

# The CroHort Study: Cardiovascular Behavioral Risk Factors in Adults, School Children and Adolescents, Hospitalized Coronary Heart Disease Patients, and Cardio Rehabilitation Groups in Croatia

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## ABSTRACT

*Based on repeated measurement of health behaviors the CroHort Study showed that health behavior explains a great deal more of class inequalities in mortality than observed in previous studies. These include decreasing prevalence of smoking and increase in obesity, hypertension and diabetes mellitus. The lowest prevalence of health risks was recorded among children and adolescents, followed by general adult population from the CroHort Study. Hospitalized coronary heart disease patients had higher risks prevalence than general population, while the highest prevalence of risks was recorded among patients in cardiac rehabilitation program. The higher levels of stress were associated to lower financial conditions, poorer social functioning and poorer mental health for both men and women. Higher levels of stress were also associated with heart problems, higher alcohol consumption in men while in women stress was associated to poorer general health, higher age and lower levels of education.*

**Key words:** cardiovascular behavioral risk factors, prevalence, cumulative incidence, socioeconomic differences

## Introduction

Lifestyle and health related behaviors are recognized as major determinants of morbidity and mortality worldwide<sup>1-3</sup>. Concurrently, there is evidence to suggest that the socioeconomic differences in morbidity and mortality have increased<sup>4-11</sup>. Combinations of potentially modifiable behavioral factors such as smoking, alcohol consumption, dietary patterns, physical activity, and body mass index have been shown to explain 12% to 54% of the socioeconomic differences in mortality<sup>12-17</sup>.

For almost last 40 years, a fundamental question surrounding the relationship between socioeconomic factors and health status has been: How much of socioeconomic

differences and health can be attributed to socioeconomic differences in health behaviors? This Collegium Antropologicum Supplement represents contribution to understanding the determinants of health by providing a better answer than some of previously available about this fundamental issue. This question is important because even though the patterning of a wide variety of health outcomes by socioeconomic status has been demonstrated in numerous studies, well-established behavioral health risk factors, such as smoking, physical activity, dietary patterns, and alcohol consumption, also show a similar socioeconomic gradient. For the most part, after

controlling for relevant health behaviors, there is still a significant amount of variation in health outcomes to be explained by socioeconomic factors<sup>11,14–16,18,19</sup>. Moreover, socioeconomic inequalities in health are not reducible to health behaviors, although these inequalities are part of what creates them.

In most of previously mentioned studies, health behaviors typically have been assessed at only one point in time, assuming implicitly that they remain constant over time. Based on repeated measurement of health behaviors in the Croatian Adult Health Cohort Study (CroHort), Vuletić and all showed that health behavior explains a great deal more of class inequalities in mortality than observed in previous studies. These include the decreasing prevalence of smoking and a remarkable increase in obesity, hypertension and diabetes mellitus. The lowest prevalence of health risk factors was recorded among children and adolescents, followed by general adult population from the CroHort Study. As expected, hospitalized coronary heart disease patients had higher risk factors prevalence than general population, while the highest prevalence of risk factors was recorded among patients in cardiac rehabilitation program. In our study, we showed that higher levels of stress were associated to lower financial conditions, poorer social functioning and poorer mental health for both men and women. Higher levels of stress were also associated with heart problems and back pain, higher alcohol consumption in men while in women stress was associated to poorer general health, higher age and lower levels of education (Table 1).

Perhaps even more important, the CroHort study does not suggest that socioeconomic differences in health are reducible to socioeconomic differences in unhealthy behaviors. Accordingly, it would be incorrect to infer that there is no need to be concerned with social and economic justice, only health behavior. CroHort study has been conceptualized as a relatively narrow band of the overall socioeconomic spectrum in Croatian society, and the repeated finding that lower-ranked civil servants experienced poorer health on a wide variety of outcomes indicate that it was possible to simply extrapolate the pattern at both ends of the gradient to individuals with lower or higher socioeconomic status outside of the civil service. By this logic, these findings could be considered a reflection of Croatian society at large. The debate surrounding factors accounting for health status has been characterized as a simplistic matter of the stress of low socioeconomic status vs. behavior as the explanation for socioeconomic inequalities in health<sup>11</sup>. With a broader conceptualization of stress, it is possible to consider both factors as part of the same pathway between relatively low socioeconomic status and health. Unhealthy behaviors are more common among individuals with low socioeconomic status because of the stress of low socioeconomic status<sup>20,21</sup>. Accordingly, there is a direct causal pathway between low socioeconomic status and poor health as well as an indirect causal pathway through health behavior, which reinforce one another over the lifecourse. That is, the stress pathway is partly a behavioral pathway and

unhealthy behaviors are coping mechanisms for the stress of low socioeconomic status. This observation does not dismiss the importance of behavioral risk factors nor suggest that reducing unhealthy behaviors would not be influential on population health. The problem is that traditional individually oriented health behavior education interventions are not very effective, and individuals with low socioeconomic status have been notoriously difficult to reach with such programs<sup>22</sup>.

The inference that should be drawn from CroHort study is that both health behaviors and social and economic determinants of health remain important factors. Moreover, the stress of low relative socioeconomic status vs. health behaviors argument should be considered obsolete. Socioeconomic differences exist for almost every major contemporary and historical cause of morbidity and mortality, suggesting the presence of a common pathway. Moreover, plausible evidence suggests that those pathways are traceable to the development of self-regulation and executive function early in life.

Socioeconomic position with health behaviors and mortality policies and interventions focusing on individual health behaviors has the potential not only to increase the population's health but also to substantially reduce inequalities in health. On the other hand, if health behaviors are socially patterned and determined, for example, by financial actors<sup>14,16</sup>, the capacity to respond to health education messages<sup>23,24</sup>, or the environment in which they live<sup>25</sup>, the same policies aimed at improving the population's health may contribute to an increase in social inequalities in health.

Most of the published results of CroHort studies present the status and causes of chronic diseases in Croatia. However, the entire CroHort program, implemented from 2003 to 2011, should be observed also as a kind of public health intervention and evaluation of the existing prevention of chronic, non-communicable diseases. From the management perspective, the project is actually a form of »force field« analysis. On the one side there are »negative« forces that directly cause or contribute to development of chronic non-communicable diseases. On the other side, there are »positive« forces trying to reduce the impact of »negative« force.

## Conclusion

This analysis leads to the neglected concept of »Integrated Chronic Disease Prevention and Control«, and need to understand chronic disease prevention as a comprehensive public challenge, necessary connected to many social determinants and public service<sup>26</sup>. Thus the results of the project CroHort determined two key generators of successes or failures in the prevention of cardiovascular diseases. The first, set of problems resulting from the overall social environment, values and relationships; and the second, mixture of inefficiency and ineffectiveness of health care system. These findings are part of the general public health knowledge, but they are poorly or not at all incorporated into immediate activities to

**TABLE 1**  
SUMMARY OF CARDIOVASCULAR RISK STUDIES' RESULTS

Authors	Variable	Prevalence (%)				Cummulative incidence (%)	
		2003		2008		2003–08	
		Men	Women	Men	Women	Men	Women
CroHort							
Musić Milanović et al.	Obesity (BMI ≥ 30)	20.6	20.1	25.3	34.1	8.7	20.5
Erceg et al.	Hypertension					36.9	33.0
Pucarín et al.	Unhealthy nutrition	18.4	12.4	16.7	9.9	14.3	9.1
Samardžić et al.	Smoking	34.1	22.5	25.3	22.4	1.1	2.3
Marić Bajš et al.	Physical inactivity	33.3	33.9	36.8	38.1	27.2	31.1
Vukušić Rukavina et al.	Psychological distress	28.5	32.1	33.0	34.1		
		1999		2009			
Rehabilitation		Men	Women	Men	Women		
Heim et al.	Overweight and obesity (BMI ≥ 25)	52.8	45.2	88.2	78.0		
	Hypertension	52.0	74.2	78.0	83.5		
	Hypercholesterolemia	85.3	88.7	87.3	85.8		
	Diabetes mellitus ID	2.6	1.6	4.3	5.5		
	Diabetes mellitus NID	19.1	11.3	12.1	10.2		
	Impaired fasting glucose	12.6	17.7	8.1	11.0		
	Diabetes mellitus ID+NID+GI	34.2	30.7	24.5	26.8		
	Smoker	42.4	32.3	39.3	27.6		
		2007–2010					
Hospitalized CHD patients		Total	Men	Women			
Vražić et al.	Overweight (25 ≤ BMI < 30)	48.2	49.8	44.4			
	Obesity (BMI ≥ 30)	28.6	26.9	32.8			
	Central obesity	54.5	44.3	79.5			
	Hypertension	70.1	65.8	80.6			
	Smoking	42.6	47.4	30.8			
	* Sedentary behaviour	88.5	88.9	88.1			
	* Binge drinking	11.5	13.1	4.3			
	Diabetes mellitus	31.6	30	35.7			
	Impaired fasting glucose	22.3	24.5	16.8			
	Hypercholesterolaemia (increased total cholesterol)	72	71.7	72.7			
	Hypercholesterolaemia (increased LDL-cholesterol)	72.3	72.4	72.1			
	Hypercholesterolaemia (decreased HDL-cholesterol)	42.6	39.6	50.2			
	Hypertriglyceridaemia	51.5	52.8	48.5			
Children (8th grade of primary school; average age 14.66 years for girls and 14.73 for boys)		2003–2004					
		Total	Men	Women			
Musil et al.	Hypertension	6.5	5.3	7.9			

\* Unpublished data

overcome problems and change the existing situation. Entire set of results, but also the experiences during implementation of the project CroHort suggest that Croatia needed two coordinated strategies for the prevention of cardiovascular diseases. One which would act as a broad

social program – for professionals recognized as »primordial« prevention; and another, intended for health workers as a program of »capacity building«. The information and communication technology could have a non-neglecting role in both strategies<sup>27,28</sup>. As the authors sta-

ted, the information and communication technologies would change the existing health care to pervasive health care as follows: from acute to continuous, from hospitalization to home and out-patient care, from reactive to pro-active and preventive care, from just information technology to assistive technology, from centralized to pervasive, from sampling to monitoring, and from doctor-centric to patient-centric<sup>27</sup>. Some investigations already showed the successful role of information and communication technology in weight decrease intervention<sup>28</sup>.

## REFERENCES

1. BERKMAN L, BRESLOW L, Health and Ways of Living: The Alameda County Study (New York, NY: Oxford University Press, 1983). — 2. MOKDAD AH, MARKS JS, STROUP DF, GERBERDING JL, JAMA, 291 (2004) 1238. — 3. KHAW KT, WAREHAM N, BINGHAM S, WELCH A, LUBEN R, DAY N, PLoS Med, 5 (2008) 12. — 4. SINGH GK, SIAHPUSH M, Int J Epidemiol, 31 (2002) 600613. — 5. MEARA ER, RICHARDS S, CUTLER DM, Health Aff, 27 (2008) 350360. — 6. MACKENBACH JP, BOS V, ANDERSEN O, CARDANO M, COSTA G, HARDING S, Int J Epidemiol, 32 (2003) 830. — 7. LYNCH JW, KAPLAN GA, SALONEN JT, Soc Sci Med, 44 (1997) 809. — 8. LAKKA TA, KAUKANEN J, SALONEN JT, Int J Epidemiol, 25 (1996) 86. — 9. MARTIKAINEN P, BRUNNER E, MARMOT M, Soc Sci Med, 56 (2003) 1397 — 10. MACINTYRE S, Soc Sci Med, 44 (1997) 723. — 11. TOWNSEND P, DAVIDSON N, Inequalities in Health: The Black Report (Harmondsworth, England: Penguin Books, 1982). — 12. LAAKSONEN M, TALALA K, MARTELIN T, RAHKONEN O, ROOS E, HELAKORPI S, Eur J Public Health, 18 (2008) 38. — 13. LANTZ PM, HOUSE JS, LEPKOWSKI JM, WILLIAMS DR, MERO RP, CHEN J, JAMA, 279 (1998) 1703. — 14. SCHRILJVERS CT, STRONKS K, VAN DE MHEEN HD, MACKENBACH JP, Am J Public Health, 89 (1999) 535. — 15. STRAND BH, TVERDAL A, J Epidemiol Community Health, 58 (2004) 705. — 16. VAN OORT FV, VAN LENTHE FJ, MA-

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CKENBACH JP, J Epidemiol Community Health, 59 (2005) 214. — 17. WOODWARD M, OLIPHANT J, LOWE G, TUNSTALL-PEDOE H, Prev Med, 36 2003;36(5): 561–568. — 18. MARMOT MG, ROSE G, SHIPLEY MJ, HAMILTON PJS, J Epidemiol Community Health, 32 (1978) 244. — 19. LAAKSONEN M, TALALA K, MARTELIN T, RAHKONEN O, ROOS E, HELAKORPI S, Eur J Public Health, 18 (2008) 38. — 20. ROD NH, GRONBAK M, SCHNOHR P, PRESCOTT E, KRISTENSEN TS, J Intern Med, 266 (2009) 467. — 21. UMBERSON D, LIU H, RECZEK C, Adv Life Course Res, 13 (2008) 19. — 22. SYME SL, MARMOT M, Soc Prev Med, 51 (2006) 247. — 23. PURSLOW LR, YOUNG EH, WAREHAM NJ, FOUHI N, BRUNNER EJ, LUBEN RN, BMC Public Health, 8 (2008) 112. — 24. MACINTYRE S, Br J Sports Med, 34 (2000) 6. — 25. MACINTYRE S, MACIVER S, SOOMAN A, 22 (1993) 213. — 26. WORLD HEALTH ORGANIZATION, Chronic diseases and health promotion. Integrated chronic disease prevention and control, accessed 31.05. 2011. Available from: URL: [http://www.who.int/chp/about/integrated\\_cd/en/](http://www.who.int/chp/about/integrated_cd/en/). — 27. HAUX R, GIETZELT M, HELLRUNG N, LUDWIG W, MARSCHOLLEK M, SONG B, WOLF KH, Stud Health Technol Inform, 150 (2009) 14. — 28. NEVE M, MORGAN PJ, COLLINS CE, J Med Internet Res, 13 (2011). Available from URL: <http://www.jmir.org/2011/4/e83/> (HTML) and <http://www.jmir.org/2011/4/e83/PDF>.

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## STUDIJA CroHort: KARDIOVASKULARNI PONAŠAJNI RIZICI ODRASLIH, ŠKOLSKE DJECE I ADOLESCENATA, HOSPITALIZIRANIH KORONARNIH PACIJENATA I PACIJENATA NA REHABILITACIJI U HRVATSKOJ

## SAŽETAK

Ponavljanjem mjerenja studija CroHort je pokazala da zdravstvena ponašanja objašnjavaju veći dio nejednakosti u mortalitetu nego što su to pokazale prijašnje studije. Studija je pokazala pad prevalencije pušenja i porast debljine, hipertenzije i dijabetesa. Najniža prevalencija zdravstvenih rizika zabilježena je u djece i adolescenata, zatim u općoj odrasloj populaciji, nakon čega slijedi populacija hospitaliziranih koronarnih pacijenata i populacija pacijenata na kardio-rehabilitacijskim programima. Najviša razina stresa povezana je s nižim financijskim stanjem, lošijem socijalnim funkcioniranjem i slabijim mentalnim zdravljem kako u muškaraca tako i u žena. Viša razina stresa povezana je sa srčanim problemima i višom konzumacijom alkohola u muškaraca, dok je u žena stres povezan s lošijim zdravstvenim stanjem, starijom dobi i nižom edukacijskom razinom.