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Impact of health determinants on Greek health level, as capture of health production function

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Επίδραση προσδιοριστικών παραγόντων υγείας στο επίπεδο υγείας του ελληνικού πληθυσμού, ως αποτύπωση της συνάρτησης παραγωγής υγείας

Περίληψη στο τέλος του άρθρου

The macroeconomic dimensions of health production function in Greece were studied, by linking doctors' number, per capita health expenditures, population percentage living in material deprivation conditions, pollutant emissions and alcohol consumption with health indicators. Articles were searched, by recording data from databases (Hellenic-European Statistical Service, Organisation for Economic Co-operation and Development [OECD]) and medical personnel number, per capita health expenditures, population segment living in poverty, pollutant emissions (expressed as CO_2/capita) and alcohol use variation were correlated with changes in infant mortality, healthy life years and life expectancy. By above methodology, strong negative correlation of doctors' number with infant mortality (0.90% approximately) (1960–2015) and significantly positive corresponding in life expectancy change (0.94% approximately) (2000–2015) were captured. The strong negative association of per capita health expenditure on infant mortality (84% for years 2000–2015 and 96% for years 1989–2011), 90% negative correlation of people living in material deprivation conditions with healthy life years were highlighted (2008–2015), as well as negative correlation (about 95%) of environmental pollution, expressed as per capita CO_2 emitted amount, with life expectancy change (2007–2015) and the 95% approximate connection of alcohol consumption with life expectancy (2005–2014). The studied cases and correlation with longitudinal health indicators' modification document macroeconomic dimensions of health production function and measures to mitigate negative consequences/enhance beneficial effects on life quality are proposed.

Key words

Alcohol, material deprivation
Environmental pollution
Health costs
Health indicators
Health production function
Health services
Quality of life

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INTRODUCTION

The World Health Organization (WHO) (1946) defines health as a situation of physical, mental and social well-being and not exclusively absence of disease. Furthermore, apart from factors related to medicines, plenty of others determine the definition of health, including traits such as social, economic, behavioural, cultural, environmental, which, interacting, affect health level. In addition, life quality, subject to principles of individualization (subjective criteria) within a social framework, is related to numerous parameters and consequently, the term has not been precisely defined, with the Organisation for Economic Co-operation and Development (OECD) linking it to issues as health, provision of goods-services and quality of working life.[1]

HEALTH DETERMINANT FACTORS – LIFE QUALITY

An analysis of health determinant factors classifies them in medical (health, epidemiological-medical knowledge and practices), economic-political (social-economic development, income distributional practices, financial planning), socio-economic (housing traits, rural-urban structure, lifestyle, inequalities), those related to structure-functioning of society (production relations, social stratification), psychosocial-cultural (education level, social trends, morals-customs, habits), demographic (population's development-density, study of gender, age, occupation, migration), geophysical (climate, land productivity, raw materials) and environmental factors (ecosystem protection-contamination). Based on above mentioned parameters, life

quality is measured by indicators, such as Karnofski-WHO functional ones, Spitzer quality index, Katz index of daily activities, Nottingham health survey, McGrill pain questionnaire, general health questionnaire, psychological scale adaptation to illness, SF-36 health survey illness impact. OECD correlates health level with life expectancy, healthy life years, mortality, morbidity, life quality.[2] The used model, mapping interaction of aforementioned factors with health level is that of Dahlgren-Whitehead, placing individual at centre and factors at perimeter (fig. 1).[3]

HEALTH PRODUCTION FUNCTION

The consumer behaviour is multiparametrical issue, defined by human capital theory (developed by Becker-applicated by Grossman), determining that each behaves as consumer and producer and this, taking into account Wagstaf's model, is depicted in four pillars, recording consumption behaviour, income limitation, production behavior and financial limitation. Each, as consumer, produces "health", with its status determined by health index Ht, expressing the number of days/years with health in full extent. Its minimum reserve is denoted as Hmin and Hmax corresponds to 365 days. Health production function is depicted as a curved line, initially having minimum value Hmin and gradually becoming asymptotic towards Hmax. Also, the consumer produces goods-services, allocating time-income in activities, while its health "stock" decreases over time. The form of production function is expressed as HS=F{HC, K, D, Gym, To, Al, Dis, Ed}. HS is health index, HC health system, K residence, D healthy diet, Gym sports activity, To consumption of cigarettes, Al consumption of alcoholic beverages, Dis stress and Ed education, diagrammatically analysed across two axes, with horizontal recording health inputs and vertical the produced product change. Equal increases of inputs do not correspond to the same improvement of health level (in initial stages there is significant increase but gradually inputs correspond to lower health amelioration). As form of health production function, the impact of mortality (infant, neonatal, post-neonatal, live births, general) is recorded, which as dependent variable influenced by independent inputs (for instance, income, health expenditure as GDP share, alcohol use) is expressed logarithmically (Cobb-Douglas function). In addition, there are also other health determinant indicators, as social and environmental factors.[4]

Figure 1. Göran Dahlgren and Margaret Whitehead model.

HEALTH INDICATORS

In order to define health status at a given time, indicators used are separated in positive (life expectancy, birth-fertility rate), negative, related to occurrence of diseases – pathological conditions (morbidity index, mortality rate), financial – administrative indicators (health expenditure as % GDP, per capita health expenditure, number of doctors, nursing staff, hospital beds, hospital admissions/discharges, average stay length, outpatient visits – laboratory tests, average bed occupancy rate, Roemer Case Complexity and Severity Index), equivalent healthy life years (in perfect health), potentially lost life years, self-esteemed quality-weighted life years, healthy life expectancy (without serious disability) and disability-weighted life years (related to causes of disability).[5] Mortality is linked with socio-economic effects, related to gender, age, residence place, marital status, health care conditions, harmful habits (smoking, alcohol consumption), diet, heredity and inductively is linked with economic development – improved living conditions, amelioration of health services and dissemination of technology. Also, infant mortality reflects population's health state, highlighting prevailing conditions and numerous indicators are combined with demographic measures (infant-neonatal mortality).[6] Concerning infancy-childhood, most deaths are due to respiratory-infectious diseases and cancer – cardiovascular diseases cause most deaths in old age, followed by chronic diseases (such as diabetes, respiratory, degenerative musculoskeletal diseases, mental disorders).[7]

Medical staff – health costs

Aligned with WHO guidelines, the pillars of a health system are efficiency (life expectancy, health level measured by early-general mortality), efficiency correlated with inputs (nursing-medical staff, infrastructure – medical technology equipment) and outputs (hospitalization days – patient

health improvement), in light of rational distribution of resources, general-equal access to health structures, fair distribution of tax weights and social justice. The Greek National Health Systhem (NHS) is characterized by structures producing health-preventive services, including primary care centers, national emergency center, public hospitals, insurance funds and private sector (hospitals, diagnostic centers, maternity – medical – dental clinics) distinguished in three health care categories; the primary, including services for diagnosis (without requiring hospitalization), secondary (hospitalization's services) and tertiary care (offered by universities-general hospitals, where research in field of medicine is also implemented).[8] The doctors number is crucial element of efficiency of NHS, impacting on health indicators. There is correlation between doctor numbers/1,000 inhabitants and infant mortality in Greece (1960–2015) – OECD data (2017), with high negative correlation (-0.897) and change is shown diagrammatically in figure 2 (exponentially decreasing infant mortality linked with doctors number). Additionally, there is correlation between doctors number/1,000 inhabitants and life expectancy change in Greece (2000–2015, OECD 2017 data), with high positive correlation (0.939) and change is diagrammatically presented in figure 3, where life expectancy's linear increase is reflected combined with doctors' number's increase. As measure of domestic health system's efficiency, it is worth mentioning the importance of per capita health expenditure (in purchasing power parity expressed in US $) and correlation with infant mortality change in Greece (2000–2015) is recorded (OECD 2017 data) with high negative correlation (-0.841), as well as change is diagrammatically presented in figure 4, with trend line referring to two rolling average periods. The multiple linear regression statistics as example

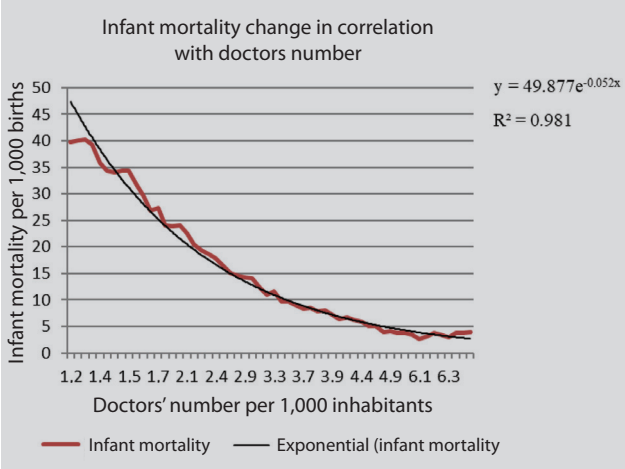

Figure 2. Correlation of infant mortality with doctors' number (Source: OECD 2017).

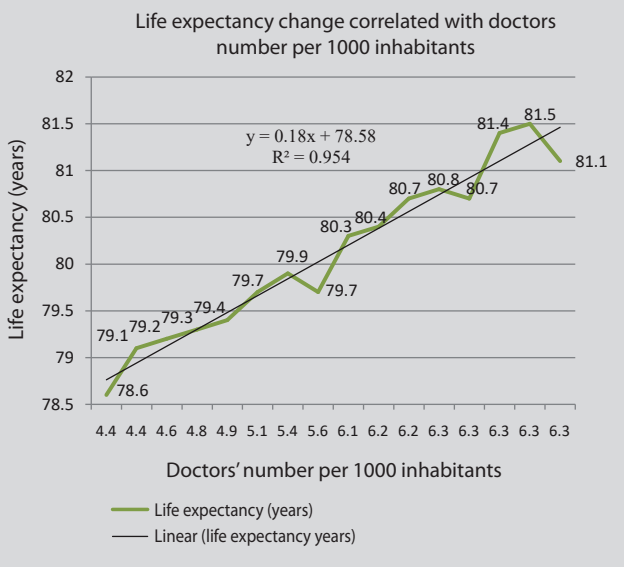

Figure 3. Comparison of life expectancy with doctors' number (Source: OECD 2017).

for independent variables on infant mortality/1,000 births (1989–2011) for Greece (tab. 1, OECD 2017 data), an adjusted multiple correlation coefficient-R value of 0.9521929 was found (ranging from 0 to +1), the independent variable for current per capita health expenditure in US $ had p-value of 0.00031028 (fig. 5, statistical regression analysis) and therefore, the independent variable in question is

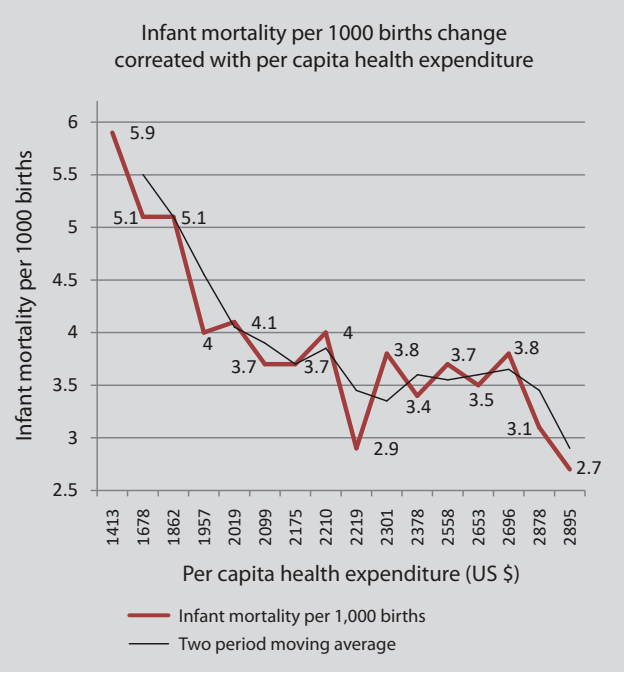

Figure 4. Infant mortality – Per capita health expenditure (Source: OECD 2017).

Table 1. Multiple linear regression statistics of infant mortality (1989–2011).

Years	Infant mortality/ 1,000 births	Current health expenditure (% of GDP)	Per capita current health expenditure (US $)	Per capita public and insurance expenditure (US $)	Hospital beds/1,000 inhabitants	Per capita alcohol consumption in liters (15 years and over)	Doctors/1,000 inhabitants
1989	9.7	6.0	779	439	5.1	10.2	3.3
1990	9.7	6.1	807	437	5.0	10.3	3.4
1991	9.0	5.9	829	449	5.0	10.2	3.6
1992	8.4	6.5	927	516	4.9	10.0	3.7
1993	8.5	7.3	1,041	579	5.0	10.7	3.8
1994	7.9	8.0	1,184	608	4.9	10.4	3.9
1995	8.1	8.0	1,228	649	4.9	10.1	3.9
1996	7.2	7.9	1,271	688	5.0	9.7	3.9
1997	6.4	7.7	1,319	711	4.9	9.5	4.0
1998	6.7	7.6	1,365	727	4.9	9.0	4.2
1999	6.2	7.8	1,433	785	4.8	9.5	4.3
2000	5.9	7.2	1,413	871	4.8	8.5	4.4
2001	5.1	8.0	1,678	1,061	4,8	8.6	4.4
2002	5.1	8.2	1,862	1,126	4.8	8.1	4.6
2003	4.0	8.2	1,957	1,208	4.7	9.5	4.8
2004	4.1	7.9	2,019	1,230	4.7	9.6	4.9
2005	3.8	9.0	2,301	1,420	4.8	10.0	5.1
2006	3.7	9.0	2,558	1,630	4.9	9.4	5.4
2007	3.5	9.1	2,653	1,641	4.9	9.7	5.6
2008	2.7	9.4	2,895	1,689	4.8	9.5	6.1
2009	3.1	9.5	2,878	1,972	4.9	9.1	6.2
2010	3.8	9.6	2,696	1,862	4.5	9.0	6.2
2011	3.4	9.1	2,378	1,569	4.5	8.0	6.3

Source: OECD 2017

statistically significant (assumed different from 0), verified diagrammatically in figure 6. The statistical regression has the form Y=A0+A1*B1+A2*B2+A3*B3+A4*B4+A5*B5+A6*B6+E, where Y denotes infant mortality/1,000 births, A0 is a constant, A1, A2, A3, A4, A5, A6 partial regression coefficients and B1 current health expenditure (% GDP), B2 per capita current health expenditure (in US $), B3 per capita government-insurance expenditure (in US $), B4 available hospital beds/1,000 inhabitants, B5 per capita alcohol consumption in liters (from 15 years and over), B6 doctors/1,000 inhabitants, E standard error and partial coefficients' values are A0=-14.94289, A1=0.1661555, A2=-0.006295, A3=0.0028559, A4=3.4523888, A5=0.5111159 and A6=1.2540703. This statistical regression selected as infant mortality is health key indicator and statistics were complete (without "gaps"). It is emphasized that alcohol consumption was not excluded as input.

Living conditions – input in health production function

Differences in material conditions (income, housing, nutrition, work environment) characterize inequalities of health determinants.[9] Furthermore, improvement in life expectancy is primarily attributed to amelioration of material conditions in conjunction with measures concerning public sanitary conditions. The high correlation between poverty and reduced health level reflects association of material goods with health indicators, highlighting poverty as the most important health determinant,[10] with income's distribution also affecting health level. A widely accepted way of measuring income distribution level is poverty line calculation (in EU frame is defined as 60% of median income – the used indicator is population with income below poverty line).[11] Correlation of living conditions with health level is also reflected in health services' use. There

Output

Regression statistics	
Multiple R	0.98246
R Square	0.96523
Adjusted R Square	**0.95219**
Standard error	0.49965
Sample size	23

Analyzing variance

	Degrees of freedom	*SS*	*MS*	*F*	*Significance F*
Regression	6	110.89163	18.48194	74.03037	0.00000
Rest	16	3.99446	0.24965		
Total	22	114.88609			

	Coefficients	*Standard error*	*t*	*P-value*	*Lower 95%*	*Higher 95%*
Y-intercept	-14.94289	7.29419	-2.04860	0.05727	-30.40589	0.52011
CURRENT HEALTH EXPENDITURE (% OF GDP)	0.16616	0.27176	0.61141	0.54952	-0.40995	0.74226
PER CAPITA CURRENT HEALTH EXPENDITURE (US$)	-0.00630	0.00138	-4.57673	**0.00031**	-0.00921	-0.00338
PER CAPITA PUBLIC AND INSURANCE EXPENDITURE (US$)	0.00286	0.00183	1.56113	0.13805	-0.00102	0.00673
HOSPITAL BEDS PER 1000 INDIVIDUALS	3.45239	1.26272	2.73409	0.01471	0.77554	6.12924
PER CAPITA ALCOHOL CONSUMPTION IN LITERS (15 YEARS & OVER)	0.51112	0.19617	2.60546	0.01913	0.09525	0.92698
DOCTORS PER 1000 INDIVIDUALS	1.25407	0.61240	2.04781	0.05736	-0.04415	2.55229

Figure 5. Statistical regression analysis (for per capita health expenditure).

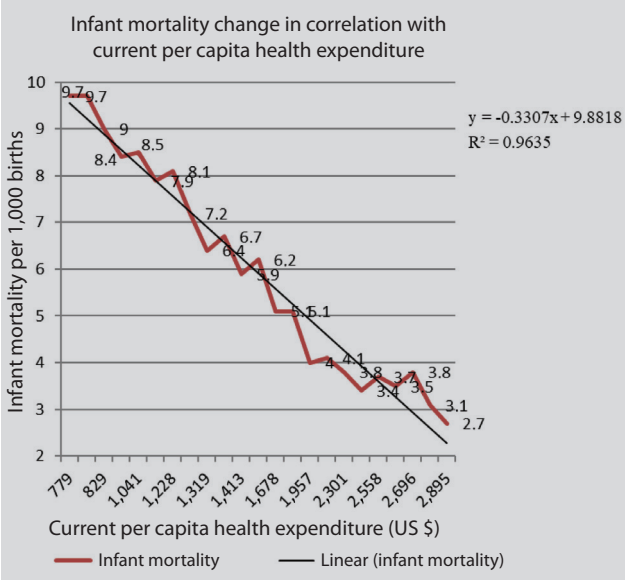

Figure 6. Infant mortality – Per capita health expenditure (Source: OECD 2017).

are two categories of poverty, the absolute (poverty) and the relative (inequality) with effects of social inequalities proportionally graded on health (increased morbidity of people of lower socio-economic stratification) combined with added behavioural characteristics of people in lower socio-categories (such as high rates of alcohol consumption). There is correlation of material deprivation as % of population (Eurostat 2017 and ELSTAT press release. 23.6.2017) with healthy life years (Eurostat, 2008–2015), with high correlation (-0.895) with change diagrammatically depicted in figure 7. Given the numerous factors influencing healthy life years, no absolute downward slope of their change line was recorded in relation to material deprivation conditions.

Environmental pollution effect on health

Atmospheric pollution is presence of chemical substances in quantity/concentration/duration that affect human health, living organisms and ecosystems.[12] The main sources of air pollution include natural, anthropogenic activities, producing primary pollutants (sulfur dioxide, carbon monoxide, nitrogen monoxide, hydrocarbons and suspended particles) with added ozone being conventional pollutants, with addition of gaseous pollutants derived from vehicular traffic, followed by central heating and industrial activities. The sources of atmospheric pollutants are divided in domestic sewage, industrial-organic waste (lubricants, solvents, oil paints, petroleum products), and waste from agricultural activity (fertilizers, pesticides), while suspended atmospheric particles are distinguished in solid and liquid phases (dust, dioxins, smoke, heavy metals, polycyclic aromatic hydrocarbons, insecticides) categorized in those

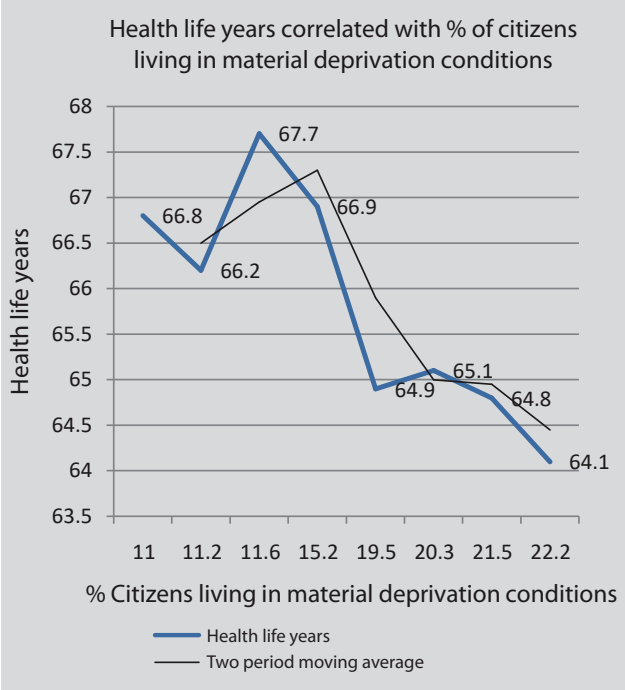

Figure 7. Material deprivation correlated with healthy life years. Source: Eurostat and ELSTAT 2017.

with diameter of 2,5–10 pm (particulate matter) and those whose diameter exceeds 10 pm. Pollutants causally related to morbidity-mortality are carbon-nitrogen compounds, sulfur dioxide, ozone and soot, often causing disabilities, miscarriages, reproductive disorders.[13] Health is sensitive to changes in concentrations of gases-air pollutants, with immediate adverse health effects when thresholds are exceeded, including subclinical disturbances in physiology, symptom onset, medication use, increased medical visits, hospital admissions and premature deaths.[12] Allergies, neurological diseases, respiratory infections, cancers, liver damage, leukemia, cardiovascular diseases (and baby births with congenital heart problems), asthma exacerbation, chronic obstructive pulmonary disease (COPD), neoplasms, pulmonary edema are diseases related to atmospheric pollution. According to data extracted from European Agency for Public Health Education Accreditation (APHEA), increased hospital admissions for respiratory diseases are due to air pollution and other studies document association of fluctuating atmospheric temperature (linked to concentration of air chemical substances) with exacerbation of acute coronary events, worsening in conjunction with climate change. In addition, worldwide, child mortality under the age of 5 due to air pollution is five times higher than that of the general population. Moreover, studies of Committee on Medical Effects of Air Pollutants (COMEAP) record that in Britain, ozone may be causative for 700–12,500 premature deaths and 500–9,900 emergency hospital admissions per year. Studies in the United States of America (USA) recorded for 50 μg/m^3 increase in pm 10, 5.1% raise in total mortality, 18.1% in mortality from respiratory problems, 7.2% from cardiovascular diseases, 9.9% increase in hospital admissions with asthma attack, 4.1% with respiratory events, 15.4% increase in use of bronchodilators and 15.9% raise in asthma attacks. Based on a report by European Environment Agency, 60,000 deaths/year were recorded in European urban centers and 3,000,000 worldwide were related to long-term exposure to air pollutants and regarding to childhood morbidity, air pollution is assessed as primary cause related in industrialized countries and second cause in developing industrialized.[13] According to Eurostat data (2017), there is correlation of per capita gas emissions, expressed equivalently in tons of CO_2, with evolution of life expectancy in Greece (2007–2015), with high correlation (-0.945), and change is diagrammatically illustrated in figure 8. CO_2 emissions due to human factors are used as an indicator (CO_2 equivalents) that captures total emissions of polluting gases, impacting on greenhouse effect (with consequent negative effects on health). Given the multitude of factors affecting life expectancy, a perfectly linear downward trend in relation to per capita CO_2 emissions was not recorded. Finally, studies recorded association of genes and environment with allergies (asthma, rhinitis and eczema are related to genetic-environmental factors).[14]

Alcohol consumption impact on health

Ethyl alcohol, a component of the human body, is detected in blood at a ratio of less than 1.5 mg/L and the amount for a person under alcohol influence is 800 mg/L. When ethyl alcohol enters body, it is distributed in all

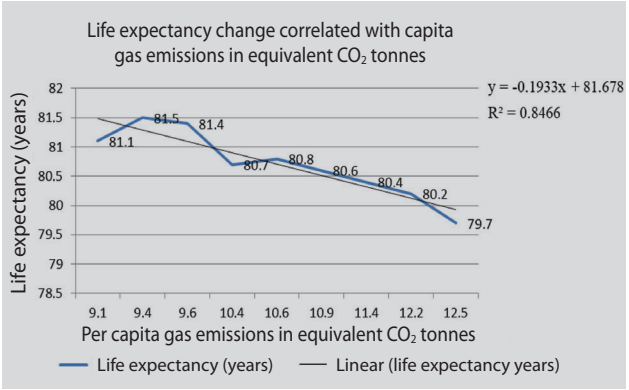

Figure 8. Per capita CO_2 emissions – Life expectancy (Source: Eurostat 2017).

fluids, tissues, muscles and apart from liver damage, all physiological body functions are affected in various ways with possibility of causing other adverse effects (as depression, mental disorders).[5] In Greece, alcohol consumption is characteristic of Mediterranean lifestyle, so its abuse is sometimes underdiagnosed,[15] while it is linked with frequency of deaths (in Europe and America, rates are 6.5% and 5.6%, respectively). Chronic diseases are related to alcohol and in 2007 World Cancer Research Fund (WCRF) published recommendations for maximum daily alcohol consumption, which varies, with decreasing gradation from countries of North to those of South, with Greece and Spain having the highest percentages of people without alcohol consumption, while Denmark and Germany had the highest proportion. It is noted that 10% of cancer cases in men and 3% in women can be attributed to alcohol use in European countries, with higher detection rate of cancer in upper respiratory tract, followed by that of liver. The highest percentage in men was for upper respiratory cancer and in women for chest cancer. By assessing high carcinogenesis rate from alcohol use, strengthening efforts to reduce alcohol consumption is highlighted.[16] A study of 33,593 people in Australia (1979–2005) and Death Registry data showed that increased alcohol use has positive link with early mortality.[17] Additionally, stomach cancer connection with alcohol was documented, according to studies from Europe, Asia and North America.[18] Furthermore, despite hereditary etiology of drinking habit, few genes were identified as significantly linked with alcohol consumption.[19] It is therefore undeniable that alcohol dependence causes diseases and these are the fifth most important cause of disability and risk of premature death worldwide. According to National Drug Information and Documentation Center (2010 data) and related to implementation of alcohol treatment request index, 43.3% reported mental health disorder, 41.8% physical problems, and 14.9% both. In parallel, taking into account National Health Survey data, 10% of the Greek population consumes alcohol daily.[5] Studies confirm that worldwide 5.9% of deaths are attributed to alcohol abuse (WHO 2015), causally related to over 200 diseases and eight different types of cancer (WHO 2015).[20] Also, alcohol consumption is linked with increased frequency of alcoholic psychosis, pancreatitis and related to violence-accidents.[7] There is alcohol consumption link (OECD 2017 data) with life expectancy (Eurostat 2017 data), with high correlation (-0.95) (2005–2014) and change is diagrammatically illustrated in figure 9. Given the multitude of factors influencing life expectancy, the alcohol consumption change line was not completely downward sloping. Since liver transplantation is main treatment for

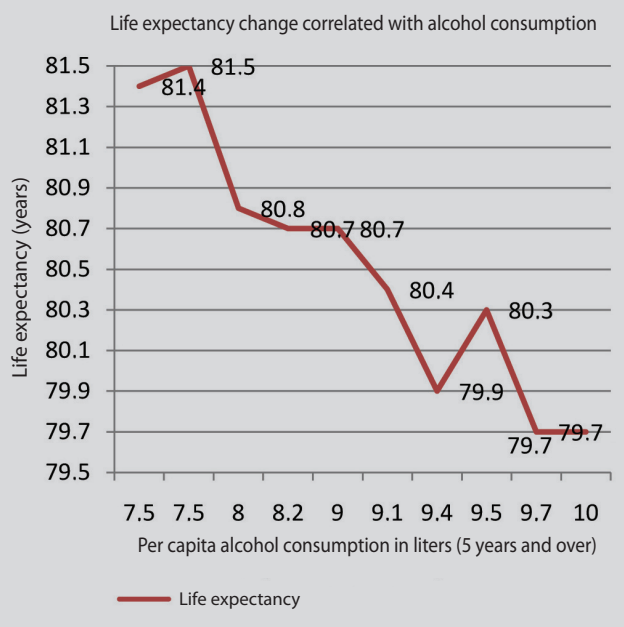

Figure 9. Alcohol consumption correlation with life expectancy (Source: OECD and Eurostat).

alcoholic cirrhosis, an increase in incidence of the latter, leading to liver transplantation, was observed in Greece and for 37% alcoholic cirrhosis was primary diagnosis.[21] A study conducted by EPIC (European Prospective Investigation into Cancer and Nutrition) in 10 countries with 380,395 participants recorded 20,453 deaths with 2,053 of them related to cancer alcohol-related, highlighting alcohol abuse as crucial mortality determinant.[22]

DISCUSSION

As representative samples of the macroeconomic dimension of the health production function, input-output correlations were listed and measures are proposed, aiming to reverse negative findings and improve positive effects. Targeting to improve health services, the monitoring of efficiency of health sector and development of primary health care services, enhancement of family doctor's role, control of health indicators, education for health issues, rational redistribution of resources, evaluation of existing health technology and cooperation with health agencies are recommended.[23] Thus, through NHS restructuring (with rearrangement of medical potential "dispersion" according to national regions' needs), control – fairer distribution and effective utilization of funding sources can be achieved so as to maximize social utility and vanish inequalities. Secondly, and addressing poverty, distributive efficiency,

social justice by tackling social exclusion and institutionalizing minimum living standards of "weaker" income groups and improvement of health indicators can be realized with social protection programs' implementation, emphasizing on income distribution – transfers to the poorest, by activating fiscal mechanism.[11] Thirdly, targeting to minimize environmental burden on health, it is necessary to use reliable international statistical models to investigate, detect and predict seasonality, the main pollution points and parameters affecting changes of pollutants in connection with implementing measures (such as solid fuels use with low sulfur content, limiting industrial emissions of pollutants and vehicle exhaust gases from better engine operation, use of catalyst, use of low-emission fuels, based on standards of anti-pollution technology),[13] and reduction of pollution emissions, with more efficient use of energy, alternative and renewable forms.[12] It is also necessary to draw national environmental strategy, enhancing citizens' activation, modernization of environmental law, as well as behavioural change. Finally, aiming to reduce excessive alcohol consumption, many treatment methods for alcohol dependence are available, such as medications (disulfiram, naltrexone), behavioural management, and supportive methods. Many factors influence differentiation of clinical symptomatology and treatment choice, including economic, psychological and genetic factors, the management of which is expected to reduce alcohol abuse, improving health and productivity.[24] Concerning the implementation of prevention programs, alcohol consumption can be limited by imposing high taxes with increase in prices of alcoholic beverages.[25] A multifactorial approach to alcoholism is required with information programs, provision of pharmacological approach – psychological support services and preventive policies, aiming to improve individual-public health, through promoting healthy behaviors.

CONCLUSIONS

Health is a primary investment that, on the one hand, has catalytic effect on improving the standards of living of a population and on the other, increases individuals' productive power and therefore the investment in this sector, assessed by health indicators, is evaluated as productive expenditure, primarily promoting individuals' life quality and consequently the wider socio-economic development of the population.

ΠΕΡΙΛΗΨΗ

Επίδραση προσδιοριστικών παραγόντων υγείας στο επίπεδο υγείας του ελληνικού πληθυσμού, ως αποτύπωση της συνάρτησης παραγωγής υγείας

I. ΜΕΝΤΗΣ

Τμήμα Οικονομικών Επιστημών, Σχολή Οικονομικών και Πολιτικών Επιστημών, Εθνικό και Καποδιστριακό Πανεπιστήμιο Αθηνών, Αθήνα

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Μελετήθηκαν οι μακροοικονομικές διαστάσεις της λειτουργίας παραγωγής υγείας στην Ελλάδα, συνδέοντας τον αριθμό ιατρών, τις κατά κεφαλήν δαπάνες υγείας, το ποσοστό πληθυσμού που ζει σε συνθήκες υλικής στέρησης, τις εκπομπές αερίων ρύπων και την κατανάλωση οινοπνεύματος με δείκτες υγείας. Αναζητήθηκαν άρθρα, καθώς και δεδομένα από βάσεις δεδομένων (ελληνική-ευρωπαϊκή Στατιστική Υπηρεσία, Οργανισμός Οικονομικής Συνεργασίας και Ανάπτυξης [ΟΟΣΑ]), και ο αριθμός ιατρικού προσωπικού, οι κατά κεφαλήν δαπάνες υγείας, το τμήμα του πληθυσμού που ζει σε συνθήκες ένδειας, οι εκπομπές ρύπων (εκπεφρασμένες ως CO_2/κάτοικο) και η διακύμανση της χρήσης οινοπνεύματος συσχετίστηκαν με αλλαγές στη βρεφική θνησιμότητα, τα έτη υγιούς ζωής και το προσδόκιμο ζωής. Με την προαναφερθείσα μεθοδολογία αποτυπώθηκε η ισχυρή αρνητική συσχέτιση του αριθμού ιατρών με τη βρεφική θνησιμότητα (0,90% περίπου) (1960–2015) και η σημαντικά θετική μεταβολή του προσδόκιμου ζωής (0,94% περίπου) (2000–2015). Επισημάνθηκε η ισχυρή αρνητική συσχέτιση της κατά κεφαλήν δαπάνης υγείας στη βρεφική θνησιμότητα (84% για τα έτη 2000–2015 και 96% για τα έτη 1989–2011), η αρνητική συσχέτιση (κατά 90%) των ατόμων που ζουν σε συνθήκες υλικής στέρησης με τα έτη υγιούς ζωής (2008–2015), καθώς και η αρνητική συσχέτιση (περίπου 95%) της περιβαλλοντικής ρύπανσης, εκπεφρασμένης ως κατά κεφαλήν εκπεμπόμενης ποσότητας CO_2, με την αλλαγή του προσδόκιμου ζωής (2007–2015) και την κατά προσέγγιση 95% συσχέτιση της κατανάλωσης οινοπνεύματος με το προσδόκιμο ζωής (2005–2014). Οι περιπτώσεις που μελετήθηκαν και η συσχέτιση με την τρο-

ποποίηση των διαχρονικών δεικτών υγείας τεκμηριώνουν τις μακροοικονομικές διαστάσεις της συνάρτησης παραγωγής υγείας και προτείνονται μέτρα για τον μετριασμό των αρνητικών συνεπειών/ενίσχυσης των ευεργετικών επιπτώσεων στην ποιότητα ζωής.

Λέξεις ευρετηρίου: Δείκτες υγείας, Κόστος υγείας, Οινόπνευμα, Περιβαλλοντική ρύπανση, Ποιότητα ζωής, Συνάρτηση παραγωγής υγείας, Υλική στέρηση, Υπηρεσίες υγείας

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