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Perceived Health Status and Morbidity and Mortality: Evidence from the Kuopio Ischaemic Heart Disease Risk Factor Study

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Background. Previous studies have reported an increased risk of death in those who report their health is poor, however the role of underlying and subclinical disease in this association has not been carefully studied.

Methods. The associations between perceived health status and mortality from all causes and cardiovascular disease, incidence of myocardial infarction, carotid atherosclerosis, forced expiratory volume, and maximal exercise capacity were studied in the Kuopio Ischaemic Heart Disease Risk Factor Study, a population-based study of 2682 men, aged 42–60, in eastern Finland.

Results. There were strong, statistically significant, age-adjusted associations between level of perceived health and mortality from all causes ($RH_{bad\ versus\ good}$ = 3.67), cardiovascular causes ($RH_{bad\ versus\ good}$ = 6.64), and incidence of myocardial infarction ($RH_{bad\ versus\ good}$ = 3.87). Perceived health levels were strongly associated with risk factors and disease indicators. The associations with mortality and myocardial infarction outcomes were considerably weakened with progressive adjustment for eight risk factors and prevalent disease. Higher levels of perceived health were associated with less carotid atherosclerosis, and greater forced expiratory volume and maximal exercise capacity. Associations between level of perceived health and these indicators were considerably stronger in those with prevalent diseases than in those who were healthy.

Conclusions. The overall pattern of results suggests that perceived health levels mainly reflect underlying disease burden.

Keywords: perceived health, morbidity, mortality, cardiovascular disease

Since the early 1980s more than a dozen studies have reported an association between self-rated or perceived health status and mortality from all causes.[1–14] The general consistency of results in these studies, coupled with the heterogeneity of populations and age groups examined, is impressive, particularly in light of the simple measurement of perceived health. While there were earlier reports of such associations,[15] and many earlier studies incidentally included a measure of perceived health status as a covariate in analyses, the large number of recent reports on this association gives further impetus to attempts to understand the mechanisms that explain this association.

While more complex hypotheses are possible,[14,16] the simplest explanation is that perceived health reflects an individual's awareness of symptoms, diagnoses, and performance decrements that are associated with mortality risk. This explanation has been addressed in most studies with varying degrees of success in capturing 'objective' health status. Measures of health status have been based on self-reported conditions and symptoms, diagnoses from medical records, medication review, severity-weighted diagnoses, and other information. With few exceptions,[10] perceived health has remained an independent predictor of mortality in multivariate

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models. The exception is, however, instructive. In the analyses of the mortality experience of men in the British Regional Heart Study, Wannamethee and Shaper[10] found that men who reported poor health, compared to those who perceived health more positively, were more likely to report medication use, sickness absence, major illnesses, angina pectoris, breathlessness, and other characteristics indicative of poorer health. When these characteristics were taken into account, there was no longer a significant or important association between perceived health and risk of death.

Thus, it is possible that there would be a weakening of the association between perceived health and mortality risk with better measures of objective health status. In this study we were able to examine this possibility through analyses of the mortality experience of a population-based cohort of men for whom extensive information was available about diagnosed conditions, symptoms, behavioural and biological risk factors, fitness, lung function, carotid atherosclerosis, and other characteristics. We reasoned that, as we moved from models with adjustment for age to models that included adjustment for risk factors and then disease characteristics, there should be a weakening of the association between perceived health and mortality risk. In addition, we were able to examine in the same way the association between perceived health status and risk of myocardial infarction, fitness, lung function, and extent of carotid atherosclerosis. Finally, by dividing prevalent health conditions into those that would be likely to be symptomatic versus those that would be asymptomatic and/or out of awareness, we were able to test the mediating role of symptoms in the association between perceived health and mortality risk.

MATERIALS AND METHODS

Study Population

The Kuopio Ischaemic Heart Disease (KIHD) study is a population-based study designed to investigate previously unestablished risk factors for carotid atherosclerosis and ischaemic heart disease among middle-aged men from the Kuopio region in Eastern Finland, an area of high coronary morbidity and mortality.[17] The baseline study was carried out between March 1984 and December 1989. A total of 3235 men aged 42, 48, 54, or 60 years were eligible for the study, and of these, 2682 (82.9%) agreed to participate. The mortality and myocardial infarction (MI) analyses presented here were based on 2512 men who had complete data on the perceived health measure, risk factors, health status, and outcome measures at baseline. Data on fitness, lung function, and carotid atherosclerosis were available on a subset: fitness data were available for 2225 men, lung function data for 1355, and carotid atherosclerosis data for 1202.

Perceived Health Measure

Perceived health was measured from a self-administered questionnaire at the time of the baseline examination. Subjects responding to 'How do you rate your current state of health?' were grouped into one of three categories: (1) good or extremely good, (2) average, or (3) bad or extremely bad.

Risk Factors

Body mass index was computed as the ratio of weight to height squared (kg/m^2). High (HDL) and low density lipoprotein (LDL) fractions were separated from fresh plasma using both ultracentrifugation and precipitation. Blood pressure was measured as the mean of random-zero sphygmomanometer readings after a sitting rest of 5 and 10 minutes. Conditioning leisure-time physical activity, smoking status, alcohol consumption, and current income were recorded using a self-administered questionnaire.

Health Status Measures

Disease groups. Eight disease groups were created, based upon previous physician diagnoses, use of medications, or maximal exercise test results administered during the study. Symptomatic coronary heart disease (previous MI or angina pectoris diagnosis or use of antianginal medication or history of angiography or positive on Rose angina questionnaire); asymptomatic coronary heart disease (no symptomatic coronary heart disease as above and ischaemia on exercise test or exercise test terminated due to chest pain); other cardiovascular disease (cardiomyopathy or congestive heart failure or functional heart problems or claudication or any other cardiovascular disease); stroke (any history of cerebral stroke); respiratory disease (chronic bronchitis or bronchial asthma or pneumoconiosis or tuberculosis); hypertension (systolic blood pressure $\geq$165 mmHg or diastolic blood pressure $\geq$95 mmHg or use of antihypertensive medication); diabetes (previous diagnosis or blood glucose $\geq$11.1 mmol/l); and cancer (any diagnosis). In some analyses, these disease groups were further divided into two categories: those with symptomatic and those with asymptomatic conditions. The group with symptomatic conditions included men with any history of symptomatic coronary heart disease, other cardiovascular disease, cerebral stroke, respiratory disease, diabetes, or cancer. The group with asymptomatic conditions included men with asymptomatic coronary heart disease or hypertension.

Fitness and lung function. Exercise capacity was measured by a maximum symptom-limited exercise tolerance test on a bicycle ergometer. The testing protocol comprised a linear increase of work load by 20 W/min (Medical Fitness Equipment 400 L bicycle ergometer, Mearn, The Netherlands). Respiratory gas exchange was measured breath-by-breath with an MGC 2001 analyser (Medical Graphics Corporation, St Paul, MN). The highest value of oxygen uptake was defined as the maximal oxygen uptake (VO_2Max). Forced expiratory volume (FEV_1) was defined as an outbreath capacity per second.

Carotid atherosclerosis. Intima-media thickness (IMT) was assessed using a B-mode ultrasound examination of the far wall of the right and left common carotid arteries.[18] The projection showing the greatest distance between the lumen-intima interface and the media-adventitia interface was located and recorded on a VCR system. Image-Measure morphometry software was used to measure IMT from the recorded scannings.

Outcomes

Mortality and myocardial infarctions. All-cause and cardiovascular mortality were ascertained by linkage to the Finnish national death registry. Deaths included those that occurred between the time of study entry and December 1992. Cardiovascular deaths were classified according to the Ninth International Classification of Diseases for codes 390–459. Average follow-up time was 5.8 years. Fatal and non-fatal MI were ascertained by reports from the Finmonica coronary registry.[19]

Data Analyses

The association between perceived health and the outcome measures was assessed using the Cox Proportional Hazards Model.[20] Age, risk factor, and disease group-adjusted models containing two dummy variables representing the average and bad self-reported perceived health groups were fitted to the data. The good perceived health group was used as the reference. The means for fitness, lung function, and IMT at each level of perceived health were computed using the method of least squares in the SAS GLIM procedure. In models in which there was adjustment for the eight disease conditions, each condition was entered as a separate covariate. A healthy subgroup was formed by excluding participants who were positive for any of the eight groups of conditions. Analyses which adjusted for symptomatic versus asymptomatic conditions used the dichotomous categorization indicated above.

RESULTS

Mortality and Myocardial Infarction Outcomes

During the follow-up period, there were 153 all-cause (10.5/1000 person-years) and 81 cardiovascular deaths (5.5/1000 person years). There were 205 MI between study entry and December 1992 (14.6/1000 person-years). In age-adjusted models (Table 1 and Figure 1), perceived health was strongly associated with risk of death from all causes or from cardiovascular disease, and with incidence of MI. The 14.7% (n = 370) who rated their health as bad or extremely bad were at threefold increased risk of death from all causes or incidence of MI, and were at over sixfold increased risk of death from cardiovascular disease, compared to the 36.2% (n = 980) who rated their health as good or extremely good. Respondents who rated their health as average (49.0%, n = 1232) were also at increased risk compared to the more positive group.

Tables 2 and 3 present risk factor status and health status by levels of perceived health. The prevalence of a diagnosis in each of the disease groupings, and the mean IMT, is considerably higher among those who perceived their health as bad or extremely bad compared to those who reported good or extremely good health. Those who reported average health are intermediate. Risk factor levels are generally worse among those with bad or extremely bad perceived health. The only exception is for HDL and LDL cholesterol levels, which do not vary by perceived health status, and conditioning leisure-time physical activity, which is less common among those who reported average health.

With adjustment for risk factors, and then for disease groups, there was a progressive weakening of the association for all three outcomes (Table 1). The increased relative risk associated with bad versus good perceived health was reduced with adjustment for risk factors and disease groups by 54.0%, 69.1%, and 61.5% for all-cause mortality, cardiovascular mortality, and MI incidence, respectively.

Role of Symptoms

We examined the role of symptoms in the association between perceived health and all-cause mortality by adjusting, in separate age- and risk factor-adjusted models for symptomatic versus asymptomatic diseases. The increased risk associated with bad versus good perceived health was reduced by 25.4% (RH = 2.12 reduced to 1.69) when symptomatic conditions were

TABLE 1 *Association between perceived health, mortality from all causes and cardiovascular disease, and incidence of myocardial infarction*

Model	All cause		Cardiovascular		Myocardial infarction (fatal and non-fatal)	
	Relative hazard	95% CI	Relative hazard	95% CI	Relative hazard	95% CI
Age-adjusted						
Good (ref.)	1.00	–	1.00	–	1.00	–
Average	1.60	1.04–2.46	2.07	1.05–4.08	1.66	1.15–2.41
Bad	3.67	2.33–5.80	6.64	3.36–13.12	3.87	2.61–5.74
+ Risk factors[a]						
Good (ref.)	1.00	–	1.00	–	1.00	–
Average	1.21	0.78–1.88	1.57	0.78–3.14	1.3	0.89–1.91
Bad	2.12	1.31–3.45	3.85	1.87–7.96	2.65	1.74–4.04
+ Disease groups[b]						
Good (ref.)	1.00	–	1.00	–	1.00	–
Average	1.05	0.67–1.66	1.08	0.53–2.21	0.93	0.62–1.38
Bad	1.69	1.01–2.82	2.05	0.96–4.38	1.49	0.95–2.33

[a] Body mass index, smoking, HDL cholesterol, LDL cholesterol, systolic blood pressure, conditioning leisure-time physical activity, alcohol consumption, income.
[b] Symptomatic coronary heart disease, respiratory disease, other cardiovascular disease, hypertension, stroke, asymptomatic coronary heart disease, diabetes, and cancer.

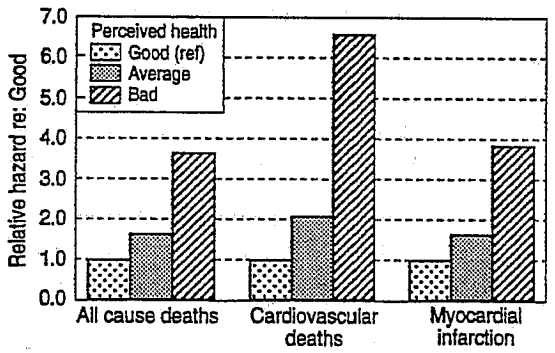

FIGURE 1 *Age-adjusted association between perceived health, mortality from all causes and cardiovascular disease, and incidence of myocardial infarction*

included, and by only 1.0% (RH = 2.12 reduced to 2.10) when asymptomatic conditions were included.

Other Outcomes

Carotid Atherosclerosis. Intima-media thickness monotonically increased with poorer perceived health ratings (Table 4). When analyses were restricted to the 35.1% of the sample who had none of the diseases listed in the eight disease groups, there was only a 6.0% difference in intima-media thickness between those who reported bad versus good perceived health. For those who had prevalent diseases, the mean intima-media difference between those with good versus bad perceived health was almost twice (11.8%) as large as in the healthy subgroup.

Lung function. Forced expiratory volume in one second (FEV_1) decreased monotonically with decreasing level of perceived health (Table 4). Those who reported bad health had 8.9% lower FEV_1 ($P < 0.05$) than those who reported good health. When analyses were done separately for the healthy and unhealthy subsamples, the FEV_1 difference between those who rated their health as good and those who rated their health as bad was approximately twice as large in the unhealthy group (13% versus 6.7%).

Fitness. Maximal exercise capacity decreased with decreasing perceived health (Table 4). Those who perceived their health as bad had 24.2% lower VO_2Max than those who perceived their health as good ($P < 0.05$). This difference was markedly reduced when the extremely healthy subsample was considered

TABLE 2 *Prevalence of disease conditions, carotid atherosclerosis (IMT), fitness (VO_2Max) and lung function (FEV_1) by perceived health*

Health condition	Perceived health status		
	Prevalence (%) or mean		
	Extremely good/good	Average	Bad/extremely bad
Symptomatic coronary heart disease[a] (%)	10.1	29.6	57.8
Respiratory disease[b] (%)	6.8	14.5	24.9
Other cardiovascular disease[c]	8.1	18.3	33.5
Hypertension (%)	29.7	41.0	48.4
Stroke (%)	0.2	2.6	6.0
Diabetes (%)	1.4	5.7	7.0
Cancer (%)	1.7	1.9	2.4
Intima-media thickness (mm)	0.89	0.97	1.01
VO_2Max (% lowest quintile)	6	22.9	46.8
FEV_1 (% lowest quintile)	11.1	23.6	36.1

[a] Myocardial infarction or angina diagnosis or use of antianginal medication or angina on Rose Questionnaire or history of angiography.
[b] Chronic bronchitis or asthma or pneumoconiosis or tuberculosis.
[c] Cardiomyopathy or congestive heart failure or functional heart problems or claudication or any other cardiovascular disease not listed as symptomatic.

TABLE 3 *Risk factor prevalence and means by perceived health status*

Risk factor	Perceived health		
	Prevalence (%) or mean		
	Extremely good/good	Average	Bad/extremely bad
Current smoker (%)	25.6	37.0	42.2
Body mass index (wt/ht^2)	26.3	27.1	27.6
High density lipoprotein (mmol/l)	1.3	1.3	1.3
Low density lipoprotein (mmol/l)	4	4.1	4.1
Systolic blood pressure (mmHg)	129.9	130.6	132.2
Conditioning leisure-time physical activity (h/year)	122.4	101.2	121.3
Alcohol consumption (g/wk)	65.2	78.8	94.7
Income (FIM)[a]	91 340	73 670	57 576

[a] In Finnmarks.

(8.6% lower VO_2Max), and was considerably larger in the unhealthy group (32.0% lower VO_2Max).

DISCUSSION

In our analyses, perceived health is associated with risk of death from all causes and from cardiovascular disease, incidence of MI, extent of carotid atherosclerosis, FEV_1, and VO_2Max. However, this association appears, to a great extent, to be a reflection of underlying disease. The prevalence of most disease groups and risk factors is substantially elevated among those who report bad or extremely bad perceived health. With successive adjustment for a comprehensive set of risk factors, which might index the likelihood of preclinical disease and a large set of disease conditions, there is a consistent decrease in the association between perceived health and all outcomes examined. Indeed, better objective measures of health, for example those that assess severity of disease, might reduce the residual association between perceived health status and mortality even further.

TABLE 4 *Association between perceived health and age-adjusted intima-media thickness (IMT), forced expiratory volume (FEV_1), and maximal exercise capacity (VO_2Max)*

All subjects	Mean IMT (mm) (n = 1202)	Mean FEV_1 (l) (n = 1355)	Mean VO_2Max (ml/kg/min) (n = 2225)
Good (ref.)	0.891	3.84	33.66
Average	0.97***	3.64*	29.40***
Bad	1.01***	3.40*	25.53***
%Δ Bad versus Good	13.5%	8.9%	24.2%
Healthy subjects			
Good (ref.)	0.83	3.99	35.71
Average	0.88*	3.81**	32.93**
Bad	0.88	3.74	32.63***
%Δ Bad versus Good	6.0%	6.7%	8.6%
Unhealthy subjects			
Good (ref.)	0.93	3.75	32.11
Average	1.01**	3.55***	27.95***
Bad	1.04**	3.32***	24.33***
%Δ Bad versus Good	11.58%	13.0%	32.0%

[a] Statistical significance compared to reference category.
* $P < 0.10$, ** $P < 0.05$, *** $P < 0.001$.

Further support for perceived health status being a measure of underlying disease burden comes from the analyses that were restricted to the very healthy subsample. While mortality analyses are not practical in this group because of too few deaths, when we examined the association of perceived health with carotid atherosclerosis, FEV_1, or VO_2Max in this group, it was greatly attenuated compared to the results for the group as a whole. Thus, in healthy participants, who presumably have few symptoms of disease, little association was found. Similarly, in the participants who had various chronic conditions, ratings of perceived health were much more strongly associated with these outcomes. Finally, the differential degree of confounding seen when adjusting for symptomatic versus asymptomatic diseases suggests that symptoms are important determinants of perceived health.

While the association between perceived health and mortality and MI outcomes was substantially reduced with adjustment for risk age, risk factors, and disease groups, there remained a marginally statistically significant excess risk of 49% to 105%, depending on the outcome. Whether this indicates an independent role for perceived health, or not, is a matter of judgement. It is possible that better measurement of risk factors, including adjustment for measurement error, and more sensitive disease indicators, including severity measures, would further reduce this excess risk. In the absence of any clearly defined biological notion of what else perceived health might be reflecting, and in the context of the current results, it seems more parsimonious to posit that perceived health reports index the total burden from a wide range of underlying, occult, and diagnosed conditions and symptoms.

In summary, the present results suggest that the association between perceived health status and health outcomes reflects the fact that perceived health status is closely related to more objective measures of health status. Thus, it may not have the singular role originally posited by Kaplan and Camacho.[1] However, this does not mean that it should be dismissed as unimportant. For one, in the absence of more objective measures, perceived health status may be a suitable proxy measure of health status in epidemiological studies. Moreover, as pointed out in our earlier report, increased emphasis on technological medicine in clinical settings has tended to devalue the importance of what patients say.[1,21] The literature on perceived health status and health outcomes, including the current report, suggests that clinically useful information may be lost in the process.

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