Clustering of risk behaviors with cigarette consumption: A population-based survey

Arnaud Chiolero *, Vincent Wietlisbach †, Christiane Ruffieux, Fred Paccaud, Jacques Cornuz

Prevention Unit, University Institute of Social and Preventive Medicine, 17, rue du Bugnon, 1005 Lausanne, Switzerland

Abstract

Objective. This study assessed clustering of multiple risk behaviors (i.e., low leisure-time physical activity, low fruits/vegetables intake, and high alcohol consumption) with level of cigarette consumption.

Methods. Data from the 2002 Swiss Health Survey, a population-based cross-sectional telephone survey assessing health and self-reported risk behaviors, were used. 18,005 subjects (8052 men and 9953 women) aged 25 years old or more participated.

Results. Smokers more frequently had low leisure time physical activity, low fruits/vegetables intake, and high alcohol consumption than non- and ex-smokers. Frequency of each risk behavior increased steadily with cigarette consumption. Clustering of risk behaviors increased with cigarette consumption in both men and women. For men, the odds ratios of multiple (≥ 2) risk behaviors other than smoking, adjusted for age, nationality, and educational level, were 1.14 (95% confidence interval: 0.97, 1.33) for ex-smokers, 1.24 (0.93, 1.64) for light smokers (1–9 cigarettes/day), 1.72 (1.36, 2.17) for moderate smokers (10–19 cigarettes/day), and 3.07 (2.59, 3.64) for heavy smokers (≥ 20 cigarettes/day) versus non-smokers. Similar odds ratios were found for women for corresponding groups, i.e., 1.01 (0.86, 1.19), 1.26 (1.00, 1.58), 1.62 (1.33, 1.98), and 2.75 (2.30, 3.29).

Conclusions. Counseling and intervention with smokers should take into account the strong clustering of risk behaviors with level of cigarette consumption.

© 2006 Elsevier Inc. All rights reserved.

Keywords: Smoking; Clustering; Risk behavior

Introduction

Modifiable risk behaviors are the leading cause of death in developed countries (Mokdad et al., 2004). Smoking, poor diet, and some other behavioral risk factors increase the risk of cardiovascular disease and various cancers independently and at different rates (Willet et al., 1999; Doll et al., 2004). Moreover, some changes in behavior, such as increasing physical activity or quitting smoking, are independently associated with lower rates of death from all causes and from coronary heart disease (Paffenbarger et al., 1993).

Risk behaviors are interrelated (Serdula et al., 1996; Laaksonen et al., 2002; Orleans, 2004). Clustering of risk behaviors in the same individual may have multiplicative effects on disease risk (Johansson and Sundquist, 1999; Berrigan et al.,

2003). It was recently shown that daily intake of fruits/vegetables and regular physical activity could reduce by 40% the risk of myocardial infarction; if smoking was also avoided, risk was reduced by more than three-quarters (Yusuf et al., 2004). This shows the high risk associated with the clustering of multiple risk behaviors.

Previous studies have found paired associations between smoking and other risk behaviors (Thornton et al., 1994). Smokers tend to eat fewer fruits and vegetables (Serdula et al., 1996), to adopt unhealthy patterns of nutrient intake (Thompson et al., 1992; Dallongeville et al., 1998), to drink more alcohol (Bien and Burge, 1990), and to get less physical activity than non-smokers (Kvaavik et al., 2004).

Few recent population-based data on the clustering of more than two risk behaviors are available (Laaksonen et al., 2001; Schuit et al., 2002; Fine et al., 2004). Furthermore, most studies that looked at the association of smoking with other risk behaviors have not taken into account the number of cigarettes smoked daily. This is an important issue because

* Corresponding author. Fax: +41 21 314 73 73.
  E-mail address: arnaud.chiolero@chuv.ch (A. Chiolero).
† Deceased.

health risk increases sharply with daily cigarette consumption (Doll et al., 2004). Whether the degree of clustering of risk behaviors changes with daily cigarette consumption merits study.

Using a large representative sample of a general adult population, our objective was to analyze clustering of major risk behaviors (i.e., low leisure time physical activity, low fruits/vegetables intake, and high alcohol consumption) with smoking, taking into account the number of cigarettes smoked daily.

Methods

Study population and design

The Swiss Health Survey is a cross-sectional, nationwide, population-based telephone survey conducted every 5 years since 1992 by the Federal Statistical Office of Switzerland to track public-health trends (Rehm and Spuhler, 1993; Eichholzer and Bisig, 2000). It consists of questions on health status and health behaviors, asked of a representative sample of adults and adolescents (aged 15 years or more) living in Switzerland.

The study population was chosen by stratified random sampling of a database of all private Swiss households with telephones in 2002. The entire sample (30,824 households) received a letter inviting one household member to participate in the survey. Sample households were contacted thereafter by phone. The survey was completed by 19,706 subjects (8909 men and 10,797 women, participation rate 63.9%). Interviewers used computer-assisted telephone interview (CATI) software to manage dialing and data collection (Niemann, 2003). Each interview took about 40 min.

Definition of variables

For the present study, only data on subjects aged 25 years or more were analyzed. Three age categories were considered, namely, 25–44 years, 45–64 years, and 65 years and above. Nationality was categorized as either Swiss or foreign. Education was categorized as follows (OECD, 1990; Cavelaars et al., 2000): (1) no education completed, (2) first level (primary school), (3) lower secondary level, (4) upper secondary level, and (5) tertiary level, which included university and other forms of education after the secondary level. We defined "low education" (categories 1 and 2), "middle education" (categories 3 and 4), and "high education" (category 5) groups.

Subjects were categorized as "non-smokers" if they did not smoke currently and had never smoked regularly for more than 6 months. Subjects were categorized as "ex-smokers" if they had ever smoked regularly for 6 months or more but did not smoke any more. Subjects who smoked cigarettes were divided in three predefined categories according to daily consumption: "light smoker" (1–9 cigarettes/day), "moderate smoker" (10–19 cigarettes/day), and "heavy smoker" (20 or more cigarettes/day). Subjects smoking only cigars, pipes, or cigarillos were categorized as "other smokers." Smokers who smoked less than 1 cigarette/day ($N = 353$, 2.0% of subjects aged 25 years or more) were not considered in the analysis.

Subjects were asked about what physical activity they performed regularly during leisure time. Low leisure time physical activity was defined as the absence of any physical activity during leisure time that caused the subject to sweat. Self-reported leisure time physical activity has been shown to be inversely related to risk of mortality, cardiovascular disease, and some cancers (US Department of Health and Human Services, 1996).

Intake of fruits, fruit juice, and vegetables was assessed as part of a brief food questionnaire (Eichholzer and Bisig, 2000). Low fruits/vegetables intake was defined as either not taking fruits (or fruit juice) every day or not taking vegetables (including lettuce, not including potatoes) every day.

Alcohol use was assessed by beverage-specific, quantity/frequency questionnaire items; grams of alcohol drunk daily estimates were calculated (Gmel, 2000). High alcohol consumption was defined as >20 g of alcohol per day in women and >40 g of alcohol per day for men. These cut-offs are frequently used to define alcohol consumption having measurable health and social-cost consequences (Rehm and Spuhler, 1993; Saunders et al., 1993).

Statistical analysis

We computed the proportions of subjects having 0, 1, 2, 3, or 4 of the risk behaviors (smoking, low leisure time physical activity, low fruits/vegetables intake, and high alcohol consumption) and estimated the frequency of each risk behavior (other than smoking) by smoking categories stratified by sex and age. We also computed the proportion of each category of smokers to four degrees of clustering of other risk behaviors (0, 1, 2, or 3 other risk behaviors). Logistic models (Kleinbaum and Klein, 2002) were fitted to assess the association of smoking categories with the clustering of 2 or 3 other risk behaviors vs. 0 or 1 such behaviors. The models were fitted independently for men and women. Both models included smoking category as an independent variable and were adjusted for age, educational level, and nationality. Hosmer–Lemeshow tests were performed to assess the goodness-of-fit of our models (Hosmer and Lemeshow, 2000). Analyses were performed with SPPS 12.0 software.

Results

Characteristics of subjects are shown in Table 1. A higher proportion of men than women were smokers, and a higher proportion of male smokers were heavy smokers (≥ 20 cigarettes/day). A lower proportion of older subjects were heavy smokers. Smoking habits by educational level varied with age in some age ranges: above 64 years, smoking was more frequent among highly educated persons, while no difference

Table 1

Percentage of men ($N = 8052$) and women ($N = 9953$) by demographic characteristics, smoking habits, and other risk behaviors

Characteristics	Men		Women	
	N	%	*N*	%
Age (years)				
25–44	3420	42.5	3804	38.2
45–64	2858	35.5	3561	35.8
≥65	1774	22.0	2588	26.0
Nationality				
Swiss	6978	86.7	8838	88.8
Foreign	1074	13.3	1115	11.2
Educational level [a]				
High	2152	26.8	1004	10.1
Middle	4937	61.4	6508	65.5
Low	953	11.9	2427	24.4
Smoking habits				
Non-smokers	3005	38.8	5621	58.2
Ex-smokers	2255	29.1	1786	18.5
Cigarette smokers	1878	24.2	2226	23.0
Light (1–9 cigarettes/day)	384	5.0	662	6.9
Moderate (10–19 cigarettes/day)	504	6.5	755	7.8
Heavy (≥20 cigarettes/day)	990	12.8	809	8.4
Other smokers [b]	607	7.8	30	0.3
Low leisure time physical activity	2665	35.8	4314	44.9
Low fruits/vegetables intake	3320	42.1	2385	24.2
High alcohol consumption	655	8.2	504	5.1

Swiss Health Survey 2002.

[a] Educational level: low = no education completed or first level (primary school); middle = lower secondary level and upper secondary level; high = tertiary level, including university and other forms of education after the secondary level.

[b] Smokers of cigars, pipes, or cigarillos defined as "other smokers."
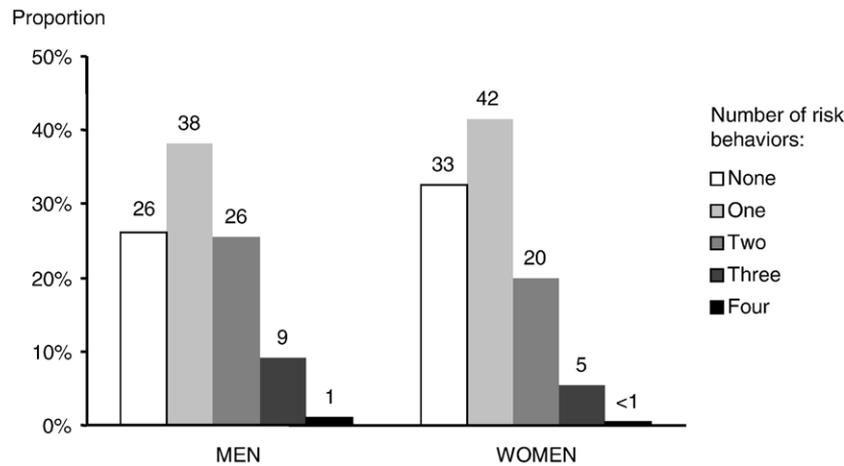
Fig. 1. Proportion of men and women with 0 to 4 risk behaviors (i.e., smoking, low leisure time physical activity, low fruits/vegetables intake, and high alcohol consumption). Swiss Health Survey 2002.

between education levels was observed at 45–64 years, and smoking was less frequent among highly educated persons below 45 years (data not shown). Men were more frequently physically active during leisure time than women, but they less frequently ate fruits or vegetables and more frequently had high consumption of alcohol.

Clustering of two or more risk behaviors occurred with one man out of three and one woman out of four (Fig. 1). Clustering of all four risk behaviors occurred with only a few people: 80 men (1.1%) and 38 women (0.4%).

For both sexes, all risk behaviors except high alcohol consumption were equally frequent in non-smokers and ex-smokers (Table 2); high alcohol consumption was more frequent in ex-smokers. In youngest light smokers, risk behaviors were as frequent as in young non- or ex-smokers; in older light smokers, risk behaviors tended to be more frequent compared to non- or ex-smokers. Among smokers, in all age strata, all risk behaviors were more frequent with

increasing daily cigarette consumption. In the oldest age stratum, a dose-dependent relationship was not always observed; however, heavy smokers were always involved more frequently in other risk behaviors than light smokers. Other smokers (cigar, pipe, or cigarillo smokers) had similar risk behaviors frequency as moderate smokers.

The distribution of categories of cigarette smokers varied with number of other risk behaviors (Fig. 2). Among subjects with no other risk behaviors, the proportion of each category of smoker was similar in men; a higher proportion of light and moderate smokers was observed in women. With accumulation of risk behaviors, a progressive shift in the distribution toward heavy smokers was observed in both men and women. Thus, about two thirds of smokers accumulating three other risk behaviors smoked 20 cigarettes or more daily.

Clustering of two or more risk behaviors other than smoking was associated with older age in men and women, lower educational level (significantly in men, not in women), and

Table 2
Percentage of men and women with each risk behavior (low leisure time physical activity, low fruits/vegetables intake, high alcohol consumption) according to smoking habits, stratified for sex and age categories

|	Age (year)	Men (%)			Women (%)		
		25–44	45–64	≥65	25–44	45–64	≥65
Low leisure time physical activity	Non-smokers	23.8	33.3	46.7	33.8	39.5	64.2
	Ex-smokers	26.1	33.6	44.8	33.9	36.0	60.5
	1–9 cigarettes/day	21.6	40.5	63.8	31.8	38.1	65.1
	10–19 cigarettes/day	33.9	41.5	51.9	40.1	49.6	67.7
	≥20 cigarettes/day	46.3	52.0	66.7	51.5	57.9	68.8
Low fruits/vegetables intake	Non-smokers	47.8	35.8	28.5	28.7	18.9	18.6
	Ex-smokers	44.4	35.8	31.1	25.7	19.0	17.0
	1–9 cigarettes/day	47.9	41.0	37.5	29.9	24.2	18.8
	10–19 cigarettes/day	55.5	44.6	36.5	26.8	28.7	28.1
	≥20 cigarettes/day	64.6	53.0	50.8	45.2	35.7	23.8
High alcohol consumption	Non-smokers	4.0	5.6	7.1	2.5	4.8	4.6
	Ex-smokers	7.8	9.4	8.5	2.6	7.3	7.1
	1–9 cigarettes/day	2.8	13.1	16.7	2.8	6.3	4.7
	10–19 cigarettes/day	9.1	11.2	11.1	4.5	8.6	12.5
	≥20 cigarettes/day	12.3	16.3	25.8	10.1	10.7	12.5

Swiss Health Survey 2002.
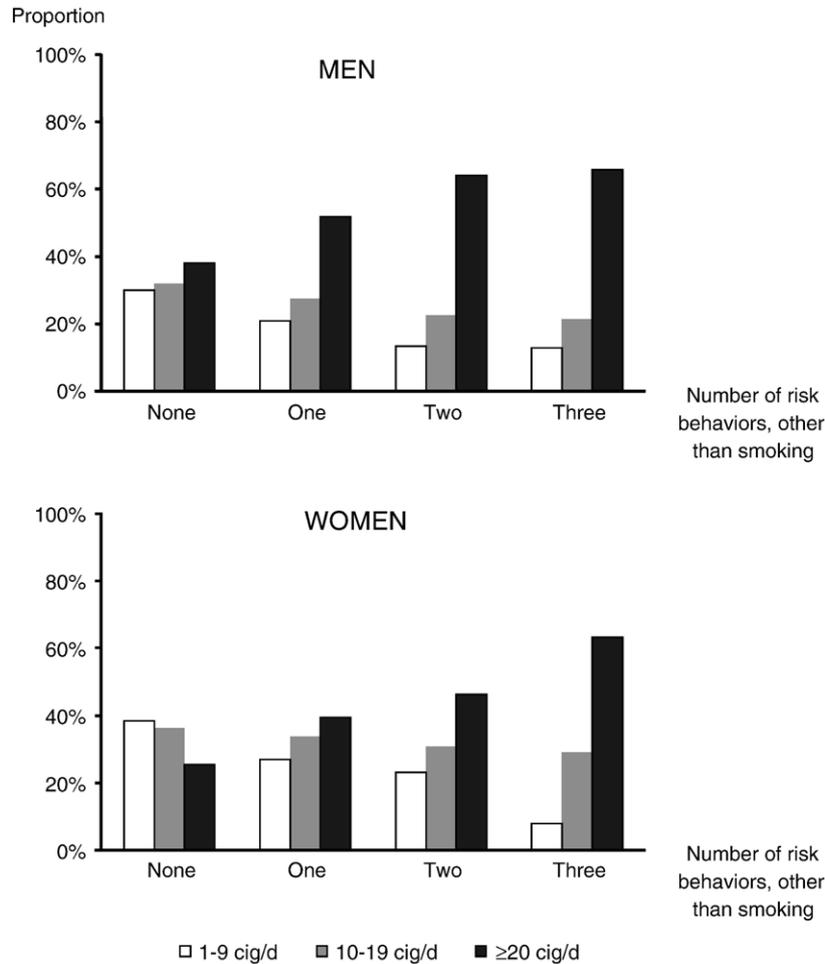
Fig. 2. Proportion of smokers (men, *N* = 1805; women, *N* = 2177) who are light (1–9 cigarettes/day), moderate (10–19 cigarettes/day), or heavy smokers (≥20 cigarettes/day), sorted according to accumulation of 0, 1, 2, or 3 risk behaviors other than smoking (i.e., low leisure time physical activity, low fruits/vegetables intake, and high alcohol consumption). Swiss Health Survey 2002.

foreign nationality in women (Table 3). Clustering was strongly associated with smoking habits. Non- and ex-smokers had equal odds of accumulating risk behaviors, whereas the odds increased steadily with smoking intensity: light smokers had slightly higher odds than non- and ex-smokers of cumulating risk behaviors (non-significantly in men), but lower odds than moderate and heavy smokers. Heavy smokers had the highest odds of accumulating risk behaviors. In short, degree of clustering increased with number of cigarettes smoked daily in both sexes.

Discussion

This study finds that clustering of risk behaviors is frequent, and more frequent in men than in women. Adoption of risk behaviors was associated with smoking. Heavy smokers more frequently adopted other risk behaviors than did light or moderate smokers, whereas light smokers tended to have about the same number of risk behaviors as non- or ex-smokers. Finally, clustering of multiple risk behaviors increased strongly and steadily with daily cigarette consumption in both men and women.

One strength of this study is that a comprehensive panel of major risk behaviors was captured for a large representative sample of a general adult population. This allowed us to analyze risk behaviors according to various categories of smoking habit and by sex and age strata. Moreover, major potential confounding factors could be taken into account, especially educational level. The present study also has some limitations. A short questionnaire was used to evaluate diet and physical activity; misclassification for these risk behaviors is possible (Eichholzer and Bisig, 2000). Similarly, alcohol consumption might have been underreported (Rehm and Spuhler, 1993). However, the misclassification is likely to be non-differential and would tend to dilute the association with smoking habits.

Because of the cross-sectional design of this study, it cannot be inferred that smoking is the "cause" of adopting other risky behaviors. However, the consistency of the association with risk behaviors, independently of age, educational level, and nationality, as well as the dose-dependent relationship of the cigarettes smoked daily with clustering of risk behaviors, strongly suggests that smoking might be a cornerstone for the accumulation of unhealthy behaviors (Laaksonen et al., 2001; Paavola et al., 2004).

Table 3
Association (odds ratio, OR) with 95% confidence interval (CI) of smoking habits, age, educational level and nationality with clustering of 2 or 3 risk behaviors (low leisure time physical activity, low fruits/vegetables intake, and high alcohol consumption) vs. zero or one risk behaviors, in men and in women

	Men			Women		
	0/1 risk behavior	2/3 risk behaviors	OR (95% CI)	0/1 risk behavior	2/3 risk behaviors	OR (95% CI)
	N	N		N	N	
Smoking habits						
Non smokers	2287	437	1.00	4627	732	1.00
Ex-smokers	1669	389	1.14 (0.97, 1.33)	1489	227	1.01 (0.86, 1.19)
1–9 cigarettes/day	306	71	1.24 (0.93, 1.64)	551	103	1.26 (1.00, 1.58)
10–19 cigarettes/day	369	120	1.72 (1.36, 2.17)	595	144	1.62 (1.33, 1.98)
≥20 cigarettes/day	595	344	3.07 (2.59, 3.64)	560	224	2.75 (2.30, 3.29)
Age (year)						
25–44	2530	607	1.00	3085	557	1.00
45–64	2045	546	1.15 (1.00, 1.33)	2932	484	0.94 (0.82, 1.08)
≥65	1194	350	1.37 (1.16, 1.63)	2024	422	1.29 (1.10, 1.50)
Educational level [a]						
High	1675	339	1.00	830	143	1.00
Middle	3573	923	1.18 (1.02, 1.37)	5412	889	0.92 (0.75, 1.12)
Low	518	239	2.14 (1.73, 2.65)	1794	429	1.22 (0.98, 1.52)
Nationality						
Swiss	5054	1296	1.00	7257	1260	1.00
Foreign	715	207	0.93 (0.77, 1.12)	784	203	1.47 (1.24, 1.75)

Result of a multiple logistic regression analysis. Swiss Health Survey 2002.

[a] Educational level: low = no education completed or first level (primary school); middle = lower secondary level and upper secondary level; high = tertiary level, including university and other forms of education after the secondary level.

Our study extends results from a study of Finish adult population using similar definitions for each risk behavior (Laaksonen et al., 2001), though differences in definitions of the behaviors limit the comparison. Laaksonen et al. found that smoking had the strongest and most consistent association with other unhealthy behaviors, but the number of cigarettes smoked daily was not considered. In the population studied by Laaksonen et al., the association of lower education level with clustering of multiple risk behaviors was also found to be stronger in men than in women (Laaksonen et al., 2003).

We found that ex-smokers behaved similarly to non-smokers or light smokers. In a study of middle-aged Danes (Osler et al., 2002), intake of healthy foods among ex-smokers was associated with time since cessation: long-term ex-smokers had the same behaviors as non-smokers, whereas those who had recently quit had the same behaviors as light or moderate smokers. In a Swiss urban population, Morabia et al. (1999) showed similarly that, with longer duration of smoking cessation, consumption of total carbohydrates and complex carbohydrates increased and consumption of alcohol decreased. With other studies (Thornton et al., 1994, Laaksonen et al., 2002), this may suggest that smoking cessation is associated with positive change in other health risk behaviors.

We analyzed clustering of risk behaviors (Berrigan et al., 2003) with smoking level without considering specific *patterns* of risk behaviors. Association with specific patterns of risk behaviors is complex since pairwise association could not predict association between more than two risk behaviors (Laaksonen et al., 2001). Analyzing association of smoking level with specific patterns of risk behaviors would merit another report.

In recent years, clinical and community level guidelines have recommended to tackle patients about major risk behaviors one at a time (Orleans, 2004). The strength of the clinician–patient relationship is key element to the success of interventions with risk behaviors (Goldstein et al., 2004). In primary practice, some evidence exists for the efficacy of single risk behavior interventions for smoking, risky drinking, and unhealthy diet, whereas the evidence is poor for the efficacy of intervention for physical activity (Pronk et al., 2004). Multiple risk behaviors intervention in the secondary prevention setting (e.g., with cardiovascular disease) has been shown to be efficient (Pronk et al., 2004). A recent systematic review by Goldstein et al. (2004) suggests that there are opportunities for primary-care clinicians to provide health behavior counseling over long periods of time, allowing them to address multiple risk behaviors. Such a strategy is challenging and should combine repeated consultations, waiting-room reminders, and telephone supports, involving collaboration between physicians, nurses, and receptionists.

Screening of multiple risk behaviors might be encouraged. Our findings suggest that taking daily cigarette consumption into account could be an efficient way to identify subjects with multiple risk behaviors. Evaluations of interventions addressing clustered risk behaviors are needed.

Acknowledgment

References

Berrigan, D., Dodd, K., Troiano, R.P., Krebs-Smith, S.M., Barbash, R.B., 2003. Patterns of health behavior in U.S. adults. Prev. Med. 36, 615–623.

Bien, T.H., Burge, R., 1990. Smoking and drinking: a review of the literature. Int. J. Addict. 25, 1429–1454.

Cavelaars, A.E., Kunst, A.E., Geurts, J.J., Crialesi, R., Grotvedt, L., Helmert, U., et al., 2000. Educational differences in smoking: international comparison. BMJ 320, 1102–1107.

Dallongeville, J., Marecaux, N., Fruchart, J.C., Amouyel, P., 1998. Cigarette smoking is associated with unhealthy patterns of nutrient intake: a meta-analysis. J. Nutr. 128, 1450–1457.

Doll, R., Peto, R., Boreham, J., Sutherland, I., 2004. Mortality in relation to smoking: 50 years' observations on male British doctors. BMJ 328, 1519.

Eichholzer, M., Bisig, B., 2000. Daily consumption for (red) meat or meat products in Switzerland: results of the 1992/93 Swiss health Survey. Eur. J. Clin. Nutr. 54, 136–142.

Fine, L.J., Philogene, G.S., Gramling, R., Coups, E.J., Sinha, S., 2004. Prevalence of multiple chronic disease risk factors. 2001 National Health Interview Survey. Am. J. Prev. Med. 27 (Suppl. 2), 18–24.

Gmel, G., 2000. The effect of mode of data collection and of non-response on reported alcohol consumption: a split-sample study in Switzerland. Addiction 95, 123–134.

Goldstein, M.G., Whitlock, E.P., DePue, J., 2004. Multiple behavioral risk factor interventions in primary care. Am. J. Prev. Med. 27 (2), 61–79.

Hosmer, D.W., Lemeshow, S., 2000. Applied Logistic Regression, 2nd ed. Chichester, New York.

Johansson, S.E., Sundquist, J., 1999. Change in lifestyle factors and their influence on health status and all-cause mortality. Int. J. Epidemiol. 28, 1073–1080.

Kleinbaum, D.G., Klein, M., 2002. Logistic regression. A self-learning text, 2nd ed. Springer Verlag, New York.

Kvaavik, E., Meyer, H.E., Tverdal, A., 2004. Food habits, physical activity and body mass index in relation to smoking status in 40–42 year old Norwegian women and men. Prev. Med. 38, 1–5.

Laaksonen, M., Prättälä, R., Karisto, A., 2001. Patterns of unhealthy behaviour in Finland. Eur. J. Public Health 11, 294–300.

Laaksonen, M., Luoto, R., Helakorpi, S., Uutela, A., 2002. Associations between health-related behaviors: a 7-year follow-up of adults. Prev. Med. 34, 162–170.

Laaksonen, M., Prattala, R., Lahelma, E., 2003. Sociodemographic determinants of multiple unhealthy behaviours. Scand. J. Public Health 31, 37–43.

Mokdad, A.H., Marks, J.S., Stroup, D.F., Gerberding, J.L., 2004. Actual causes of death in the United States, 2000. JAMA 291, 1238–1245.

Morabia, A., Curtin, F., Bernstein, M.S., 1999. Effects of smoking and smoking cessation on dietary habits of a Swiss urban population. Eur. J. Clin. Nutr. 53, 239–243.

Niemann, S., 2003. Using CATI in survey research by telephone. Soz.-Praventivmed. 48 (5), 327–328.

Organization for Economic Co-operation and Development, 1990. Education in OECD countries 1987–89. A Compendium of Statistical Information. OECD, Paris.

Orleans, C.T., 2004. Addressing multiple behavioral health risks in primary care; broadening the focus of health behavior change research and practice. Am. J. Prev. Med. 27 (2), 1–3.

Osler, M., Tjonneland, A., Suntum, M., Thomsen, B.L., Stripp, C., Gronbaek, M., Overvad, K., 2002. Does the association between smoking status and selected healthy foods depend on gender? A population-based study of 54 417 middle-aged Danes. Eur. J. Clin. Nutr. 56, 57–63.

Paavola, M., Vartiainen, E., Haukkala, A., 2004. Smoking, alcohol use, and physical activity: a 13-year longitudinal study ranging from adolescence into adulthood. J. Adolesc. Health 35, 238–244.

Paffenbarger, R.S.Jr., Hyde, R.T., Wing, A.L., Lee, I.M., Jung, D.L., Kampert, J.B., 1993. The association of changes in physical-activity level and other lifestyle characteristics with mortality among men. N. Engl. J. Med. 328, 538–545.

Pronk, N.P., Peek, C.J., Goldstein, M.G., 2004. Addressing multiple behavioral risk factors in primary care; a synthesis of current knowledge and stakeholder dialogue sessions. Am. J. Prev. Med. 27 (2), 4–17.

Rehm, J., Spuhler, T., 1993. Measurement error in alcohol consumption: the Swiss Health Survey. Eur. J. Clin. Nutr. 47 (Suppl. 2), S25–S30.

Saunders, J.B., Aasland, O.G., Babor, T.F., de la Fuente, J.R., Grant, M., 1993. Development of the alcohol Use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. Addiction 88, 791–804.

Schuit, A.J., van Loon, A.J., Tijhuis, M., Ocke, M., 2002. Clustering of lifestyle risk factors in a general adult population. Prev. Med. 35, 219–224.

Serdula, M.K., Byers, T., Simoes, A.H., Mendlein, E., Coates, J.M., 1996. The association between fruit and vegetable intake and chronic disease risk factors. Epidemiology 7, 161–165.

Thompson, R.L., Margetts, B.M., Wood, D.A., Jackson, A.A., 1992. Cigarette smoking and food and nutrient intakes in relation to coronary heart disease. Nutr. Res. Rev. 5, 131–152.

Thornton, A., Lee, P., Fry, J., 1994. Differences between smokers, ex-smokers, passive smokers and non-smokers. J. Clin. Epidemiol. 47, 1143–1162.

U.S. Department of Health and Human Services, 1996. Physical activity and health: a report of the surgeon general. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Atlanta, GA.

Willet, W.C., Dietz, W.H., Colditz, G.A., 1999. Guidelines for healthy weight. N. Engl. J. Med. 341, 427–434.

Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanas, F., et al., 2004. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case–control study. Lancet 364, 937–952.