Rev Saúde Pública 2012;46(3)

Ludmila Correa Muniz

Bruna Celestino Schneider

Inácio Crochemore Mohnsam da Silva

Alicia Matijasevich

Iná Silva Santos

Accumulated behavioral risk factors for cardiovascular diseases in Southern Brazil

ABSTRACT

OBJECTIVE: To estimate the prevalence of, and identify factors associated with, accumulated risky behavior relating to cardiovascular diseases among adults.

METHODS: This was a population-based cross-sectional study on a representative sample of 2732 adults of both sexes in Pelotas, Southern Brazil, in 2010. The behavioral risk factors investigated were: smoking; leisure-time physical inactivity; habitual consumption of visible fat in meat; and daily consumption of processed meats, red meat and whole milk. The study outcome was the accumulated behavioral risk factors score, ranging from zero to three: no behavioral risk factor for cardiovascular diseases or exposure to 1, 2 or ≥ 3 behavioral risk factors. Multinomial logistic regression was performed to evaluate the adjusted effect of individual characteristics on behavioral risk factors accumulation, taking individuals without any of these factors as the reference category.

RESULTS: Physical inactivity was the most prevalent risk factor (75.6%), followed by habitual consumption of visible fat in meat (52.3%). Two thirds of the population presented two or more behavioral risk factors. Combined physical inactivity and habitual consumption of visible fat in meat was observed in 17.5% of the sample; and combined physical inactivity, habitual consumption of visible fat in meat and smoking in 6.7%. The odds ratios for accumulation of two or more risk factors were higher among men and were inversely associated with a national economic indicator.

CONCLUSIONS: There was a high accumulation of behavioral risk factors for cardiovascular diseases among the study population. Public interventions with the capacity to prevent simultaneous occurrence of these factors are needed.

DESCRIPTORS: Cardiovascular Diseases. Sedentary Lifestyle. Food Habits. Smoking. Risk Factors. Cross-Sectional Studies.

Programa de Pós-Graduação em Epidemiologia. Universidade Federal de Pelotas. Pelotas, RS, Brasil

Correspondence:
Ludmila Correa Muniz
R. Marechal Deodoro, 1160 – 3º piso
Centro
96020-220 Pelotas, RS, Brasil
E-mail: ludmuniz@yahoo.com.br

Received: 8/29/2011
Approved: 1/15/2012

Article available from: www.scielo.br/rsp

INTRODUCTION

Chronic non-communicable diseases and disorders (CNCDs) are one of the biggest public health problems of today. According to estimates from the World Health Organization (WHO), CNCDs are responsible for around 60% of all deaths in the world and 46% of the overall disease burden that affects the world's population.[16,26] CNCDs follow a similar pattern in Brazil and were the main cause of death in 2007, especially cardiovascular diseases (CVDs) (31.9%).[a] CVDs were responsible for 32.1% of all deaths in the southern region over the same period.[a]

[a] Ministério da Saúde (BR), Departamento de Informática do SUS. Sistema de informações sobre mortalidade. Brasília (DF); 2010 [cited 2012 Feb 24]. Available from: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?idb2009/c08.def

According to WHO, a small set of modifiable risk factors account for the great majority of deaths and for a significant proportion of the disease burden due to CNCDs. Among these factors are smoking, physical inactivity and dyslipidemias (associated mainly with excessive consumption of fats of animal origin).[26] Brazilian population-based studies and studies on specific populations have shown high prevalences of these factors separately.[2,b,c] The household survey on at-risk behavior and reported morbidity relating to CNCDs in 15 state capitals and the federal district of Brazil, in 2002-2003[b] showed that there were high prevalences of smoking (12.9% to 25.2%), physical inactivity (28.2% to 54.5%), consumption of whole milk (61% to 87.2%) and consumption of the visible fat in meat (48% to 49.3%) in the different age groups and regions of this country. However, knowledge of the prevalence of each risk factor separately only provides a partial view of the problem, given that they frequently occur in combination, and this may explain many variations at individual or population-based level regarding cardiovascular health.

Studies in developed countries have shown that cardiovascular risk factors tend to coexist in certain sociodemographic groups[19,23] and that they are more prevalent among men, younger individuals and individuals of lower economic and educational level. Population-based information on accumulated behavioral risk factors (BRFs) for CVDs is scarce in Brazil,[4,8,14,18] especially with regard to coexistence of factors such as smoking, physical inactivity and excessive consumption of fats of animal origin.

Given that BRFs can be modified through interventions at individual and population-based levels, the aims of this study were to estimate the prevalence and distribution of combinations of BRFs and identify factors associated with their accumulation.

METHODS

This was a cross-sectional population-based study on a representative sample of 2732 adults aged 20 years and over, in the urban zone of Pelotas, between January and May 2010. Pelotas is a medium-sized municipality located in the south of the state of Rio Grande do Sul (Southern Brazil) with a population of approximately 350,000 inhabitants, of whom 90% live in the urban zone.[d] Institutionalized individuals and those with mental incapacities that made it impossible for them to answer the questionnaire were considered to be ineligible for the study.

The following prevalence estimates were used for calculating the sample size: smoking, 27%;[4] leisure-time physical inactivity, 70%;[2] habitual consumption of visible fat in meat, 30%;[b] daily consumption of whole milk, 55%;[b] daily consumption of processed meats, 18%; and daily consumption of red meat, 18%. The last two factors were based on unpublished data from the Pelotas 1982 birth cohort that were obtained when the individuals reached the age of 23 years. The other parameters used in the sample size calculation were an acceptable error of three percentage points and a 95% confidence interval. To allow for possible losses and refusals, 10% was added to the calculation, and the quantity obtained was multiplied by two to compensate for the estimated effect of the sampling design. Thus, the greatest sample size needed for investigating the prevalence of BRFs for CVDs was 2,321 individuals.

The sample was selected in two stages, and the census tracts defined by the *Instituto Brasileiro de Geografia e Estatística* (IBGE – Brazilian Institute for Geography and Statistics) were used as the primary sampling unit. The 404 census tracts were listed in increasing order of mean income of the head of the family and were selected using probabilities proportional to size. After the draw, a recognition and updating process was started, given that the spreadsheets from the IBGE census tracts came from the 2000 census and were probably out of date. An average of ten households was systematically sampled in each census tract drawn, in order to minimize the effect of the sampling design. This process resulted in drawing 130 census tracts and 1512 households. Individuals aged 20 years and over of both sexes, in each household, were considered eligible.

Six BRFs for CVDs were defined operationally:

a) Smoking: one or more cigarettes per day for more than one month.

b) Leisure-time physical inactivity: less than 150 minutes of physical activity practiced during the week preceding the interview, in accordance with current recommendations.[27] This information was obtained from the leisure section of the long version of the International Physical Activity Questionnaire.[5]

c) Habitual consumption of visible fat in meat, which was obtained through two questions: "Do you remove the fat before eating meat? (yes/no)" and "Do you remove the skin before eating chicken? (yes/no)". The interviewees who answered "no"

[b] Ministério da Saúde (BR). VIGITEL Brasil 2009: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico. Brasília (DF); 2010 [cited 2011 Jul 29]. Available from: http://189.28.128.100/dab/docs/publicacoes/geral/publicacao_vigitel_2009.pdf

[c] Ministério da Saúde (BR), Secretaria de Vigilância em Saúde, Secretaria de Assistência à Saúde; Instituto Nacional do Câncer. Inquérito domiciliar sobre comportamentos de risco e morbidade referida de doenças e agravos não transmissíveis–Brasil: 15 capitais e Distrito Federal, 2002/2003. Rio de Janeiro: Inca; 2004 [cited 2012 Feb 24]. Available from: http://www.inca.gov.br/inquerito/docs/completa.pdf

[d] Instituto Brasileiro de Geografia e Estatística. Censo demográfico, 2000. Rio de Janeiro; 2001 [cited 2012 Feb 24]. Available from: http://www.ibge.gov.br/censo/

to at least one of these questions were considered to be habitual consumers of visible fat in meat.

d) Daily consumption of processed meat: consumption of *linguiça* sausage, hot dog sausages, ham, salami, mortadella sausage or meat paste at least once a day, over the year preceding the interview.

e) Daily consumption of red meat: consumption of beef, pork or lamb in presentations with and without bone (steaks and stews) at least once a day, over the year preceding the interview.

f) Daily consumption of whole milk, which was obtained through four questions: "Do you usually drink some type of milk? (yes/no)"; "What type of milk do you usually drink? (cow, goat, soybean or other)"; "When you drink cow's milk, what type do you usually drink? (whole milk, semi-skimmed or skimmed)"; and "Think about last week. From <day of last week> to today, on how many of these days did you drink milk? (zero to seven)". The interviewees were considered to be daily consumers of whole milk if they reported consuming this type of milk on all the days of the week preceding the interview, independent of the quantity consumed.

The questions used were extracted and adapted from a food consumption frequency questionnaire for gathering information on daily consumption of processed and red meats.[24] The instrument for assessing the consumption of whole milk was drawn up and pretested by the authors.

The independent variables used were sex, age, skin color (as observed by the interviewer), schooling level, conjugal situation, self-perceived health and quintiles of a national economic indicator. This indicator was developed from possession of 12 items and the head of the family's schooling level, through principal component analysis.[3] The items used for this indicator were the number of bedrooms in the home, number of bathrooms, number of television sets, number of cars and possession of a radio, refrigerator or freezer, videocassette player, clothes washing machine, microwave oven, telephone line, microcomputer and air conditioning unit. Skin color was dichotomized as white and black/other, because of the low proportions of black (9.5%), mixed color (9.0%), Oriental (0.2%) and Amerindian (0.1%) individuals.

The information was gathered by means of a standardized and precoded questionnaire, with the aid of personal digital assistant devices, by trained interviewers whose schooling had reached at least completed high school level. The questions had previously been tested in a pilot study in a district of the city that was not selected to form part of the main study. Quality control was done by revisiting 10% of the sample, which was selected randomly for application of a shortened version of the original questionnaire, in order to confirm that the interview had been conducted and that the responses were repeatable. The repeatability rates for the questions on milk consumption, smoking and habitual consumption of chicken skin that were used in the quality control questionnaire were, respectively, 77%, 91% and 73%.

Descriptive analysis was done to characterize the sample and calculate the prevalence of each BRF. Bivariate analysis was conducted and Pearson's chi-square test for heterogeneity or linear trends was applied. The significance level was taken to be 5%. Both for bivariate and for multivariate analysis, the outcome was accumulation of BRFs for CVDs. An accumulation score was created to portray the presence of any combination among these factors. The score could range from zero to three, such that zero = no exposure; 1 = exposure to one factor; 2 = exposure to two factors; and 3 = exposure to three or more factors. The adjusted effect of the individual characteristics on the accumulation of BRFs was evaluated by means of multinomial logistic regression, taking the reference category to be individuals without any risk factors. Except for schooling level, which presented a strong correlation with the national economic indicator, the other variables were input to the multivariate analysis and were taken out in a backward manner. Variables with p values greater than 0.10 were removed one by one. The effect of the sampling design was taken into consideration in all the analyses, using the *"survey"* (svy) set of commands in Stata 11.0.

The present study was approved by the Research Ethics Committee of the Medical School of the Federal University of Pelotas (Procedural No. 127/09). The participants signed a free and informed consent statement.

RESULTS

In the 1,512 households visited, 3,059 individuals were considered to be eligible for this study. Of these, 2,732 were interviewed, and thus 10.7% of the sample was lost or refused to participate. The effects of the sampling design in relation to smoking, leisure-time physical inactivity, habitual consumption of visible fat in meat and daily consumption of processed meats, red meat and whole milk were, respectively, 1.7, 1.2, 1.7, 1.6, 2.4 and 1.3.

The sample was composed predominantly of females (57.9%), whites (81.2%) and individuals aged 60 years and over (23.2%). More than half of the sample was living with a partner (58.8%); one fifth said that they had completed between zero and four years of schooling (20.0%) and around one third perceived their health as fair or poor (31.5%) (Table 1). The interviewees' mean age was 46.1 years (SD 17.0), with a range from 20 to 96 years (data not presented in tables).

Physical inactivity was the most prevalent BRF (75.6%), and was more common among the women ($p < 0.001$). Habitual consumption of visible fat in meat was the second most prevalent and was found in around half of the interviewees (52.3%), with greater prevalence among the men ($p < 0.001$). The third most frequent BRF was consumption of whole milk (22.3%). Smoking, which was reported by more than one fifth of the sample, was more frequent among the men ($p < 0.001$) (Table 2). No statistically significant difference was observed between the men and women in relation to daily consumption of processed meats, red meat or whole milk. Around three quarters of the sample (74.2% [95% CI: 71.9;76.3]) was consuming at least one of the types of fat of animal origin that was investigated (data not presented in tables).

Two thirds of the sample presented two or more factors (66.6%), and this accumulation was more frequent among the men (70.7%) than among the women (63.3%) ($p = 0.001$) (data not presented in tables). For both sexes, the main combination of two BRFs was physical inactivity and habitual consumption of visible fat in meat (17.5%; 18.2% among the men and 17.0% among the women). The second most prevalent combination was physical inactivity and daily consumption of whole milk (5.4%; 4.4% among the men and 6.1% among the women). In relation to simultaneous presence of three BRFs among the men and women, the most prevalent combination was physical inactivity, habitual consumption of visible fat in meat and smoking (6.7%; around 8% among the men and 5.4% among the women). All the possible combinations for four or five BRFs were explored, but none of them showed prevalence greater than 1.5%.

Except for age, there were statistically significant differences in score distribution according to the other independent variables in the bivariate analysis (Table 1). Greater prevalence of accumulations of three or more BRFs was observed among the men (35.1%); among the individuals aged 40-49 years (35.8%), in comparison with younger individuals (25.1%); among the individuals with a partner (32,5%); and among those with 5-8 years of schooling (36.9%), in comparison with those with 12 or more completed years of schooling (24.0%). An inverse linear association with the national economic indicator was observed (i.e. the greater the income quintile was, the lower the prevalence of ≥ 3 BRFs was), and there was greater accumulation among individuals whose self-perceived health was fair or poor.

Sex and the national economic indicator were associated with the likelihood of having three or more BRFs in the multinomial logistic regression (Table 3). The men presented a likelihood of presenting three or more BRFs that was 71% greater than shown by the women. A one-point increase in the national economic indicator implied reductions of 3%, 7% and 9% in the likelihoods of presenting 1, 2 and 3 or more BRFs, respectively.

DISCUSSION

In this study, some of the most important BRFs for development of CVDs were investigated, such as smoking, physical inactivity and excessive consumption of fats of animal origin (represented by habitual consumption of visible fat in meat and daily consumption of red meat, processed meats and whole milk).[26] The prevalence of each type of behavior was greater than 10%, both among men and among women. Habitual consumption of visible fat in meat and leisure-time physical inactivity among both sexes were observed in more than half of the population.

This study had a large number of participants, small numbers of losses and refusals, detailed and standardized data gathering for several BRFs and high repeatability of responses regarding the presence of the factors investigated.

The epidemiology of CVDs and the results from intervention studies have shown that CVDs are preventable.[9] However, preventing them is not easy because this involves changing the behavior of individuals and society. CVDs are ailments that develop over decades.[9] The pre-pathogenesis period of its natural history includes the presence of BRFs: smoking; sedentarism; diets poor in cereals, fruits, greens, other vegetables and fish; and high consumption of eggs, dairy products, refined sugar and salt. These are added to the development of other risk factors such as obesity, systemic arterial hypertension, diabetes mellitus and dyslipidemias. Sedentarism is responsible for 22% of the cases of cardiopathy and for 10% and 16% of the cases of breast and colon cancer, respectively.[16] Studies investigating habitual consumption of fat of animal origin have found that high intake of saturated fats and cholesterol-rich foods increase the risk of coronary disease, ischemia and other CVDs.[12,15] Likewise, because red meat, processed meats and whole milk are foods of animal origin, they are sources of cholesterol and saturated fat, and excessive consumption of these foods may lead to dyslipidemia (hypercholesterolemia).[16] High consumption of processed meats is a risk factor for the development of systemic arterial hypertension, because of the high sodium content.[9]

High concomitance of risk factors for CVDs, such as smoking, alcohol abuse, physical inactivity, obesity, systemic arterial hypertension, diabetes, hypercholesterolemia and insufficient intake of fruit, greens and other vegetables was found in previous studies in Brazil[4,8,14,18] and in other parts of the world.[19,23] A study that investigated the combined prevalence of systemic arterial hypertension, diabetes mellitus, smoking, physical inactivity and excess weight showed that around 40% of the adult population in Pelotas presented two risk factors in 2003, and the most prevalent combination was between physical

Table 1. Accumulated behavioral risk factors for cardiovascular diseases according to independent variables. Pelotas, Southern Brazil, 2010. (n = 2,732)

Variable	n	%	% (95%CI) 0 (n = 131; 5.9%)	1 (n = 609; 27.5%)	2 (n = 796; 36.0%)	3 or more (n = 676; 30.6%)	p*
Sex							< 0.001
Male	1,151	42.1	5.1 (3.7;6.5)	24.3 (21.4;27.1)	35.5 (32.6;38.5)	35.1 (31.7;38.5)	
Female	1,581	57.9	6.6 (5.3;7.9)	30.1 (27.4;32.7)	36.3 (33.6;39.1)	27.0 (24.7;29.3)	
Skin color							0.027
White	2,218	81.2	6.5 (5.3;7.7)	28.3 (25.8;30.8)	35.2 (33.1;37.4)	30.0 (27.5;32.5)	
Black/other	513	18.8	3.6 (1.9;5.2)	24.4 (20.3;28.5)	39.1 (34.3;43.9)	32.9 (28.0;37.9)	
Age (years)							0.051
20 to 29	595	21.8	6.3 (4.3;8.2)	31.9 (28.0;35.8)	36.7 (32.7;40.7)	25.1 (21.4;28.8)	
30 to 39	462	16.9	5.6 (3.6;7.6)	25.0 (20.6;29.4)	36.2 (31.9;40.4)	33.3 (28.3;38.2)	
40 to 49	545	20.0	7.3 (4.6;9.9)	24.2 (19.8;28.5)	32.8 (28.2;37.4)	35.8 (31.5;40.0)	
50 to 59	495	18.1	5.1 (2.9;7.2)	27.9 (22.8;32.9)	36.7 (31.8;41.6)	30.4 (26.0;34.8)	
60 and over	635	23.2	5.2 (3.0;7.4)	27.6 (23.0;32.2)	37.5 (32.5;42.5)	29.7 (25.1;34.3)	
Conjugal situation							0.008
With partner	1,606	58.8	5.3 (4.0;6.6)	25.5 (22.7;28.4)	36.7 (33.8;39.5)	32.5 (29.5;35.5)	
Without partner	1,126	41.2	6.9 (5.2;8.6)	30.5 (27.4;33.7)	35.0 (31.7;38.2)	27.6 (24.3;30.9)	
Schooling levela (years)							< 0.001
0 a 4	513	20.0	4.1 (2.0;6.2)	22.3 (18.0;26.7)	38.3 (33.0;43.6)	35.3 (30.7;39.8)	
5 a 8	773	30.1	3.9 (2.3;5.5)	22.1 (18.3;25.8)	37.2 (33.3;41.0)	36.9 (32.5;41.2)	
9 a 11	732	28.5	6.6 (4.7;8.5)	32.0 (28.2;35.8)	34.6 (31.1;38.1)	26.8 (23.3;30.3)	
12 or more	547	21.3	9.7 (6.8;12.6)	31.4 (27.2;35.7)	34.9 (30.7;39.2)	24.0 (20.0;27.9)	
National economic indicator (quintiles)							< 0.001
1st	562	20.7	3.5 (1.7;5.3)	23.8 (19.3;28.3)	36.3 (30.7;41.9)	36.3 (30.8;41.9)	
2nd	649	23.9	4.1 (2.3;5.9)	23.6 (20.1;27.1)	40.4 (36.3;44.4)	32.0 (28.0;35.9)	
3rd	452	16.7	8.9 (6.2;11.6)	26.3 (21.9;30.8)	34.4 (29.7;39.1)	30.4 (25.7;35.1)	
4th	547	20.1	4.9 (3.2;6.7)	29.3 (24.3;34.2)	37.6 (32.8;42.4)	28.2 (23.7;32.7)	
5th	505	18.6	8.5 (5.4;11.7)	34.2 (29.9;38.4)	30.8 (26.3;35.3)	26.5 (21.6;31.5)	
Self-perceived health							< 0.001
Excellent/very good	678	24.9	8.7 (6.5;10.8)	31.2 (27.1;35.4)	32.9 (29.0;36.9)	27.2 (23.2;31.2)	
Good	1,189	43.6	6.0 (4.4;7.7)	26.8 (24.0;29.6)	36.5 (33.5;39.4)	30.7 (27.5;33.9)	
Fair/poor	859	31.5	3.1 (1.7;4.5)	25.3 (21.5;29.1)	38.2 (33.9;42.4)	33.4 (29.3;37.5)	

[a] Maximum number of unknown values (n = 167) for the schooling variable
* Difference in score distribution according to the independent variables (p values estimated using Pearson's chi-square test for heterogeneity)

inactivity and excess weight.[4] A study on the combined prevalence of systemic arterial hypertension, smoking, excessive alcohol consumption and sedentarism in Porto Alegre, Rio Grande do Sul, showed that the main combination of two factors was physical inactivity and smoking, for both sexes.[8]

Physical inactivity has been the most prevalent factor in all the combinations in different studies. These high prevalences of physical inactivity may have resulted from lack of knowledge of the benefits of an active lifestyle, lack of safe and appropriate places for regular practicing of physical activity and the inherent difficulty in making behavioral changes.[18] However, restriction of physical activity assessments just to leisure time, while neglecting other times at which individuals might practice exercises, such as in making journeys, doing domestic activities and doing work activities, may have contributed towards the high rates of physical inactivity seen in this study.

Studies in Brazil and in other countries on combinations of risk factors have presented variations in the sets of factors analyzed, which has made it difficult to

Table 2. Prevalence of behavioral risk factors for cardiovascular diseases in the whole sample and after stratification according to sex. Pelotas, Southern Brazil, 2010.

Risk factors	% (95%CI) General (n = 2.732)	Men (n = 1.151)	Women (n = 1.581)	p*
Leisure-time physical inactivity	75.6 (73.8;77.4)	68.2 (65.2;71.1)	81.0 (79.0;83.0)	< 0.001
Habitual consumption of visible fat in meat	52.3 (49.8;54.8)	66.7 (63.6;69.8)	41.8 (39.2;44.5)	< 0.001
Daily consumption of whole milk	22.3 (20.5;24.1)	21.1 (18.5;23.7)	23.2 (21.0;25.3)	0.206
Smoking	21.3 (19.3;23.4)	25.4 (22.2;28.6)	18.4 (16.3;20.5)	< 0.001
Daily consumption of processed meats[a]	16.6 (14.6;18.5)	17.9 (15.4;20.5)	15.5 (13.3;17.7)	0.129
Daily consumption of red meat	14.8 (12.7;16.9)	16.0 (13.4;18.6)	13.9 (11.5;16.3)	0.124

[a] Maximum number of unknown values (n = 421) for daily consumption of processed meats
* Difference between men and women (p value from Pearson's chi-square test for heterogeneity)

Tabela 3. Odds ratio adjusted for the number of accumulated behavioral risk factors for cardiovascular diseases, according to multinomial logistic regression. Pelotas, Southern Brazil, 2010. (n = 2,732)

Variable	Number of risk factors[a] 1 factor OR (95%CI)	2 factors OR (95%CI)	3 or more factors OR (95%CI)	p*
Male sex	1.07 (0.73;1.56)	1.27 (0.92;1.77)	1.71 (1.19;2.45)	< 0.001
Black/other skin color	1.39 (0.79;2.46)	1.67 (0.98;2.83)	1.58 (0.88;2.84)	0.195
With partner	1.11 (0.77;1.61)	1.40 (0.93;2.12)	1.54 (0.99;2.38)	0.080
Self-perceived health				0.055
Good	0.59 (0.34;1.03)	0.56 (0.32;0.98)	0.54 (0.31;0.95)	
Excellent/very good	0.48 (0.28;0.84)	0.37 (0.21;0.67)	0.35 (0.19;0.65)	
National economic indicator[b,c]	0.97 (0.93;1.02)	0.93 (0.88;0.98)	0.91 (0.87;0.96)	< 0.001
Age (completed years)[c]	0.99 (0.98;1.01)	0.99 (0.98;1.00)	0.99 (0.98;1.01)	0.884

[a] Reference category: zero risk factor
[b] Maximum number of unknown values (n = 17) for the national economic indicator variable
[c] Continuous variables
* p value estimated for the association between the variables and the polytomous outcome, according to the Wald test

compare the findings. Hypercholesterolemia, which has been a component in most studies on accumulated cardiovascular risk factors, was evaluated indirectly in the present study, through ascertaining occurrences of excessive habitual consumption of fats of animal origin, a form of behavior that has been recognized as presenting a risk of development of dyslipidemias.[26]

Differences in accumulations of three or more BRFs were identified according to sex. Greater accumulation was observed among the men, which goes against estimates from some Brazilian studies that did not find such differences.[4,8,14,18] In the present study, BRFs relating to food were investigated, which may explain this discrepancy. Women may have greater interest in issues relating to healthy eating, following diets, consuming foods with low calorie content and taking care with health and the body, which thus may influence their habits and lifestyles.[25]

Age-related differences were observed in greater accumulations of BRFs (three or more factors). Other studies have shown a direct relationship between greater accumulation of risk factors and greater age,[8,14,18,19,23] probably because they evaluated factors such as systemic arterial hypertension, obesity, dyslipidemia and diabetes mellitus, which tend to become more prevalent with increasing age. In older age groups, a decline in the frequency of smokers is expected, given that more people quit smoking because of concerns about their health or because of the presence of diseases.[17] In addition, older individuals tend to frequent healthcare services more, because of the greater prevalence of incapacities and chronic diseases in this age group. These individuals may receive a greater amount of advice about reducing their intake of fats of animal origin and about the importance of regular physical exercise practices. Behavioral changes over the course of life were not explored in this study because of its cross-sectional nature. Such investigations would make it possible to dismiss prevalence bias, and smaller accumulations of BRFs among more elderly individuals would then indicate that absence of such behavior would be associated with longevity.

Lower prevalence of BRF combinations was observed among individuals with higher income and schooling levels. Individuals who perceived their own health to be fair or poor presented greater prevalence. A household survey that investigated biological risk factors and BRFs for CVDs in 16 Brazilian state capitals showed that accumulation of risk factors was inversely associated with income and schooling levels and was more frequent among individuals with worse self-assessed health.[18] The relationship between higher education or income levels and fewer BRFs may suggest that such individuals had greater access to healthcare information and services, thereby resulting in healthy behavioral practices. However, this relationship is of complex nature: it varies over the course of life and cannot be picked up in cross-sectional studies. In the present study, greater accumulations of BRF combinations occurred among individuals who were living with a partner, contrary to what was found in another study, in which this characteristics was a protective factor.[1]

Although age, race and sex cannot be modified, the majority of the risk factors relate to lifestyle and behavioral patterns that can be modified. A variety of interventions aimed at reducing BRFs have been implemented over recent decades. In relation to physical activity, for example, interventions within the physical/constructed environment (provision of spaces with access to physical activity practices) and within the social environment, and approaches among younger age groups, such as among schoolchildren, have been shown to be effective.[11] The "Active Curitiba" program,[22] which promotes reduced use of cars and encourages the use of active transportation, is an example of a successful experience. Other health promotion initiatives have included prohibition of advertising campaigns for cigarettes in the communication media and imposition of the obligation to put informative images about the harm done by smoking on the product labels.

Even though simultaneous changes to several BRFs are more difficult to implement and maintain, counseling aimed at reducing multiple BRFs is more effective in changing at least one factor than are separate approaches towards each factor.[10] The "North Karelia" program in Finland is one of the best-documented examples of a community-based intervention covering several BRFs simultaneously: increased availability of low-fat dairy products, antismoking legislation and improvements to school meals. Educational campaigns were carried in the media, in schools and in workplaces, with endorsement by personalities within sports, education and agriculture. The prevalences of smoking, hypercholesterolemia and systemic arterial hypertension fell within five years and, over a 20-year period, Finland underwent a drastic reduction in the mortality rate due to CVDs, from a situation in which it had had the highest rate in the world.[20] Despite the well-known socioeconomic and cultural differences between developed countries like Finland and low and medium-income nations like Brazil, successful health promotion strategies are important and need to be stimulated, provide that they are adapted to the realities of different situations.

This study presents some limitations. Selecting all the adults in each household may have produced artificial homogeneity in the sample, since dietary habits tend to be shared among the members of the same family.[13] The prevalence of BRFs relating to diet may have been overestimated, and the likelihood of being a smoker or having sedentary leisure-time habits is greater for individuals in families in which other members are smokers and have sedentary habits.[7,21]

Other factors that, when present, could affect the likelihood of accumulating BRFs (such as morbidity and use of healthcare services) were not explored. A study on the primary healthcare network in Pelotas showed that the proportion of medical consultations in which sedentarism, smoking and inappropriate diet were explored was small, as was the proportion of individuals who received recommendations for ways of preventing these BRFs.[5]

Four of the six score components related to dietary components, although only 3.6% of the individuals presented consumption of fat of animal origin in the category of ≥ 3 BRFs (six consumed fat, processed meats and milk; 15 consumed fat, processed meats and red meat; and three, all four sources). Consumption of fat of animal origin was present for 11.3% of the individuals with two factors. The other participants presented combinations that included at least one of the other two types of behavior. The score was then reconstructed such that in the category of ≥ 3 BRFs, there would be at least one behavioral pattern from each of the three groups, in order to test whether the way in which they were constructed would influence the results. In comparison with the score used, there was an increase in the prevalence of individuals with two BRFs (from 36.0% to 47.4%) and a reduction in the prevalence of individuals with three BRFs (from 30.6% to 14.5%). In multivariate analysis, all the independent variables were found to be significantly associated with accumulation of BRFs, except for skin color. The direction of the risks was consistent with what had been observed in the analyses using the original score.

Use of a simplified score for BRFs that did not make any distinction between the components made it possible to outline a BRF profile for the adult population of Pelotas in a broad manner, with important implications for planning health promotion actions. The high prevalence of multiple BRFs for CVDs reinforces the importance of interventions and public policies aimed towards reducing them. There is evidence that interventions for reducing the prevalence of physical inactivity, inappropriate diet and smoking have an effect. Programs for preventing BRFs for CVDs that encompass multiple factors and reach high coverage of the population are necessary.

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The authors declare no conflicts of interests.