Perspect. 2013;119:1218–1226. doi:10.1289/ehp.1103500.
16. Zanobetti, A., Bind, M.-A.C., Schwartz, J. Particulate air pollution and survival in a COPD cohort. Environ. Health.2008;7:48. http://dx.doi.org/10.1186/1476-069X-7-48.
17. Pope CA, Thun MJ, Namboodiri MM, Dockery DW, Evans JS. Speizer FE, Heath CW. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. Am. J. Respir. Crit. Care Med.1995; 151:669–674.doi: 10.1164/ajrccm/151.3_Pt_1.669.
18. Pope CA, Burnett RT, Thurston GD, Thun MJ, Calle EE, Krewski D, Godleski JJ. Cardiovascular mortality and long-term exposure to particulate air pollution: epidemiological evidence of general pathophysiological pathways of disease. Circulation.2004;109:71–77.doi: 10.1161/01.CIR.0000108927.80044.7F.
19. Pope CA, Burnett RT, Turner MC, Cohen A, Krewski D, Jerrett M, Gapstur SM, Thun MJ. Lung cancer and cardiovascular disease mortality associated with ambient air pollution and cigarette smoke: shape of the exposure-response relationships. Environ. Health Perspect.2011; 119:1616–1621. doi: 10.1289/ehp.1103639.
20. Anenberg SC, Talgo K, Arunachalam S, Dolwick P, Jang C, West JJ. Impacts of global, regional, and sectoral black carbon emission reductions on surface air quality and human mortality. Atmos. Chem. Phys.2011;11:7253-7267.https://doi.org/10.5194/acp-11-7253-2011.
21. Cesaroni G, Forastiere F, Stafoggia M, Andersen ZJ, Badaloni C, Beelen R, et al. Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE project. BMJ. 2014; 348:7412.doi: 10.1136/bmj.f7412.
22. Beelen R, Raaschou-Nielsen O, Stafoggia M, Andersen ZJ, Weinmayr G, Hoffmann B, et al. Effects of long-term exposure to air pollution on natural-cause mortality: an analysis of 22 European cohorts within the multicentre ESCAPE project. Lancet. 2014;383:785–795. doi: 10.1016/S0140-6736(13)62158-3.
23. Hamra GB, Guha N, Cohen A, Laden F, Raaschou-Nielsen O, Samet JM, Vineis P,Forastiere F, Saldiva P, Yorifuji T, Loomis D. Outdoor particulate matter exposure and lung cancer: a systematic review and meta-analysis. Environ. Health. Perspect. 2014; 122: 906–911. doi:10.1289/ehp.1408092.
24. Korek MJ, Bellander TD, Lind T, Bottai M, Eneroth KM, Caracciolo B, de Faire UH, Fratiglioni L, Hilding A, Leander K, Magnusson PKE, Pedersen NL, Östenson CG, Pershagen G, Penell JC. Traffic-related air pollution exposure and incidence of stroke in four cohorts from Stockholm. J. Expo. Sci. Environ. Epidemiol.2015; 25: 517–523. doi: 10.1038/jes.2015.22.
25. Brauer M, Freedman G, Frostad J, van Donkelaar A, Martin RV, Dentener F, VanDingenen R, Estep K, Amini H, Apte JS, Balakrishnan K, Barregard L, Broday DM, Feigin V, Ghosh S, Hopke PK, Knibbs LD, Kokubo Y, Liu Y, Ma S, Morawska L, TexcalacSangrador JL, Shaddick G, Anderson HR, Vos T, Forouzanfar MH, Burnett RT, Cohen A. Ambient air pollution exposure estimation for the global burden of disease 2013. Environ. Sci. Technol. 2015; 50:79–88. doi: 10.1021/acs.est.5b03709.
26. Brunekreef B, Holgate ST. Air pollution and health. Lancet. 2002;360:1233–1242. doi: 10.1016/S0140-6736(02)11274-8.
27. Shi L, Zanobetti A, Kloog I, Coull BA, Koutrakis P, Melly SJ, Schwartz JD. Low concentration PM 2.5 and mortality: estimating acute and chronic effects in a population-based study. Environ. Health Perspect.2016; 124:46–52.doi:10.1289/ehp.1409111.

28. Pope CA, Dockery DW. Health effects of fine particulate air pollution: lines that connect. J. Air Waste Manage. Assoc. 2006;56:709–742. https://doi.org/10.1080/10473289.2006.10464485.
29. Kan H, Gu D. Association between long-term exposure to outdoor air pollution and mortality in China: a cohort study. Epidemiology. 2011; 22:29. doi: 10.1016/j.jhazmat.2010.12.036.
30. Zhou M, Liu Y, Wang L, Kuang X, Xu X, Kan H. Particulate air pollution and mortality in a cohort of Chinese men. Environ. Pollut. 2014;186:1–6. doi: 10.1016/j.envpol.2013.11.010.
31. Zhang P, Dong G, Sun B, Zhang L, Chen X, Ma N, Yu F, Guo H, Huang H, Lee YL, Tang N, Chen J. Long-term exposure to ambient air pollution and mortalitydue to cardiovascular disease and cerebrovascular disease in Shenyang, China; 2011. doi: 10.1371/journal.pone.0020827.
32. Shang Y, Sun Z, Cao J, Wang X, ZhongL, Bi X, Li H, Liu W, Zhu T, Huang W. Systematic review of Chinese studies of short-term exposure to air pollution and dailymortality. Environ. Int. 2013;54:100–111. https://doi.org/10.1016/j.envint.2013.01.010
33. Lai HK, Tsang H, Chau J, Lee CH, McGhee SM, Hedley AJ, Wong CM. Health impact assessment of marine emissions in Pearl River Delta region. Mar. Pollut. Bull. 2013a;66:158–163. http://dx.doi.org/10.1016/j.marpolbul.2012.09.029.
34. WHO. Health Effects of Particulate Matter: Policy Implications for Countries in Eastern Europe, Caucasus and central Asia. World Health Organization, Denmark; 2013.ISBN: 978 92 890 0001 7.
35. USEPA. Provisional Assessment of Recent Studies on Health Effects of Particulate Matter Exposure. United States Environmental Protection Agency. EPA/600/R-12/056F; 2012. Available at: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=247132.
36. Lu F, Xu D, Cheng Y, Dong S, Guo C, Jiang X, ZhengX. Systematic review and meta-analysis of the adverse health effects of ambient PM2.5 and PM10 pollution in the Chinese population. Environ. Res.2015; 136:196–204.doi: 10.1016/j.envres.2014.06.029.
37. Kim KH, Kabir E, Kabir S.A review on the human health impact of airborne particulate matter. Environ. Int.2015; 74:136–143.doi: 10.1016/j.envint.2014.10.005.
38. Pope CA, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, Thurston GD. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. JAMA 2002;287,1132–1141. doi:10.1001/jama.287.9.1132.
39. IHME and HEI. State of Global Air/2017: A Special Report on Global Exposure to Air Pollution and Its Disease Burden. Institute for Health Metrics and Evaluation, and Health Effects Institute; 2017. Available at: https://www.stateofglobalair.org.
40. Forouzanfar MH, Afshin A, Alexander LT, Anderson HR, Bhutta ZA, Biryukov S, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388:1659–1724. doi: 10.1016/S0140-6736(16)31679-8.
41. HEI. Health Effects Institute Releases First Annual State of Global Air Report. Health Effects Institute; 2017. Available at: https://www.healtheffects.org.

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