Verification of the SCORE model for cardiovascular death risk in the Warsaw population

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Abstract. The aim of this paper was to evaluate the 10 year old SCORE model for global risk of death from cardiovascular diseases using the parameters of the algorithm SCORE, establish the predictors and their importance in determining the incidence of death in the Warsaw population in the 34–54 year age group over a 10 year period and verify the SCORE algorithm for global ten year risk of death due to cardiovascular diseases in the Warsaw population. The research was based on individual data from the Warsaw study carried out in 1984, 1988 and 1993 with observation over a 10 year period from 3 screening visits in the Pol-MONICA programme. Death records included the cause of death, with special reference to incidents involving cardiovascular death. The analysis used were the Kaplan Meier life expectancy curves with the log rank test for comparison of the curves (group homogeneity) and the multifactorial Cox proportional hazards model. The measure of fit was defined as the sum of the independent differences in the percentage frequency of death in the risk quartiles of SCORE and the personal quartile index based on the Cox model. As a result of the analysis beneficial changes on the 10 year death risk due to cardiovascular diseases in the years 1984–1993 with a slower death rate observed for the population in further screenings. The level of total cholestrol is not a predictor of death due to vascular disease for the population of the right bank of the city of Warsaw. The SCORE algorythm differs by some 7–15% from the estimated death rate of the male Warsaw population in the age group 35–64 years. For women the difference in fit is less and is between 4–10% of cardiological death rate.

Introduction

The search for factors having an effect on the prevalence, death and death rate due to given disease or group of diseases is one of the main aims of epidemiological studies. As part of the WHO MONICA project – an international multi centre study of the trends and causes of cardiovascular diseases carried out during the eighties and early nineties, the Institute of Cariology carried out three cross sectional studies of the population of the right bank of the city of Warsaw in the age group 34–64 years, named Pol-MONICA Warsaw [1]. The first screening covered 1309 men and 1337 women and was carried out between December 1983 and January 1985. The second screening of 710 men and 723 women was in 1988 and the third of 764 men and 775 women in 1993.

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The results were published in many journals of the Department of Epidemiology, Prevention of Cardiovascular Diseases and Health Promotion and several Polish and internation jounals [2]. The results of the Warsaw screeings were also recently used in synthetic and comparative presentations of the prevalence, awareness, treatment and control of hypertension in 24 centres that took part in MONICA [3].

The second important aim of the MONICA project was to monitor the levels of risk and other factors affecting the health of the population and their changes. From these results and as a result of continuing observations derived towards the prevalence of given cardiological events, models of global risk due to illness and death from cardiovascular diseases were developed and these were used to predict preventative recommendations.

The Department of Epidemiology, Prevention of Cardiovascular Diseases and Health Promotion carried out continual observation of the patients who took part in screenings I, II, III of the Pol-MONICA Warsaw programme during the years 1984–1998. Statistical analysis of the collected data was used to construct a global risk model for cardiovascular diseases, and overall death rate and verify this against the use of other models developed in the NORA, RIFLE, ERICA, MRFIT Framingham and NHANES studies for the Warsaw population [4].

Since 2003 the SCORE algorythm (European Systematic COronary Risk Evaluation) has been used to ascertain the 10 year cardiologic death risk from such factors as, sex, age, level of total cholestrol, systolic blood pressure – SBP and cigarette smoking [5]. The value of the global SCORE was used to form health recommendation on the need to change life style, stop smoking, correct diet and others. Based on the value of the SCORE risk the Polish Cardiological Society also developed recommendations [6].

It is known that the algorythms used in one population may lead to overestimates or underestimates of the risk in other populations [7]. It is therefore necessary to verify the SCORE risk, used to develop recommendations for the Polish population.

Aims

a) Develop a 10 year global risk model for death from cardiovascular diseases using the SCORE algorythm and determine the predictors and their value for death rates in the Warsaw 35–64 year old population over a 10 year period.

b) Verify the SCORE algorythm for the global 10 year risk of death from cardiovascular diseases in the Warsaw population.

Methods

The data collected of individuals randomised in the 1984, 1988 and 1993 studies was based on identical screening visits using a single method in the WHO MONICA studies. The results and methods used in the study are presented in [1]. The methods for data collection during 1984–1998 and the causes of death of the patients studied in screenings I, II, III are presented in [4].

The status of patients examined in screening III in the years 1998–2003 was obtained form the Census Department of the Ministry of Internal Affairs and Administration. The causes of death were obtained from the data base of the Chief Department of Statistics.

Where the cause of death was verified the length of time in observation from the screening date to date to death was calculated (years), where the cause of death was not verifiable observations were stopped exactly after 10 years from the date of the screening.

Using the SCORE algorythm [5] the 10 year risk of incidence of heart disease was calculated for each patient in the Pol-MONICA Warsaw programme, and using the Cox proportional hazards regression model – the individual risk of death.

Statistical methods

Analysis of the life expectancy and power of prediction of the risk factors was made using a multifactorial regression analysis of the Cox proportional hazards test allowing for such factors as age, level of total cholesterol, level of systolic blood pressure, and smoking habit. Using the published SCORE coefficients [5] the risk of cardiovascular death for each patient was determined. THE SCORE algorythm for the Warsaw population was verified by comparison of the frequency of death in the quartiles of the SCORE risk groups with those predicted by the COX test.

The sum of the differences between the frequencies in all quartile groups defines the deviation between the two algorythms.

All analysis for men and women were made separately. The significance level (first degree error) was taken as $\alpha = 0.05$.

Results

The three Pol-MONICA screenings involved 2783 men and 2835 women, 35–64 years of age. [Tab. 1] gives the numbers for each screening and the number of all confirmed deaths and deaths from cardiologic diseases over a 10 year period.

Tab. 1. The numbers of deaths over 10 year period for Warsaw population in the 35–64 year age group

Years of observation	Screening 1.		Screening 2.		Screening 3.		Total	
	All deaths	Deaths due to CVD	All deaths	Deaths due to CVD	All deaths	Deaths due to CVD	All deaths	Deaths due to CVD
To year	9	7	5	2	4	2	18	11
I	24	7	8	2	3	2	35	11
II	26	13	17	8	8	4	51	25
III	21	17	16	6	14	3	51	26
IV	30	14	15	9	13	2	58	25
V	40	19	18	10	17	5	75	34
VI	40	16	19	8	15	2	74	26
VII	48	23	16	7	22	7	86	37
VIII	53	29	13	5	18	5	84	39
IX	36	21	13	3	11	4	60	28
X	37	19	23	11	21	7	81	37
Total	364	185	163	57	146	43	673	285

[Fig. 1] shows the life expectancy curves from total mortality for the ten year period. Statistical significance in the difference between the male life expectancy curves ($p = 0.0007$) was seen. The female life expectancy curves did not show any difference ($p = 0.1974$).

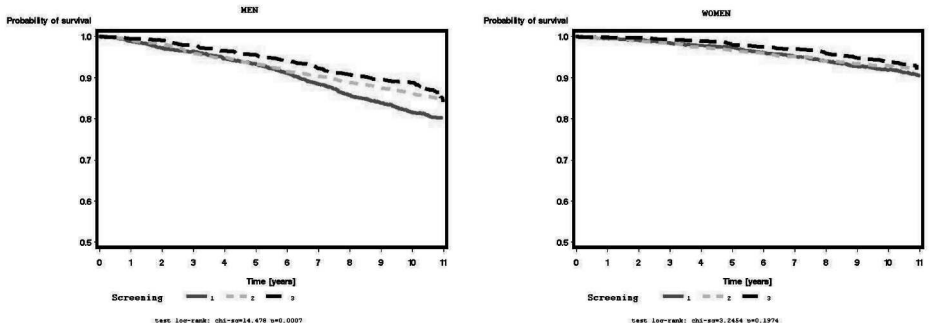

Fig. 1. 10 year life expectancy curves from all causes of death for the Warsaw population in the 35–64 year age group examined in 1984, 1988, 1993

[Fig. 2] shows the life expectancy curves from cardiovascular diseases. Statistical significance in the difference between the male ($p < 0.0001$) and female ($p = 0.0449$) life expectancy curves was seen.

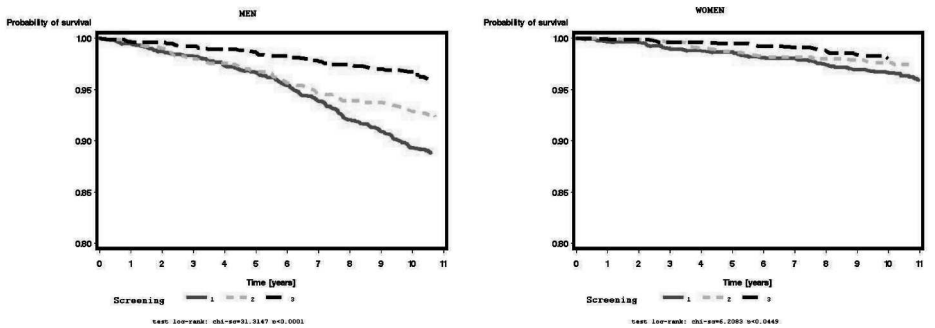

Fig. 2. 10 year life expectancy curves from cardiovascular diseases for the Warsaw population in the 35–64 year age group examined in 1984, 1988, and 1993

In order to determine the 10 year cardiovascular SCORE risk a multi factorial model was used allowing for age, smoking, cholestrol level and SBP. [Tab. 2] shows the Cox analysis results for men and women with the risk factor significance.

Tab. 2. The levels of significance of the SCORE risk factors in the right bank population of Warsaw in the 35–64 year age group

Risk factor	1984	1988	1993
Men:			
AGE	<0.0001	<0.0001	<0.0001
SMOKING	0.0004	0.1053	0.0387
CHOLESTROL	0.0577	0.1836	0.5518
SBP	<0.0001	0.0005	0.0433
Women:			
AGE	<0.0001	0.0065	0.0011
SMOKING	0.0488	0.0150	0.0008
CHOLESTROL	0.7562	0.8107	0.6861
DBP	0.0001	0.1185	0.0107

The total cholesterol level was not found to be a significant predictor of incidence of cardiovascular diseases for the Warsaw population in any analysis.

Tables 3, 4 and 5 present the frequency of death caused by cardiovascular diseases in the SCORE and Cox risk quartiles including the difference between these frequencies.

Tab. 3. The frequency of cardiologic deaths for the quartile groups of evaluated patients in 1984

Algorythm	I quartile	II quartile	III quartile	IV quartile
SCORE	4,8%	7,5%	14,0%	18,1%
Cox	2,8%	6,2%	16,4%	27,6%
Difference	2,0%	1,3%	2,4%	9,5%

a) men $\sum$ Differences = 15,2%

Algorythm	I quartile	II quartile	III quartile	IV quartile
SCORE	1,6%	2,3%	2,7%	9,8%
Cox	0,0%	1,0%	5,5%	13,9%
Difference	1,6%	1,3%	2,8%	4,1%

b) women $\sum$ Differences = 9,8%

Tab. 4. The frequency of cardiologic deaths for the quartile groups of evaluated patients in 1988

Algorythm	I quartile	II quartile	III quartile	IV quartile
SCORE	3,6%	5,3%	5,3%	11,8%
Cox	2,3%	2,8%	3,9%	20,3%
Difference	1,3%	2,5%	1,4%	8,5%

a) men $\sum$ Differences = 13,7%

Algorythm	I quartile	II quartile	III quartile	IV quartile
SCORE	0,6%	1,2%	4,1%	4,1%
Cox	0,0%	2,2%	2,2%	6,2%
Difference	0,6%	1,0%	1,9%	2,1%

b) women $\sum$ Differences = 5,6%

Tab. 5. The frequency of cardiologic deaths for the quartiles groups of evaluated patients in 1993

Algorythm	I quartile	II quartile	III quartile	IV quartile
SCORE	1,1%	2,2%	3,9%	6,2%
Cox	1,7%	1,6%	1,6%	10,0%
Difference	0,6%	0,6%	2,3%	3,8%

a) men $\sum$ Differences = 7,3%

Algorythm	I quartile	II quartile	III quartile	IV quartile
SCORE	0,5%	1,1%	1,1%	4,2%
Cox	0,0%	0,0%	2,1%	5,7%
Difference	0,5%	1,1%	1,0%	1,5%

b) women $\sum$ Differences = 4,1%

Discussion

a) The Polish population shows a decrease in death rate in general and that caused by cardiovascular diseases [8]. The presented data also shows a difference in life expectancy over the 10 year period for the 34–64 age group of the population of the right bank of the city of Warsaw. The life expectancy curves for the male population examined in 1984 (study 1.) significantly decreases more rapidly than the curves of those examined in the 1988 and 1993. The reasons for this should be sought in the changes in the conditions and style of life, medical care and others that have taken place in these years for this cross section of the population. Analysis of the curves for total mortality amongst women has shown that the female population has become more homogeneous with respect to general death rate. A significant difference in cardiovascular death rate in women was seen with a signifcant improvement in the 1993 group.

b) The SCORE algorythm was based on international multicentre prospective studies. These studies did not allow for the Polish population, specifically Warsaw. Hence the SCORE coefficient does not cover the Polish population. Use of the estimated Cox model (since date of death and survival time was determinable) on the same data base was possible to determine the specific values of risk. The degree of fit for the SCORE and Cox models to the observed cardiological death rate was made using the frequency in the risk quartiles. Since the estimate of death risk was made using maxi-

mum factorial probability, the best fit of the observed quartile number of deaths and quartile risk was obtained. The difference of frequency of death in the individual SCORE quartiles and Cox risk describes the over estimation or underestimation of the frequencies in the SCORE with respect to the Cox model. In all cases an over estimation of death rate is seen in the lower SCORE quartiles and an underestimation in the upper quartiles. The independent differences of cardiological death in the sum of all quartiles determines the degree of fit of the algorithm SCORE in the Warsaw population with respect to the estimated Cox risk model. For men this is 7–15% and 4–10% for women.

Conclusions

1. During 1984–1993 changes in the Warsaw population in the 34–64 age groups with respect to 10 year death rate compared to cardiological death rate have been observed. The 1984 population (1^{st} screening) Pol-MONICA Warsaw showed a higher death rate than those screened later.

2. The level of total cholesterol was not a significant 10 year predictor of cardiological death risk in the right bank population of Warsaw.

3. The SCORE algorithm differs from the estimated death risk of the Warsaw male population by some 7–15%. For women the degree of fit is better between 7–10%.

REFERENCES

[1] Rywik S., Sznajd J., Przestalska-Malkin H., et al., Monitorowanie trendów zachorowalności i umieralności spowodowanej chorobami układu krążenia oraz ich determinantów – badanie długofalowe Pol-MONICA. Cz. I. Założenia metodyczne badania. Prz Lek, 42, pp. 250–255, 1985.

[2] Program Pol-Monica, Kompleksowa ocena stanu zdrowia ludności Warszawy i jego zmian w latach 1984–1990, Część I–IX, Podstawowe wyniki badań przekrojowych, Biblioteka Kardiologiczna Instytutu Kardiologii, No 42–78, Warszawa 1993–2001.

[3] Antikainen R. L., Moltchanov V. A., Chukwuma Ch., et al., Trends in prevalence, awareness, treatment and control of hypertension: the WHO MONICA Project. Eur J Cardiovasc Prev Rehabil, 13, pp. 13–29, 2006.

[4] Piotrowski W., Global risk of death due to cardiovascular diseases in the East Warsaw, The Pol-MONICA Project, Kardiol Pol, 55, pp. 543–555, 2001.

[5] Conroy R. M., Pyorala K., Fitzgerald A. P., et al., Estimation of ten-year risk of fatal cardiovacsular disease in Europe: the SCORE project, Eur Heart J, 24, pp. 987–1003, 2003.

[6] Prewencja chorób układu krążenia, Wytyczne ESC, Zalecenia, Kardiol Pol, 61, supl. I., 2004.

[7] Aspelund T., Thorgeirsson G., Sigurdsson G., Gudnason V., Estimation of 10-year risk of fatal cardiovascular disease and coronary heart disease in Iceland with results comparable with those of the Systematic Coronary Risk Evaluation project, Eur J Cardiovascular Prev and Rehabil, 14, pp. 761–768, 2007.

[8] Kupść W., Jasiński B., Kurjata P., et al., Atlas chorób układu krążenia w Polsce 1960–1996, Biblioteka Kardiologiczna Instytutu Kardiologii, 62, Warszawa, 1998.