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SM Preventive Medicine and Public Health

Research Article

How to Prevent Preventable Death?

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Abstract

Study background: Considering that preventable mortality is still a significant problem in European countries and large differences exists between these countries, this study first analyses which expenditures, as percentage of the Gross Domestic Product (GDP) are related to preventable mortality. Secondly, quantitative and qualitative healthcare indicators as well as life style indicators are introduced to investigate their contribution to explain preventable mortality.

Methods: The study is cross-sectional, using data of international databases (like Eurostat and OECD) of 31 European countries. The years the data were collected vary between 2009 and 2014. The following indicators are used to explain preventable mortality: percentage of GDP expenditures on healthcare, education, and social protection, quantitative and qualitative healthcare indicators (% vaccinated children, % women screened on cervical cancer and breast cancer, the overall volume of prescribed antibiotics, standardised infant mortality, Acute Myocardial Infarction (AMI) mortality rate after hospital admission, and % of persons aged 16 and over reporting unmet needs for medical care), and life style indicators (% low reading literacy, % smokers, % of adults with insufficient physical activity, % obese persons, alcohol consumption, and exposure to air pollution). Significant indicators are analysed by forward regression.

Results: Expenditure on social protection is strongest related to preventable mortality. Significant correlations between quantitative and qualitative health care indicators disappear when social protection expenditure is introduced as explaining variable. Besides social protection expenditure, alcohol consumption and physical activity contribute to preventable mortality.

Conclusion: Strengthening the comprehensiveness and expenditures of social protection policy is essential to reduce preventable mortality. Also, this study provides concrete examples for focused action.

Introduction

High life expectancy and low infant mortality are related to high healthcare expenditure [1,2]. Investments in healthcare contribute to a healthy and productive population [3]. Well designed public health interventions and preventive measures - population and clinical based -prevent (chronic) diseases and contribute to high life expectancy [4,5].

Such successful preventive interventions may save lives and reduce preventable mortality in countries. Moreover, most public health interventions are cost-effective [6,7]. However, the demand for health care may indirectly increase on the long run due to a longer life but not in good health and therefore may increase health care costs [7,8]. Preventing a disease may result in more health care utilization on the long run and therefore not be cost-saving at the end [7,9,10]. Intervention programmes, directed on changes in lifestyle or environmental conditions (smoking, alcohol consumption, environmental pollution) are considered cost-effective and cost-saving [5,7,11,12], but not all are [13]. It raises the question: what and how should governments invest to prevent preventable deaths. Because healthcare expenditure is related to high life expectancy and high life expectancy is related to low preventable mortality [14,15], investments in health care seem to be the best way. However, education expenditure and social protection expenditure are also strongly related to life expectancy [16] and for good reasons. Education expenditure indicates the potential of economic growth as well as the chances on personal and social development of citizens, which is related to life style. Social protection expenditure indicates to what extent regulations and interventions are available to protect families and individual citizens against defined risks or needs. Therefore, one important question addressed is: which of these expenditures are worthwhile to invest in to prevent preventable mortality?

In 2013 in EU countries over 1.2 million people died from illnesses and injuries that might have been avoided through more effective public health and prevention policies or more timely and effective health care [4]. In USA half of the 1 million prematurely deaths of the five leading causes of death could be prevented yearly [17]. More than ten years ago, Jones et al. concluded that about two-thirds of child deaths could be prevented by preventive interventions that were available at that time [18]. Such figures indicate that preventable mortality should be an urgent and ethical issue, mostly because amendable and preventable deaths have a higher prevalence in vulnerable citizens compared to the 'better of' [15]. A high prevalence of preventable death may also apply to countries

causing social inequity between countries [4]. Such social inequity makes the question how to prevent preventable deaths also a matter of (inter)national policy.

Many effective prevention programmes are available [19], but not for all citizens who need these most. Many of these citizens live in worse societal conditions like low social-economic position, low educational level, and bad neighbourhoods and/or housing. The same social conditions and often related life style habits (unhealthy nutrition, limited physical activity, obesity, and alcohol and tobacco consumption) are associated with preventable mortality. Accessibility to the health care services, quality and quantity of health care provisions and personnel health care are found to be related to preventable mortality [20-23]. Therefore, another important question is: to what extent do accessibility to the health care services, quality and quantity of health care provisions and personnel health care affect preventable death?

Preventable death is defined as 'deaths which could have been avoided by public health interventions focusing on wider determinants of public health, such as behavior and lifestyle factors, socioeconomic status and environmental factors' [24]. Such interventions include measures and programmes directed to environmental and behavioural risk factors leading to premature deaths, like safe water, air pollution, social protection, illiteracy and social-economic conditions, but also counselling of persons at risk, life style interventions, vaccination and screening programmes, and clinical preventive services [24].

Materials and Methods

Preventable mortality as defined is assessed using Eurostat data base, and calculated as standardized death rate per 100.000 inhabitants [25]. To answer the first question 'which expenditures are worthwhile to prevent preventable mortality' we use the following two categories of expenditures: total expenditures by function and health care expenditures per function. Total expenditure by function is assessed for the following functions: health care, education and social protection in 2013 as % of Gross Domestic Product (GDP) [26]. Healthcare expenditure by functions is calculated as % of current healthcare expenditure in 2013 for curative and rehabilitation care, and preventive care [27].

Bivariate Pearson's correlations are calculated between preventable mortality and all expenses indicators. Significant correlations will be described. Expenditure by functions is strongly correlated [16]. Therefore, partial correlations are calculated to decide which indicator is strongest related to preventable mortality and to be included in the regression analysis to answer the second question 'to what extent does accessibility to the health care services, quality and quantity of health care provisions and personnel health care affect preventable death?'

Healthcare indicators are distinguished in quantity of healthcare provisions and professions, in quality of healthcare, and in risk factors for health. As quantitative measures of the healthcare system we use the number of curative beds, long-term beds, practicing physicians, general practitioners, and nursing and care personnel per 100.000 inhabitants in 2014. All indicators are derived from Eurostat statistics [28-31].

As indicators for quality of healthcare are used: % of vaccinated children aged 1 year for diphtheria, tetanus and pertussis in 2012 and, % women (age 20-69) screened on cervical cancer and women (age 50-69) participated in breast screening in 2012, the overall volume of prescribed antibiotics in DDS per 1000 population in 2014, standardized infant mortality (number of death infants younger than 1 year per 1000 live births [4]), 30 day Acute Myocardial Infarction (AMI) mortality rate after hospital admission, age-sex standardized of 45 years and older per 100 patients in 2013 [32], and % of persons aged 16 and over reporting unmet needs for medical care in 2013 [33].

Indicators for health risks are used as mentioned in European statistics: % low reading literacy of 15 years old pupils in 2012 [34], % smokers 15 years and older in 2009 [35], % of adults practicing insufficient physical activity in 2010 [36], % of people affected by obesity in 2014 [37], alcohol consumption in litters in 2010 [38], and exposure to air pollution in 2013 [4].

The mentioned indicators of 31 European countries are analysed as published in international data bases referred to [4,24-38]. In some cases, the yearly data are replaced by data from 1 or 2 years before, as mentioned in the used statistics. Missing data are replaced by the mean score of the participating countries.

Data are analysed using SPSS 23. First the bivariate Pearson's correlations between the mentioned indicators and preventable mortality are presented. Next the indicators which showed bivariately a statistically significant relationship with preventable mortality are analysed by forward linear regression analysis. The indicators are entered per block after the selected expenses indicator, i.e. social protection expenditure (see results). The final model of the regression analysis will be presented. Outcomes of the regression analysis are checked for co linearity.

Results

In 2013 the preventable deaths in the 31 European countries varied between 151 (Spain) and 431 (Lithuania) per 100.000 inhabitants; the mean of the participating countries was 204 preventable deaths per 100.000 inhabitants.

Healthcare expenditure (as % of GDP) in 2013 correlates -.681 with preventable mortality, i.e. low healthcare expenditure is associated with high preventable mortality (Table 1). Also expenditures on social protection and education (as % of GDP) correlate statistically significant with preventable mortality, showing that countries with high expenditures in social protection and education have lower preventable mortality. Healthcare expenses of two selected functions do no correlate statistically significant.

Healthcare expenditure and social protection expenditure are strongly related (r=.847). Partial correlations between preventable mortality and healthcare expenditure, social protection expenditure and education expenditure show the strongest association between preventable mortality and social protection expenditure when controlled for health care expenditure (r=-.334 p=.072) respectively education expenditure (r=-598 p=.000) or both (r=-331 p=.080). Therefore, social protection expenditure will be used as expenditure indicator. In table 2 the place of the 31 analysed European countries are presented in the relationship between preventable mortality and social protection expenditure.

Two quantitative healthcare indicators are statistically significant correlated with preventable mortality: number of curative beds and number of nursing and caring personnel (Table 3).

Table 1: Relation between social protection expenditure as % of GDP and preventable death per 100.000 inhabitants for 31 European countries.

	Social protection expenditure as % of GDP				
	< 20%	**20-24%**	**25-29%**	**>29%**	**Total number of countries**
Preventable death < 175 per 100.000	Malta	Cyprus	Portugal Spain Switzerland	France Greece Italy Netherlands Sweden	10
Preventable death 175-200 per 100.000		Ireland	Germany Norway United Kingdom		4
Preventable death 201-250 per 100.000	Bulgaria	Iceland Luxemburg		Austria Belgium Denmark Finland	7
Preventable death >250 per 100.000	Estonia Latvia Lithuania Poland Slovakia Romania	Croatia Czech Rep. Hungary	Slovenia		10
Total number of countries	8	7	7	9	31

Table 2: Bi-variate Pearson correlations between preventable mortality and expenditure indicators.

	Expenditure indicators as % of GDP in 2013 on			Expenditures per function as % of current health care expenditure in 2013	
	Health Care	**Social Protection**	**Education**	**Curative and rehabilitation care**	**Preventive care**
Preventable mortality	-.681**	-.707**	-.502**	-.258	-.053

* = significant at p<.05 level ** = significant at p<.01 level.

In countries with more curative beds the preventable mortality is higher, while in countries with more nursing and caring personnel the preventable mortality is lower.

Most quality of care indicators are statistically significant correlated with preventable mortality (Table 4). Participation in screening programmes on cervical cancer and breast cancer goes with low preventable mortality.

Low infant mortality and low mortality after hospital admission (in 30 days for AMI) in a country also mean low preventable death. Preventable death is however high in countries where citizens are reporting more unmet medical needs.

Two health risks indicators correlate strongly with preventable mortality: % of adults practicing insufficient physical activity and alcohol consumption (Table 5). In countries, where relatively more citizens show insufficient physical activity preventable mortality is lower, while in countries where citizens drink more alcohol preventable mortality is higher.

Forward regression analysis includes all reported statistically significant correlations and social protection expenditure as explained before. Quantitative and qualitative health care indicators and life style indicators are block wise introduced. The final model is presented (Table 6). The final model explains 74% of the variance. Expenditure on social protection is the most powerful predictor for preventable mortality, explaining 49% of the variance.

Table 3: Bi-variate Pearson correlations between preventable mortality and quantitative health care indicators.

	Quantitative health care indicators per 100.000 inhabitants number in 2013				
	Curative beds	**Long-term beds**	**Practising doctors**	**General practitioners**	**Nursing and caring personnel**
Preventable mortality	.513**	.355	-.147	-.312	-.437*

* = significant at p<.05 level ** = significant at p<.01 level.

Table 4: Bi-variate Pearson correlations between preventable mortality and qualitative health care indicators.

	Quality of care indicators						
	% vaccinated children at 1 year	**% women participating in cervical cancer screening**	**% women participating in breast cancer screening**	**Overall volume of prescribed antibiotics**	**Infant mortality 1 year or less**	**30 day mortality after hospital admission**	**% persons 16+ reporting unmet needs**
Preventable mortality	-.205	-.391*	- .425*	- 335	.399*	.479**	.410*

* = significant at p<.05 level ** = significant at p<.01 level.

Table 5: Bi-variate Pearson correlations between preventable mortality and health risk indicators.

	Health risks indicators					
	% low reading literacy	% smokers 15 years and over	% adults with insufficient physical activity	% people with obesity	Alcohol consumption in litters	Exposure to air pollution
Preventable mortality	.211	.246	- 478**	.265	.653**	.143

* = significant at p<.05 level ** = significant at p<.01 level.

Table 6: Final model forward regression analysis with preventable mortality as dependent variable.

Indicator	Standardised Beta	Significance	Total explained variance
Expenditure social protection	-.503	.000	74%
Number of curative beds	.014	.910	
Consumption alcohol in litters	.451	.000	
% insufficient physical activity	-.269	.019	

Countries which spend more on social protection show lower preventable deaths. Quantitative and qualitative health care indicators do not contribute statistically significant to the final regression model. Two life style indicators do contribute statistically significant. In countries with high alcohol consumption preventable deaths are high. In countries where a high percentage of citizens show insufficient physical activity preventable deaths are low.

Discussion

The outcomes of this study indicates that many lives could be saved if countries would invest in social protection by expending a higher % of their GDP. Investing in social protection means to implement effective prevention programmes already available [19]. Results observed suggest that in rich European countries such programmes are more often available and more successful implemented. A strong social protection policy is recommended to prevent preventable death. Social protection policy includes legislation and measures to screen pre/early symptoms of a disease and risk factors as well as to reduce behavioral and environmental health risks [24]. Social protection expenditure is based on the coverage of defined risks and needs associated to illness, disability, housing, parental responsibility, unemployment, old age and social exclusion. Our investigation also makes clear that investing in hospital beds alone is not the way to reduce preventable mortality; the reverse seems to be the case.

Screening programmes and quality of care measures are bivariately related to less preventable deaths, but these relationships disappear when social expenditure is introduced in the regression analysis. This indicates that screening and vaccination programmes as well as quality of care measures are and have to be embedded in a comprehensive health and welfare programme, i.e. social protection policy. This is in line with the call of WHO for an innovative approach that no one should leave behind [39]. WHO argues that actions directed to 'better health' have to be part of comprehensive, integral plan and need participation of citizens. Our analysis indicates that in countries like Estonia, Latvia, Lithuania, Poland, Slovakia, and Romania such comprehensive plan is lacking.

Quality of care indicators did not play a significant role in the regression analysis, while various indicators were bivariately statistically significant. The strong correlation between preventable mortality and the 30-days AMI case-fatality rate, which is considered good indicator of acute care quality [32], disappears in the regression analysis. It is evident that screening programmes and clinical preventive interventions are important factors to fight preventable deaths and they fit in a comprehensive action programme as WHO proposes [39]. Indeed, a combination of various interventions results in robust estimation of preventable mortality reduction [18]. As is stated by "Living Well for Longer": '4 of the 5 deaths under 75 years are preventable' [40]. Besides a 'wider' health care system, i.e. larger investment in public health and quality of care instead of stones and beds, policy makers should create a 'supporting environment' to stimulate 'good health' [41].

Alcohol consumption is a powerful predictor for preventable death besides social protection expenditure, as the regression analysis shows. Reduction in alcohol consumption is more effective when targeted at the total population than individual focused interventions [42]. Policy measures like advertisement ban, limited retail hours, and taxation are not only cost-effective but also cost-saving [42,43]. This underlines the necessity for a comprehensive approach to prevent preventable death.

A limitation of this study is that we only have cross-sectional data. It would be important to have longitudinal data on (changes in) social protection policies, healthcare quality, and life style indicators. Changes in life style will show benefit effect on the long term. For example, reduction in smoking during the last years in European countries [4] will show its effect on preventable mortality after decades. Longitudinal data will further show the effect of preventive programmes on subgroups within an overarching social protection policy and the effectiveness of (focused) prevention programmes for vulnerable groups. Despite this limitation, this study indicates which approach is needed to reduce preventable mortality. This study does not show only the importance of comprehensiveness and expenditures of social protection policy, but also provides concrete examples of actions to improve the health care system. Alcohol consumption has a strong influence on preventable mortality. It shows that within an integral action programme a specific programme addressed to alcohol consumption deserves a priority and specially because such interventions are cost-saving [42,43]. A strong point of the study is that the collected data are comparative in method of data collection and in validity of the measurements, which underlines the significance of our findings.

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