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Socio-professional level and long-term mortality in three Belgian large-scale studies

by

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Abstract

Introduction: *Psychosocial factors have been evidenced worldwide to influence mortality. But there are less studies that have shown long-term prediction of these psychosocial dimensions. Comprehensive multi-dimensional models (1) have been conceptualised and tested for health inequalities, mortality and morbidity but seldom for long-term mortality.*

Methods: *Data from three Belgian large-scale studies were analysed, namely the "Belgian Heart Disease Prevention Project" (BHDPP), which started in 1972, the "Physical Fitness Study" (PFS) in 1977 and the "Belgian Interuniversity Research on Nutrition and Health" (BIRNH) which started in 1982 but was restricted to working males aged between 35-59 years old.*

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Predictions by various baseline psychosocial data of All-causes and Cause-specific Mortality, respectively after 18 (BHDPP), 17 (PFS) and 10 (BIRNH) mean years of follow-up, were assessed by means of multivariate survival analyses, using Cox proportional hazard models.

Results: *After adjustment for classical risk factors, social factors showed to have a predictive power for mortality: marital status for all-causes mortality, occupation for all-causes mortality, and cardiovascular mortality.*

Conclusions: *Other psychosocial dimensions still need to be included, and evidently a psycho-socio-biomedical model should be used in order to be able to prevent disease and efficiently promote health and well-being in the working world.*

Keywords

Psychosocial, long-term prediction, mortality, coronary heart disease.

INTRODUCTION

Social health inequalities in industrialised countries have been evidenced since many years. Besides age and sex, many socio-economic factors have been shown to be associated with mortality. Indeed an inverse gradient has been observed with educational level, occupational status or income (2-9).

Moreover these various social indicators also present an inverse relationship with risk factors such as hypertension, hypercholesterolemia and obesity (10-17) for both sexes and for all adult age groups.

The same holds true for risk behaviors such as smoking, unhealthy nutrition (excess of calories, fats, carbohydrates, shortage of fibres), lack of physical activity, violent behavior and risk-taking behaviors (18-21; 1).

The present article is extensively based on the final report of the secundary analyses of the collected baseline data from the three large-scale Belgian surveys in relation to long-term prediction of mortality (Kittel F, De Smet P, Leynen F, Dramaix M, De Backer G, Kornitzer M. Etude des déterminants psycho-sociaux de la mortalité totale et spécifique dans une population âgée de 20 à 74 ans et de deux populations d'hommes au travail âgés de 40 à 59 ans après 10, 20 et 25 ans de suivi. Rapport final pour le FNRS, 30 septembre 2001).

In this article we will restrict ourselves to the social variables and not include the psychological variables which can be found in the above-mentioned report and which will be published in a forthcoming article.

METHODS

Subjects

Data from the subjects are extracted from three studies.

The "Belgian Heart Disease Prevention Project" (BHDPP) (22) is a randomised controlled cardiovascular intervention trial performed in 30 Belgian enterprises, of which baseline data (Survey 1972-1974) are available for 19,409 men aged 40-59 years. We restricted our analysis to the whole Intervention group and 10% of the Control group, because for the remaining subjects (90% Control group) most of the baseline data are unavailable by design.

The "Physical Fitness Study" (PFS) (23) is a longitudinal study among 3179 men aged 40-59 at work in 8 enterprises of which baseline measurements took place in 1976-1978.

Finally, the "Belgian Interuniversity Research on Nutrition and Health" (BIRNH) (24) is a survey of a stratified random sample from 170 municipalities. Baseline examination on 11,302 men and women aged 25-74 years representative for 42 counties of Belgium was done in 1982-1984.

For this last database we only selected the men at work aged 35-59 years in order to get a comparable sample with the two former, reducing consequently the sample size to 2257 men.

In these databases we selected existing data which could be compared between the three studies and are relevant for the topic. This resulted in the following variables:

- Risk factors: Body Mass Index (BMI), Total Cholesterol, Systolic Blood Pressure and Hypertension, Smoking and Age.
- Prevalence of coronary heart disease (CHD) detected by both the ECG abnormalities (Minnesota code) and the "ROSE standardized questionnaire on r angina".
- Socio-demographic variables: language, marital status, educational level, occupational level.

Mortality data collection

Vital status was given by the National Registry of the Belgian population for the BHDPP and PFS study or by the municipalities for the BIRNH study. For the BHDPP and the PFS, all deaths were linked at the National Insitute for Statistics to the coded death certificates (ICD-8).

We asked the National Institute of Statistics (after having obtained official permission) for the specific-cause related mortality for each dead subject. Lost of follow-up for the National Register in terms of total mortality was 22.5% for the BHDPP, 8.8% for the PFS, and 5.1% for the BIRNH subsample. In the three studies the cause-specific mortality expressed in ICD-9 codes could be determined in 92-93% of the cases.

Statistical analyses

Proportional Cox survival analyses (Forward stepwise method) have been performed. The basic assumption is that the risks are proportional on each moment, hence the name of “proportional hazard model”.

Analyses are carried out separately for the three studies with as dependent variable – in dummy variable – the type of mortality (ICD-9), namely: total mortality, cardiovascular mortality (401-444;), coronary mortality (410-414; 427-429; 439-440; 798), stroke (430-438); cancer (140-209), violent death (accidents: E800-848; E880-E888; E890-E928), (suicide: E950-E959), (homicide E960-E969).

The following bioclinical variables have been included: smoking divided into 4 categories (never, ex-smoker, < or = 20, >210 cigarettes), cholesterol (3 categories: <200, 200-249, 250+), SBP (3 categories: <140, 140-159, 160+), BMI (3 categories: <25, 25-29, 30+).

Following socio-demographic variables have been introduced: language (2 categories: Dutch, French); marital status (4 categories: married or cohabiting, single, divorced or separated, widower), educational level (3 categories: less than secondary school; accomplished secondary school, accomplished superior education); occupational level (3 categories: managers, white collars, blue collars).

The category the least at risk was chosen as reference category in order to obtain a Hazard Ratio (HR) larger than 1.

It should be noted that multivariate analyses could be performed for overall mortality in the three databases, but for coronary heart mortality only in the BHDPP due to sample size.

RESULTS

Descriptive results

The general distribution of mortality is shown in Table 1.

All mortality is higher in the BHDPP as compared to the two other studies even after controlling the mean length of follow-up. Cardiovascular diseases and cancer are the most frequent causes of death.

It can easily be inferred from table 2 that, apart from the classical risk factors (age, smoking, cholesterol, SBP, cardiovascular antecedents), marital status is an important predictor for total mortality in the BHDPP. Especially singles and widowers are at higher risks. Besides the classical risk factors (age, smoking, SBP and BMI, cardiovascular antecedents) for this study (Table 3), it seems that occupational level is an important predictor for all-causes mortality, the highest risk being observed in blue-collar workers.

The number of subjects being minimal in terms of events for the sub-sample of the BIRNH study, age has been introduced as *one* continuous variable. Moreover only pertinent variables have been introduced for this model by selecting them in advance by a forward method in order to overcome sample size in relation to the multivariate statistical analysis. Here in the BIRNH study (Table 4) only age, smoking, hypertension and prevalence of CHD have shown a significant predictive power for total mortality. But next to these predictors, occupational level added a significant contribution to total mortality prediction.

TABLE 1

Distribution of total mortality and cause-specific mortality in the three studies

	BHDPP	PFS	BIRNH
All Mortality	2 316(24.6%)	316(13.4%)	116(5.1%)
Cardiovascular	841(8.9%)	96(4.1%)	38(1.7%)
Coronary mortality	576(6.1%)	63(2.7%)	30(1.3%)
Stroke mortality	126(1.3%)	14(0.6%)	1(0.04%)
Cancer mortality	827(8.8%)	143(6.1%)	42(1.8%)
Violent death mortality	93(1.0%)	11(0.5%)	3(0.1%)
Other Mortality	555(5.9%)	3(0.1%)	2(0.1%)
Total number subjects	9417	2363	2257
Follow-up min (years)	0.03	0.35	0.01
Follow-up max (years)	23.6	19.9	14.0
Mean Follow-up (years)	18.1	16.9	9.89
Sum Subjects x Years	170,009	39,970	22,650

TABLE 2

Proportional Cox survival analyses for Total Mortality in the BHDPP

Independent Variables	Categories	HR	P
	Events	1914	
	Total N	8062	
Age	40-44	1	
	45-49	1.61	**.000**
	50-54	3.22	**.000**
	55-60	5.13	**.000**
Study level	Superior	1	
	secondary	0.96	
	<Secondary	1.12	.404
Marital status	Married	1	
	Widower	1.36	**.021**
	Single	1.39	**.001**
	Divorced/Separated	1.12	.432
Occupational level	Managers	1	
	White Collars	1.20	.113
	Blue-Colars	1.17	.183
Language	Dutch		
	French	1.10	.140
Smoking	Never	1	
	Ex-Smoker	1.21	**.035**
	≤ 20 cig/day	1.70	**.000**
	>20 cig/day	2.23	**.000**
Cholesterol (mg/dl)	<200	1	
	200-249	1.06	.380
	≥ 250	1.18	**.021**
SBP (mmHg)	<140	1	
	140-159	1.14	**.009**
	≥ 160	1.51	**.000**
BMI	<25	1	
	25-29	0.94	.197
	≥ 30	1.04	.652
Prevalence of CHD	no	1	
	yes	1.61	**.000**
Cohort	Intervention	1	
	Control	0.94	.426

For cardiovascular mortality in the BHDPP (Table 5), it appears that occupational level is a significant contributor even after adjustment for age, smoking, cholesterol, SBP, and BMI that are also significant predictors.

DISCUSSION

Before discussing results, some limitations and also qualities of the present research have to be mentioned. At the one hand, lost to follow-

TABLE 3
Proportional Cox survival analyses for Total Mortality in the PFS

Independent	Categories	HR	P
	Events	309	
	Total N	2310	
Age	40-44	1	
	45-49	1.41	**.035**
	50-54	2.17	**.000**
	55-60	2.54	**.000**
Study level	Superior	1	
	Secondary	0.87	.481
	<Secondary	0.92	.685
Marital status	Married	1	
	Divorced/ Separated/ Widower	0.94	.835
	Single	1.16	.567
Occupational level	Managers	1	
	White-Collars	1.26	.262
	Blue-Collars	1.56	**.049**
Language	Dutch	1	
	French	0.92	.546
Smoking	Never	1	
	Ex-smoker	2.49	**.000**
	≤ 20 cig/day	4.15	**.000**
	>20CGS/J	4.91	**.000**
Cholesterol (mg/dl)	<200	1	
	200-249	1.02	.906
	≥ 250	0.89	.527
SBP (mmHg)	<140	1	
	140-159	1.34	**.026**
	≥ 160	1.88	**.001**
BMI	<25	1	
	25-29	0.73	**.010**
	≥ 30	0.88	.532
Prevalence of CHD	no	1	
	yes	1.62	**.002**

up for the National Register was quite high in the BHDPP. Most cases probably moved outside of Belgium after retirement. This hypothesis could be partly confirmed after checking the dropouts, most of them having a foreign-sounding name. The search is still under way, though. Follow-up could not be extended later than 1996 due to registration shortcomings. The population study does not include women for comparison reasons. Indeed the BHDPP and the PFS, contrary to the BIRNH study, do not contain women in their databases. Study samples are restricted to working population. On the other hand, very few research studies possess both a large initial database including bioclinical risk

TABLE 4
Proportional Cox survival analyses for Total Mortality in the BIRNH subsample

Independent	Categories	HR	P
	Events	105	
	Total N	2193	
Age (continuous)			**.000**
Occupational level	Managers	1	
	White-Collars	2.12	**.040**
	Blue-Collars	1.86	.092
Smoking	Never	1	
	Ex-smoker	2.81	**.015**
	≤ 20 cig/day	3.80	**.001**
	>20 cig/day	7.15	**.000**
Hypertension	Normotensives	1	
	Hypertensives	1.63	**.015**
Prevalence of CHD	no	1	
	yes	1.97	**.016**

factors, social and psychological factors as well as mortality data. Moreover, even fewer studies have such a long-term follow-up. The baseline values for both subjects remaining in the study and those lost to follow-up have been compared allowing us to conclude that no important positive selection bias occurred (Kittel, 2001).

In the BHDPP, both total and cardiovascular mortality are not influenced by the control or intervention group. This indicates that, contrary to what was observed after 6 years of follow-up (25) but according to observations after 10 years (26), no favourable differences remained for the group that benefited from the intervention, compared to the control group.

For total mortality, bioclinical "cardiovascular risk factors" appeared (as one could expect) to be good predictors for total mortality, mainly for two reasons: cardiovascular mortality constitutes a large part of total mortality, and cardiovascular risk factors are greatly associated with other cause-specific mortality.

Considering the social factors, interestingly marital status appears to remain after 18 year of follow-up an independent total mortality predictor in the BHDPP, with singles and widowers showing the strongest risks. Social causation mechanisms (27) that could explain this finding: isolated men have worse material resources, more stress and less social support in comparison to non-isolated ones. Unhealthy health habits, which could be a fourth explanation, have been statistically controlled for in

TABLE 5

Proportional Cox survival analyses for Cardiovascular mortality in the BHDPP

Independent	Categories	HR	P
	Events	703	
	Total N	8062	
Age	40-44	1	
	45-49	1.66	**.000**
	50-54	3.21	**.000**
	55-60	5.16	**.000**
Study level	Superior	1	
	Secondary	0.67	.086
	<Secondary	0.82	.363
Marital Status	Married	1	
	Widower	1.24	.340
	Single	1.30	.106
	Divorced / separated	0.93	.784
Occupational level	Managers	1	
	White-Collars	1.83	**.003**
	Blue-Collars	1.67	**.013**
Language	Dutch	1	
	French	0.99	.919
Smoking	Never	1	
	Ex-Smoker	1.12	.416
	≤ 20 cig / day	1.65	**.000**
	>20 cig / day	1.86	**.000**
Cholesterol (mg/dl)	<200	1	
	200-249	1.32	**.026**
	≥ 250	1.74	**.000**
SBP (mm/Hg)	<140	1	
	140-159	1.27	**.005**
	≥ 160	1.93	**.000**
BMI	<25	1	
	25-29	1.04	.668
	≥ 30	1.29	**.043**
Prevalence of CHD	No	1	
	Yes	2.19	**.000**
Cohort	Intervention	1	
	Control	1.04	.748

this study, be it in an indirect way, by taking into account cholesterol and BMI.

Cultural belongingness – expressed by language – does not seem to possess any predictive power for long-term mortality, when bioclinical and main social indicators are taken into account.

After such a long follow-up, study level is not a predictor for mortality anymore either. Whereas occupational level is for total mortality in the two more recent cohorts, but in different social strata and for cardiovascular mortality in the BHDPP. The findings that social class in general are negatively linked to mortality are in agreement with many relevant studies (28-31). Those specific findings are moreover partly in accordance to Davey Smith and colleagues' (32) conclusions. Indeed, they found that occupational social class in adulthood is a better discriminator of socio-economic differentials in mortality than is education.

The finding that the predictive power of occupational status for total mortality is not observed in the BHDPP could be explained by the following. One social factor, namely marital status, is a significant predictor, and the causal mechanisms that could play a role in the occupational dimension are already covered by marital status. An argument in favor of this explanation is that for cardiovascular mortality in the BHDPP, occupation is an independent predictor, whereas marital status is not.

In the two other cohorts occupational status contributes significantly to predict total mortality. Interestingly though it has to be observed that in the Physical Fitness study, blue-collar workers are most at risk, whereas in the BIRNH study white-collar workers are.

In recent published work (33) on social inequalities and mortality in Belgium, the same results are found as in the BIRNH study. This could be explained by a healthy-worker effect (34) wherein more recent studies white-collar category is absorbing blue-collar workers who cannot perform heavy physical work anymore due to health problems. This healthy worker effect could in turn lead to artificially lower differences between occupational classes e.g. due to a specific lower-class selection consisting of health-related exits from the labour market concentrated among low socio-economic groups.

In conclusion these independent social differences in mortality are very impressive after such a delay and deserve more attention. The underlying mechanisms can be found in the realm of the psychosocial domain (35-36), which from a new public health perspective has to be further and systematically investigated. It will be possible to partially explore this by means of the present databases.

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