

# Case Oriented Approach to Co-Occurrence of Risk Lifestyle Behavior with Overweight, Excess Abdominal Fat and High Blood Pressure: The CroHort Study

Ognjen Brborović, Tea Vukušić Rukavina, Hana Fazlić, Silvije Vuletić,  
Josipa Kern and Gordana Pavleković

University of Zagreb, School of Medicine, »Andrija Štampar« School of Public Health, Croatia

## ABSTRACT

*Objective of this paper is to estimate interim risk factors (INTF) proportions and changes within 5-years of groups with at least one risk health behavior (BEHF) in CroHort population. Results show that CroHort 2008 group has higher proportions of excess abdominal fat and overweight. Men older than 65 without any BEHF have smaller proportions of INTF in 2008 than in 2003. Proportion of people with high blood pressure is smaller in 2008 for all groups except for young women who show increase. Analysis of middle age group shows significant increase in all INTF in women smokers while men smokers have the highest increase in abdominal fat. Physical inactivity in women is associated with increase of all INTF, while men have decrease in overweight INTF. Alcohol intake has protective effect on middle aged men, except for increase in waist circumference. Women show constant increase in all INTF with heavy alcohol intake.*

**Key words:** CroHort study, health behavior, lifestyle, co-occurrence, cardiovascular disease, risk factors, overweight, high blood pressure, excess abdominal fat

## Introduction

Although it is just a part of nature/nurture complexity of developing diseases, analysis of risky health behavior is good way to describe trends and prevalence of some chronic diseases within population. Lifestyle behavioral risk factors such as smoking, heavy alcohol intake, unhealthy diet and physical inactivity are connected and are assumed to be prerequisite for outcomes like coronary heart disease, stroke, and diabetes and other<sup>1,2</sup>. Since risky health behaviors are closely connected with risk factors (overweight, excess abdominal fat and high blood pressure) for the same diseases, prevalence of both risk behaviors and interim risk factors are expected to follow patterns that could be eventually tracked down to diseases in population and even individual human<sup>1,2</sup>. CroHort Study gave an excellent opportunity for population analysis of co-occurrence of health behavior and risk factors. This article is follow-up on article that has ana-

lyzed first collection of data from same cohort with a distance of 5-years.

In this article we are following the same methodology of case-oriented approach to analysis with the idea that there are distinct and singular entities of risk health behavior (BEHF) and interim risk factors (INTF) that parallel each other sufficiently to allow comparing and contrasting them<sup>3</sup>. The two most interesting groups for such analysis are those who have interim risk factors for cardiovascular diseases (BMI>25, high blood pressure or excess abdominal fat) with at least one BEHF (BIR group) and without BEHF (NO-BIR group). BEHF analyzed in this paper are: smoking, heavy alcohol, unhealthy diet or physical inactivity. Furthermore, it is possible to track groups that have specific BEHF in combination with each INTF to see whether there are signs or patterns for

development of INTF. In case-oriented approach complete groups are seen as entities thus changes and trends within 5-years are not always the same as on micro-level since groups are not the same (e.g. transition within age groups).

The objective of the paper is to estimate proportions and changes of groups within 5-years with at least one BEHF and without BEHF in CroHort population according to gender and age. Also, our aim is to see if there is specific BEHF that might be related with prevalence of individual INTF.

### Materials and Methods

All data for the analysis were taken from the CroHort2008 survey. Data collection, quality control and representativeness were described elsewhere<sup>4-7</sup>.

#### Definition of variables

For this study we have defined risky health behavior as:

**SMOKER** – Current daily smokers and ex-smokers who used to smoke regularly at least five years and quit less than 10 years ago.

**PHISICALY INACTIVE** – those who met at least three of the following criteria: driving to work, working in white collar occupation, taking less than two 30-minute session of exercise weekly, or having someone advising them on the need for more physical activity.

**EXCESSIVE ALCOHOL CONSUMPTION** – having a binge of heavy drinking at least once a week, or drinking alcohol daily and having someone constantly advising them on the need to cut down on alcohol intake.

**UNHEALTHY DIET** – those who met at least three of the following criteria: regularly eating food preparing with animal fat, regular consumption full-fat (at least 3.2%) milk and milk products, low consumption of fruits, eating smoked meat at least twice a week, and adding salt to food before tasting.

Interim risk factors for cardiovascular disease are described as:

**OVERWEIGHT** – body mass index of 25 or higher.

**EXCESS ABDOMINAL FAT** – waist circumference equal or higher than 102 cm (for men) or 88 cm (for women).

**HIGH BLOOD PRESSURE** – any measured blood pressure that exceeds cutting point of 140/90 mmHg.

#### Statistical analysis

Variables were dichotomized and analyzed according to sex using qualitative comparative analysis approach (QCA). In case-oriented approach given cases were conceived holistically as configuration of conditions. The simplest type of analysis involves binary variables – antecedents (smoking, alcohol intake, unhealthy diet, physical inactivity) and consequents variables (overweight, excess body fat, high blood pressure). In all analysis single BEHF was selected and cases were studied according to

prevalence of INTF and presence of BEHF. Results were tested for compliance to see if they agree on the INTF as outcome variables. QCA was performed by SAS Program (SAS Institute Inc., Cary, NC, USA).

### Results

In the QCA analysis the results are presented as proportions of cases with present INTF within cases analyzed according to certain BEHF. In Table 1 comparison of population was given with at least one BEHF and without BEHF according to presence of INTF, sex and age and results from 2003 and 2008.

**TABLE 1**  
PROPORTIONS OF INTF WITHIN GROUP WITH AT LEAST ONE BEHF AND GROUP WITHOUT BEHF; BY AGE AND SEX

	YES-BIR		NO-BIR		
	CAHS 2003	CroHort 2008	CAHS 2003	CroHort 2008	
Excessive Abdominal Fat	18–34 yrs				
	Men	22.0	28.6	9.5	20.8
	Women	20.1	50.7	22.5	41.2
	35–64 yrs				
	Men	42.8	50.5	45.8	46.1
	Women	57.3	64.6	60.6	67.4
	65 and over				
	Men	55.4	52.2	49.7	41.4
	Women	80.0	80.2	78.3	81.8
Overweight	18–34 yrs				
	Men	12.0	19.4	7.1	11.5
	Women	8.3	31.5	8.7	15.1
	35–64 yrs				
	Men	25.2	28.7	28.9	29.1
	Women	25.2	37.1	28.2	34.7
	65 and over				
	Men	23.9	33.7	23.1	16.8
	Women	34.7	34.3	28.1	30.3
High Blood Pressure	18–34 yrs				
	Men	22.0	20.0	16.7	11.1
	Women	7.6	19.2	5.8	12.5
	35–64 yrs				
	Men	49.2	49.9	48.4	43.0
	Women	38.3	40.9	40.4	37.6
	65 and over				
	Men	64.2	57.0	69.4	63.7
	Women	67.4	59.2	65.4	56.5

INTF – interim risk factors, BEHF – risk health behavior, YES-BIR – at least one BEHF, NO-BIR – without BEHF

As expected both NO-BIR and BIR groups of cases show higher proportions of INTF in older age groups. The increase by age varies depend on year of data collection. In 2003 range between young (18–34 years) and old (65 and more years) group was twofold (overweight) to six fold (high blood pressure) in proportions while in 2008 range was more modest from twofold (overweight) to fourfold (excessive abdominal fat). Interesting finding is that CroHort 2008 group has higher (somewhere significantly) proportions of excess abdominal fat and overweight especially between younger population. Mentioned dynamics could be seen in Figure 1, 2, and 3 depicting proportion change in time calculated as.

$$\Delta = \frac{\text{proportion2008} - \text{proportion2003}}{\text{proportion2003}}$$

It is easily to see that the most dramatic change occurred in the youngest group while with the age changes tend to became smaller. Also, No-BIR group of men older

than 65 years tend to reverse trends and have smaller proportions of INTF in 2008 than in 2003. Peculiar pattern could be seen in Figure 3 where proportion of people with high blood pressure is smaller in 2008 than in 2003 for all groups except for young women who show intense increase in proportion.

The cases with solitary BEHF and developed INTF are presented in Figures 4–7. Figures are drawn from tables with proportions of INTF only for middle age group (35–64) since that is the age when most of INTF are expected to emerge as consequences of health behavior, environment, and genes<sup>8–10</sup>. Changes were presented same way as in Figures 1–3 with exception that proportions were calculated only within population with certain behavior. In Figure 4 it is possible to see significant increase in all INTF (especially for BMI>25) for women smoker while men smoker have highest increase in abdominal fat. In many studies physical inactivity is associated with increase of all INTF. Our results show that it is true only for women of middle age (35–64), while man have modest in-

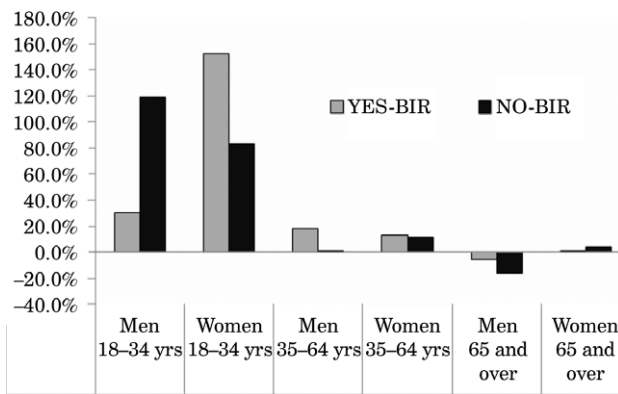


Fig. 1. 5-years change of proportion of groups with excess abdominal fat; by BIR, sex and age, YES-BIR – at least one risk health behavior, NO-BIR – without risk health behavior.

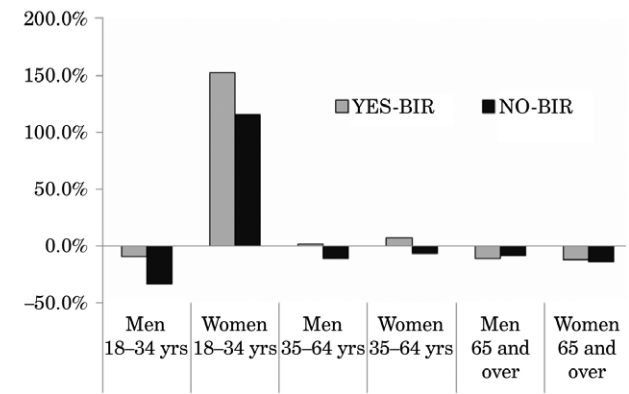


Fig. 3. 5-years change of proportion of groups with high blood pressure; by BIR, sex and age, YES-BIR – at least one risk health behavior, NO-BIR – without risk health behavior.

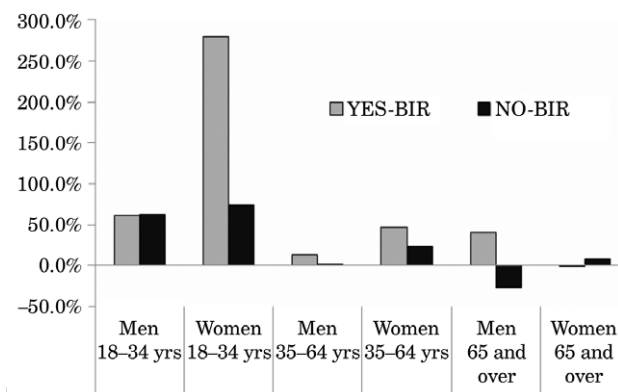


Fig. 2. 5-years change of proportion of groups with BMI>25; by BIR, sex and age, YES-BIR – at least one risk health behavior, NO-BIR – without risk health behavior.

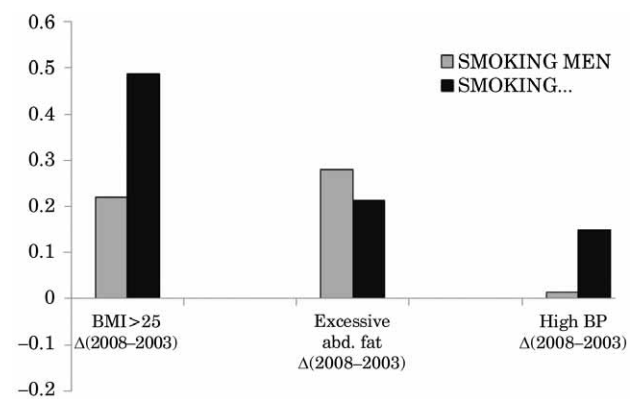


Fig. 4. Change of proportion of interim risk factors in 5-year cohort in middle age group of smokers; by sex.

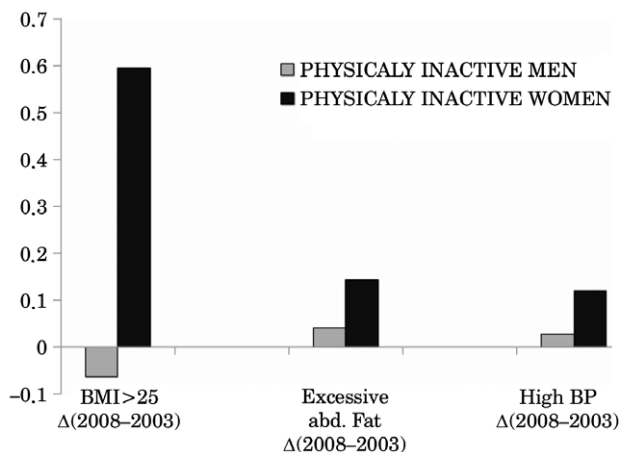


Fig. 5. Change of proportion of interim risk factors in 5-year cohort in middle age group of physical inactives; by sex.

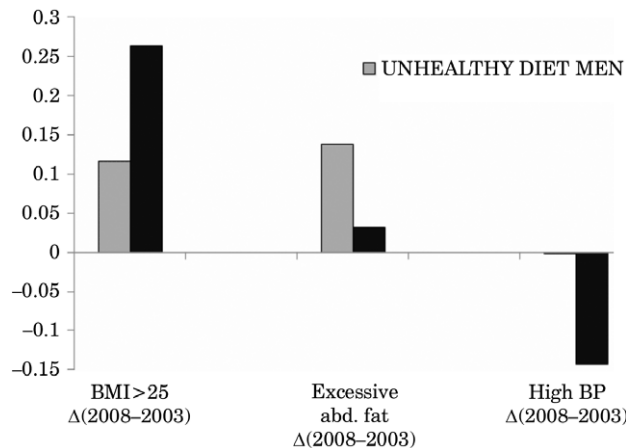


Fig. 7. Change of proportion of interim risk factors in 5-year cohort in middle age group with unhealthy diet; by sex.

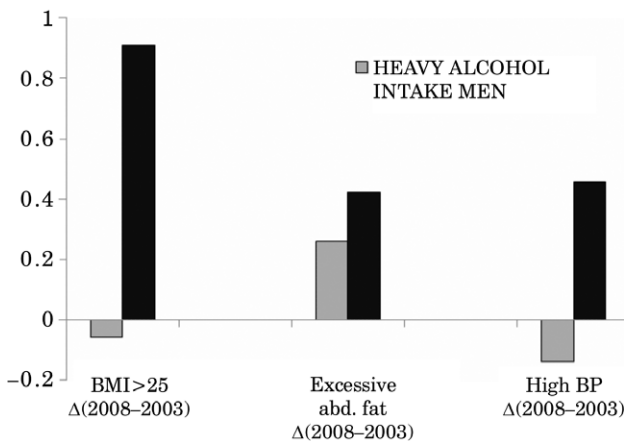


Fig. 6. Change of proportion of interim risk factors in 5-year cohort in middle age group with heavy alcohol intake; by sex.

crease or even unexpected decrease in case of overweight INTF (Figure 5). In Figure 6 we could see that alcohol intake seems to have protective effect on man of middle age except for increase in waist circumference. On the other hand women show constant increase in all INTF when cases with heavy alcohol intake are analyzed. The most »irregular picture« without clear pattern could be seen in Figure 7 where cases with unhealthy diet were analyzed. Both overweight and waist circumference increase are connected with unhealthy diet but with gender differences while it seems that unhealthy diet is connected with decrease in blood pressure in women.

### Discussion and Conclusion

It is true that interim risk factors may occur even though there is no risky health behavior. Anyhow and with precaution, the causality between BEHF and INTF

could be interpreted if and where we find clear patterns developed through time<sup>1,2,9,11-15</sup>. The major weakness of previous article on co-occurrence was that causality could not be estimated since CAHS2003 was cross-sectional study<sup>6</sup>. With the follow-up after 5-years we were given opportunity to examine if there is and what is direction of influence of certain BEHF on development of INTF. This should be taken with precaution because some weaknesses of the study still remain.

Two groups of cases were identified in the studied population, NO-BIR and BIR group of cases. In general, expected increase of INTF related with BIR could not be seen except in population of young women where there is clear pattern showing that BIR is connected with higher increase in proportion of INTF during 5-years. Also, it seems like increase in proportions of people with BMI > 25 is related with BIR. As opposite of described pattern, we could recognize decrease in proportions of groups with high blood pressure regardless of BIR (except for young women) as seen in Figure 3. Regardless of BIR, all major shifts in proportions of groups with INTF happened in young population while in oldest population there seems to be stagnation or even small decrease in proportion of INTF. There are some obstacles for that kind of conclusion and one might be that the young group (18-34 years) lost those youngest within themselves (old 18-23 years) since they were not replaced with new surveyed within 5-year cohort. Anyhow, we might find plausible that notion of targeting younger people with preventive interventions is more effective is here confirmed since major shift in proportion of INTF happened in young population.

Although major transition of proportion happened in young population we believed that examination of middle population might give more information on causality and direction of influence of BEHF. Middle age population is most stable, with moderate mortality and »old enough« for INTF to emerge as consequences of health behavior,

environment, and genes. Although changes in proportion of INTF are more moderate than in younger population it is clearly visible that all BEHF are connected with increase in waist circumference for both genders (Figures 4–7). Also, unhealthy diet is connected with increase in proportion of overweight and excess abdominal fat in both genders. Other BEHF's influences are gender specific. Smoking, heavy alcohol consumption and physical inactivity increases significantly all INTF in women while unhealthy diet decreases proportion of high blood pressure. This might be partly due to the fact that *unhealthy diet* is both hard to precisely determine and even harder to measure in population. In middle aged men, physical inactivity seems to have not so prominent influence while smoking and unhealthy diet tend to significantly increase proportion of overweight group and

group with excess abdominal fat. Alcohol in men seems to have protective effect on blood pressure. Altogether, we should say that BEHF influence on INTF is more prominent in women of middle age than in men.

Both groups of cases (INTF and BEHF) pose a real public health problem for intervention because of ominously high frequency in population.

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### REFERENCES

1. CHEN HJ, BAI CH, YEH WT, CHIU HC, PAN WH, Stroke, 37 (2006).
2. PEASEY A, BOBAK M, KUBINOVA R, MALYUTINA S, PAJAK A, TAMOSIUNAS A, PIKHART H, NICHOLSON A, MARMOT M, BMC Public Health, 6 (2006).
3. RAGIN CC, Introduction to Qualitative Comparative Analysis. In: Sarantakos S, ed. Data Analysis vol 2 (SAGE Publications, Los Angeles, 2007).
4. ANA IVIČEVIĆ UHERNIK SV, JOSIPA KERN, VLASTA DEČKOVIĆ-VUKRES, SANDRA MIHEL, MARIJAN ERCEG, IVAN PRISTAŠ, Coll Antropol, 36 Suppl 1 (2012).
5. BECUE-BERTAUT M, KERN J, HERNANDEZ-MALDONADO ML, JURESA V, VULETIC S, Public Health, 122 (2008).
6. VULETIC S, KERN J, BRBOROVIC O, VUKUSIC T, Coll Antropol, 33 Suppl 1 (2009).
7. VULETIC S, POLASEK O, KERN J, STRNAD M, BAKLAIC Z, Coll Antropol, 33 Suppl 1(2009).
8. BOYLAN S, WELCH A, PIKHART H, MALYUTINA S, PAJAK A, KUBINOVA R, BRAGINA O, SIMONOVA G, STEPANIAK U, GILIS-JANUSZEWSKA A, MILLA L, PEASEY A, MARMOT M, BOBAK M, BMC Public Health, 9 (2009).
9. DUGRAVOT A, SABIA S, STRINGHINI S, KIVIMAKI M, WESTERLUND H, VAHTERA J, GUEGUEN A, ZINS M, GOLDBERG M, NABI H, SINGH-MANOUX A, Am J Clin Nutr, 92 (2010).
10. NABI H, KIVIMAKI M, SABIA S, DUGRAVOT A, LAJNEF M, MARMOT MG, SINGH-MANOUX A, Am J Epidemiol, 169 (2009).
11. CAVELAARS AE, KUNST AE, GEURTS JJ, CRIALESI R, GROTVEDT L, HELMERT U, LAHELMA E, LUNDBERG O, MATHESSON J, MIELCK A, RASMUSSEN NK, REGIDOR E, DO ROSARIO-GIRALDES M, SPUHLER T, MACKENBACH JP, BMJ, 320 (2000).
12. SCHUIT AJ, VAN LOON AJ, TIJHUIS M, OCKE M, Prev Med, 35 (2002).
13. SINGH-MANOUX A, NABI H, SHIPLEY M, GUEGUEN A, SABIA S, DUGRAVOT A, MARMOT M, KIVIMAKI M, Epidemiology, 19 (2008).
14. STRINGHINI S, SABIA S, SHIPLEY M, BRUNNER E, NABI H, KIVIMAKI M, SINGH-MANOUX A, JAMA, 303 (2010).
15. SWINBURN B, EGGER G, BMJ, 329 (2004).

O. Brborović

University of Zagreb, School of Medicine, »Andrija Štampar« School of Public Health, Rockefellerova 4,  
10 000 Zagreb, Croatia  
e-mail: obrborov@snz.hr

### ZAJEDNIČKA POJAVNOST RIZIČNOG ZDRAVSTVENOG PONAŠANJA IPREKOMJERNE TJELESNE TEŽINE, ABDOMINALNE DEBLJINE I VISOKOG KRVNOG TLAKA: CROHORT 2008 – STUDIJA SLUČAJEVA

### SAŽETAK

Cilj rada je procijeniti razmjere čimbenike rizika (INTF) i promjene u petogodišnjem periodu u skupinama s najmanje jednim rizičnim zdravstvenim ponašanjem BEHF, u populaciji obuhvaćenoj CroHort studijom. Rezultati pokazuju da ispitanici u 2008. imaju veću proporciju viška trbušne masti i povećane tjelesne težine, posebno između mlađim stanovnicima. Skupina muškaraca starijih od 65 godina bez BEHF imaju tendenciju manje proporcije INTF u 2008. nego u 2003. Udio osoba s povišenim krvnim tlakom manji je u 2008. za sve grupe osim za mlade žene koje pokazuju povećanje. Analiza skupine srednje dobi pokazuje značajan porast u svim INTF za žene pušače, dok muškarci pušači pokazuju najveći porast abdominalne masti. Fizička neaktivnost u žena povezana je s porastom svih INTF, dok muškarci imaju smanjenje u slučaju prekomjerne težine INTF. Konzumacija alkohola ima zaštitni učinak na muškarce srednje dobi, osim u slučaju povećanja opsega struka. Žene koje pretjerano konzumiraju alkohol pokazuju konstantan rast svih INTF.