

Clustering of risk factors for non communicable diseases in adults from Florianópolis, SC

Agregação de fatores de risco para doenças e agravos crônicos não transmissíveis em adultos de Florianópolis, SC

Abstract

Objective: To investigate clustering patterns of health risk behaviors for non communicable diseases and its associated factors. **Methods:** a Random telephone survey with 1,996 adults from Florianópolis, SC, was conducted in 2005. Tobacco use, high alcoholic intake episodes, fruit consumption and physical inactivity were investigated. Clustering was examined by the ratio between observed and expected prevalence of each of the 16 possible combinations. These clustered risk factors comprised the main outcome and binomial and multinomial logistic regression was conducted to examine socio-demographic correlates. **Results:** 43% of men and 36.6% of women clustered at least two health risk factors. Three (19.2%; CI 95% 16.7 - 21.7) and five (9.8%; CI 95% 8.0 - 11.6) specific combinations exceed the expected prevalence, respectively, in men and women. Women with low schooling level and older were more likely to cluster health risk behaviors. **Conclusion:** although men showed higher prevalence of single health risk behavior and its combinations, women presented more specific combinations that clustered above the expected. Knowledge on the clustering pattern of these health risk behaviors may guide the design of more effective health promotion initiatives.

Keywords: Tobacco. Physical inactivity. Diet. Alcohol. Risk factors. Health survey.

Filipe Ferreira da Costa¹

Jucemar Benedet¹

Danielle Biazzini Leal¹

Maria Alice Altenburg de Assis^{1,II}

¹Graduate Physical Education Program, Sports Center, Universidade Federal de Santa Catarina, Florianópolis, Brazil.

^{II}Graduate Nutrition Program, Health Sciences Center, Universidade Federal de Santa Catarina, Florianópolis, Brazil.

Corresponding address: Filipe Ferreira da Costa. Programa de Pós-graduação em Educação Física, Centro de Desportos, Universidade Federal de Santa Catarina, Campus Universitário - Trindade, Florianópolis 88040-900, Santa Catarina, Brazil. Tel: 55-48- 3721-8014. E-mail: filipefcosta_1@hotmail.com

Resumo

Objetivo: Investigar o padrão de combinações de comportamentos de risco para doenças crônicas não transmissíveis e identificar os fatores sociodemográficos associados às combinações que excedem a prevalência esperada. **Métodos:** Inquérito com 1.996 adultos, residentes em domicílios servidos por linhas telefônicas fixas, no ano de 2005, em Florianópolis, SC. Os comportamentos investigados foram o tabagismo, consumo de álcool, inatividade física no lazer e consumo irregular de frutas. O padrão de simultaneidade dos comportamentos de risco foi avaliado pela razão entre a prevalência esperada e observada de cada uma das 16 possibilidades de combinação. O conjunto de comportamentos que excedeu a prevalência esperada constituiu o principal desfecho investigado. A regressão logística binomial e multinomial foi utilizada para avaliar a associação dos padrões de combinação e simultaneidade com variáveis sociodemográficas. **Resultados:** 43% dos homens e 36,6% das mulheres acumularam dois ou mais fatores de risco. Três (19,2%; IC 95% 16,7 - 21,7) e cinco (9,8%; IC 95% 8,0 - 11,6) combinações de comportamento excederam a prevalência esperada, respectivamente, entre os homens e as mulheres. Mulheres menos escolarizadas e de idade mais avançada apresentaram maior chance de agregação dos comportamentos de risco. **Conclusão:** Apesar de os homens apresentarem prevalências mais elevadas tanto dos comportamentos de risco isoladamente quanto das combinações dos mesmos, as mulheres apresentaram maior número de padrões que tenderam a se agregar além do esperado. O conhecimento sobre o padrão de combinação dos comportamentos de risco pode auxiliar no desenvolvimento de estratégias mais efetivas de promoção da saúde.

Palavras-chave: Tabagismo. Consumo de álcool. Atividade física. Alimentação. Fatores de risco. Levantamento epidemiológico.

Introduction

An unhealthy lifestyle and the resulting consequences, such as high blood pressure, elevated cholesterol levels and excess weight, are the primary cause of a number of diseases and premature death in Brazil and worldwide. Low physical activity levels, smoking, excessive alcohol consumption and an unhealthy diet (ex.: high consumption of fat, salt and sugar and low fruit and vegetable intake) are the main risk behaviors related to the high prevalence of chronic noncommunicable diseases, such as type 2 diabetes, cardiovascular diseases and some types of cancer¹. Since 2006, the Telephone-based Surveillance of Risk and Protective Factors for Chronic Diseases (VIGITEL)² has presented results on the frequency and sociodemographic distribution of these and other risk and protective factors in adults from state capitals and the Federal District. Surveys conducted in 2010 and 2011 showed prevalence of smoking, excessive alcohol consumption, irregular fruit intake and insufficient leisure-time physical activity of 15%², 17%², 69%² and 85%³, respectively.

Given that the simultaneous occurrence of health risk factors raises the likelihood of developing poor health conditions, studies have focused on determining the extent to which factors and behaviors cluster in individuals⁴⁻⁶. Evidence suggests that simultaneous risk behaviors have a synergistic effect on deteriorating health⁷, resulting in harmful, cumulative effects, instead of an additive effect of each behavior. As in individual risk factor prevalence, simultaneous behavior patterns are associated to specific sociodemographic characteristics. Being a man, low schooling and low income levels are associated to simultaneous behaviors/health risk factors^{4-5,8-12}. Of the few Brazilian studies on simultaneous health risk factors^{4-6,11-12}, only two exclusively assessed behavioral risk factors^{11,12}, recognizably more sensitive to interventions than clinical outcomes.

Despite providing important information on the extent to which individuals

accumulate risk behaviors, these studies failed to demonstrate which specific combination patterns tend to cluster. International studies used data analysis strategies that allowed investigation of specific risk factor combination patterns⁸⁻¹⁰, which could be potentially relevant in monitoring and planning more effective interventions. Accordingly, the aim of the present study was to investigate combinations of risk factors and identify sociodemographic factors associated to combinations that tend to cluster in a representative sample of adults from the city of Florianópolis, Brazil.

Methods

This is a cross-sectional, population-based study of adult residents of Florianópolis, Brazil aged 18 years or older. We present data from the Surveillance System for Risk Factors for Chronic Noncommunicable Diseases (SIMTEL) - also developed in four Brazilian state capitals (Belém, Goiânia, Salvador and São Paulo) in 2005. A total of 2013 interviews were conducted in Florianópolis. A minimum of 2000 interviews was stipulated, with a 95% confidence level and maximum error of two percent in the frequency of any risk factor in the study population¹³. The final success rate (number of interviews/number of eligible phone lines) was 78.9% and the refusal rate (number of refusals/number of eligible lines) was 11.9%. Seventeen pregnant women were excluded, resulting in a final sample of 1996 adults (51.8% women). The methods and sampling plan have been described in earlier studies^{13,14}.

Variables related to smoking, alcohol consumption, fruit intake and leisure-time physical activity were selected. Smoking was classified dichotomously (yes/no), using the current status of the respondent as reference. This information was obtained by asking the following question: "Do you smoke?". With respect to alcohol intake, consuming five or more drinks at least once in the previous month was used as

reference for classification purposes. This information was obtained by posing the following question: "Did you consume five or more alcoholic beverages on at least one occasion in the last month?". Leisure-time physical activity consisted of engaging in physical exercise or sport. Individuals who did not take part in physical exercise or sport or who did so fewer than once a week were classified as inactive. Fruit intake was assessed by asking the following question: "Do you eat fruit every day or almost every day?". It was assumed that individuals who responded "no" ate fruit fewer than five days a week, the criterion adopted by VIGITEL to characterize irregular fruit intake².

In addition, sociodemographic information (age, skin color, schooling, employment status) was obtained to investigate factors associated to the pattern of risk behavior combinations. Age was categorized into five ranges (18 to 24, 25 to 34, 35 to 44, 45 to 54 and greater than or equal to 55), skin color into white and non-white, schooling into years of study (0 to 4, 5 to 8, 9 to 11, and 12 or more) and employment status (yes/no) by asking the following question: "Are you currently working?".

Analyses were stratified by sex and prevalence estimates were produced for the total adult population of the city in accordance with the procedure described by Monteiro et al¹³. Prevalence and confidence intervals (CI95%) were described for individual risk factors. The ratio between observed and expected (O/E) prevalence for each of the 16 possible combinations was calculated in order to analyze the pattern of risk factor combinations. The expected prevalence of a specific combination of risk factors was calculated based on the individual likelihood of each risk factor in accordance with their occurrence in the study sample. For example, the expected prevalence for the simultaneous presence of smoking (S), excessive alcohol consumption (A), irregular fruit intake (F) and engaging in leisure-time physical activity (L) was calculated by the following

formula: $pS \times pA \times pF \times (1 - pL)$, where p is the likelihood (prevalence/100) of the factor in the study sample. Thus, it was possible to investigate which combinations were above or below the expected prevalence, assuming that risk factors occurred independently in the population under study⁸. When the confidence interval did not include the unit, the ratio was statistically significant.

Crude and adjusted logistic regression was used to investigate risk behavior patterns that exceeded the expected prevalence. To that end, S/A/F/L + S/F/L + A combinations for men and S/A/F/L + S/F/L + S/A/L + S/A/F + S/A combinations for women were established as the outcome. Age, skin color, schooling and employment status were included in the model as independent variables. Variables with p -value ≤ 0.20 in crude analyses were inserted into the adjusted model. Moreover, the effect of sociodemographic variables on the simultaneity of risk factors for chronic noncommunicable diseases (one, two, three or more factors) using multinomial logistic regression (reference = no factor) was determined. All analyses were conducted using Stata version 12 (STATA Corp. College Station, Texas USA) considering the weighting calculated to represent the adult population of Florianopolis based on the Census of 2000. The significance level was set at 5%.

Considering an outcome prevalence of 19.5% in men and 9.6% in non-exposed women, we determined odds ratios of 1.62 and 1.72, respectively, with 80% power and 95% confidence level.

The study was approved by the Human Research Ethics Committee of Universidade Federal de Santa Catarina and the Public Health Faculty of Universidade de São Paulo. Written informed consent was substituted by verbal consent obtained during the telephone survey.

Results

The sociodemographic characteristics

of the population studied by SIMTEL in Florianopolis was similar to those of the adult population in the municipality, according to a random sample of 10% of households surveyed in the Demographic Census of 2000, with a few exceptions. The study sample showed a higher proportion of women (59.8% versus 52.6% in the census), lower proportion of young people aged 18 to 24 years (16.6% versus 20.8% in the census) and greater proportion of individuals with 9 or more years of schooling (74.2% versus 58.2% in the census)¹⁴.

Table 1 shows the prevalence of individual health risk behaviors. The prevalence of smoking, excessive alcohol consumption and irregular fruit intake was higher in men, whereas a larger proportion of women exhibited leisure-time physical inactivity. More than half (55%) of the adults were inactive and around one-third reported irregular fruit intake. A quarter of the women (26.1%) and 18.9% of men displayed no risk factors. Forty-three percent of men and 36.6% of women had two or more risk factors.

Table 2 illustrates observed and expected prevalence for each of the possible combinations of health risk factors, as well as the ratio between both prevalences. The combination pattern that included all risk behaviors was twice as high as expected in men and 4.6 times greater in women. The prevalence of simultaneous smoking, irregular fruit intake and leisure-time inactivity was around 80% higher than expected in both sexes. Three health risk behavior combination patterns exceeded the expected prevalence in men (19.2%; CI95% 16.7 - 21.7) and five in women (9.8%; CI95% 8.0 - 11.6).

Tables 3 and 4 present associations between age, skin color, schooling and employment status and risk behavior combinations that clustered beyond expected levels. Men aged 25-34 and 45-54 years were more likely to report risk behavior combinations that exceeded those expected for the male population, although only the latter exhibited statistical significance

Table 1 - Behavioral risk factors prevalence in men and women. Florianópolis, SC, SIMTEL, 2005.**Tabela 1** - Prevalência dos comportamentos de risco à saúde em homens e mulheres adultos. Florianópolis, SC, SIMTEL, 2005.

	Men	Women	Total
	% (CI 95%)		
Smoking	24.6 (21.9-27.5)	18.7 (16.3-21.2)	21.5 (19.7-23.4)
Excessive alcohol consumption	32.4 (29.5-35.5)	8.5 (6.9-10.4)	20.0 (18.3-21.9)
Irregular fruit intake	39.1 (36.0-42.2)	26.9 (24.2-29.7)	32.8 (30.1-34.9)
Leisure time physical inactivity	47.2 (44.1-50.5)	61.4 (58.4-64.4)	54.6 (52.4-56.8)

CI: 95% confidence interval / IC: intervalo de confiança de 95%

Table 2 - Observed and expected values for combinations of behavioral risk factors in men and women. Florianópolis, SC, SIMTEL, 2005.**Tabela 2** - Prevalências observadas e esperadas para a combinação dos comportamentos de risco em homens e mulheres adultos. Florianópolis, SC, SIMTEL, 2005.

No. of factors	S	A	F	L	Men			Women		
					E	O/E (CI95%)	O	E	O/E (CI95%)	
4	+	+	+	+	3.0	1.5	2.03 (1.37-2.93)	1.2	0.3	4.58 (2.55-8.20)
3	-	+	+	+	4.0	4.5	0.89 (0.62-1.20)	1.0	1.1	0.87 (0.41-1.56)
3	+	-	+	+	5.6	3.1	1.82 (1.37-2.38)	5.0	2.8	1.77 (1.30-2.30)
3	+	+	-	+	1.8	2.3	0.78 (0.45-1.23)	1.7	0.7	2.38 (1.34-3.69)
3	+	+	+	-	1.9	1.6	1.15 (0.72-1.87)	0.7	0.2	4.25 (1.65-8.48)
2	-	-	+	+	9.5	9.4	1.01 (0.82-1.25)	12.6	12.3	1.03 (0.85-1.22)
2	-	+	-	+	2.4	7.0	0.34 (0.22-0.51)	1.2	3.1	0.39 (0.20-0.65)
2	-	+	+	-	6.3	5.0	1.25 (0.95-1.59)	0.3	0.7	0.42 (0.08-1.18)
2	+	-	-	+	4.4	4.8	0.92 (0.66-1.23)	4.1	7.7	0.53 (0.38-0.72)
2	+	-	+	-	1.6	3.4	0.47 (0.25-0.75)	1.8	1.8	1.02 (0.62-1.62)
2	+	+	-	-	2.4	2.6	0.94 (0.62-1.45)	1.3	0.4	2.90 (1.49-4.80)
1	-	-	-	+	16.6	14.7	1.13 (0.96-1.32)	34.7	33.4	1.04 (0.93-1.15)
1	-	-	+	-	7.1	10.5	0.68 (0.53-0.87)	4.3	7.7	0.56 (0.41-0.75)
1	-	+	-	-	10.6	7.8	1.35 (1.10-1.64)	1.2	2.0	0.61 (0.31-1.04)
1	+	-	-	-	3.9	5.3	0.73 (0.51-0.99)	2.9	4.8	0.60 (0.41-0.86)
0	-	-	-	-	18.9	16.3	1.16 (1.00-1.39)	26.1	21.0	1.24 (1.09-1.40)

+: factor present; -: factor absent; T: smoking; A: excessive alcohol consumption; F: non regular fruit consumption; L: leisure physical inactivity; O: observed prevalence; E: expected prevalence. Numbers in bold represents statistical significance for prevalence that exceed the expected.

+: presença do fator; -: ausência do fator; T: tabagismo; A: consumo excessivo de álcool; F: consumo irregular de frutas; L: inatividade física no lazer; O: prevalência observada; E: prevalência esperada. Valores em negrito indicam significância estatística das prevalências que excederam o esperado.

Table 3 - Factors associated with clustering of health risk behaviors that exceeded the expected prevalence in men. Florianópolis, SC, SIMTEL, 2005.

Tabela 3 - Fatores associados às combinações de comportamentos de risco à saúde que excederam a prevalência esperada em homens. Florianópolis, SC, SIMTEL, 2005.

Variables	n	CR* (%)	Crude analysis		Adjusted analysis	
			OR (CI95%)	p	OR (CI95%)	p
Age range (years)				0.002		0.005
18-24	210	16.2	1.08 (0.61-1.93)		1.04 (0.58-1.86)	
25-34	239	23.8	1.75 (1.02-3.00)		1.57 (0.89-2.76)	
35-44	215	13.5	0.87 (0.48-1.57)		0.76 (0.41-1.42)	
45-54	150	27.8	2.11 (1.19-3.75)		1.87 (1.02-3.41)	
55 or older	148	15.5	1		1	
Skin color				0.800		
Non-white	346	18.8	0.96 (0.69-1.34)			
White	616	19.5	1			
Schooling (years)				0.573		
0 to 4	196	20.9	1.20 (0.76-1.88)			
5 to 8	194	16.5	0.89 (0.55-1.44)			
9 to 11	280	20.7	1.18 (0.78-1.79)			
12 +	293	18.2	1		1	
Employed				0.075		0.202
No	206	15.0	1		1	
Yes	757	20.5	1.47 (0.96-2.24)		1.35 (0.85-2.13)	

CR: clustering of behavioral risk factors that exceed the expected prevalence; OR: odds ratio.

CR: combinações de fatores de risco que excederam a prevalência esperada; OR: odds ratio.

Table 4 - Factors associated with the clustering of health risk behaviors that exceeded the expected prevalence in women. Florianópolis, SC, SIMTEL, 2005.

Tabela 4 - Fatores associados às combinações de comportamentos de risco à saúde que excederam a prevalência esperada em mulheres. Florianópolis, SC, SIMTEL, 2005.

Variables	n	CR* (%)	Crude analysis		Adjusted analysis	
			OR (CI95%)	p	OR (CI95%)	p
Age range (years)				0.127*		0.033*
18-24	190	7.4	1.70 (0.71-4.03)		2.20 (0.87-5.55)	
25-34	246	13.8	3.39 (1.58-7.30)		4.21 (1.89-9.39)	
35-44	235	11.1	2.65 (1.20-5.82)		3.21 (1.43-7.23)	
45-54	168	10.7	2.52 (1.09-5.80)		2.96 (1.27-6.90)	
55 or older	194	4.6	1		1	
Skin color				0.429		
Non-white	324	10.8	1.19 (0.77-1.83)			
White	709	9.3	1			
Schooling (years)				0.113*		0.035*
0 to 4	224	11.2	1.58 (0.86-2.91)		2.16 (1.13-4.11)	
5 to 8	208	11.1	1.57 (0.84-2.93)		1.66 (0.86-3.10)	
9 to 11	324	10.2	1.41 (0.79-2.51)		1.52 (0.85-2.72)	
12 +	278	7.5	1		1	
Employed				0.879		
No	436	9.6	1			
Yes	597	9.9	1.03 (0.68-1.57)			

CR: clustering of behavioral risk factors that exceed the expected prevalence; OR: odds ratio. *Test for trend.

CR: combinações de fatores de risco que excederam a prevalência esperada; OR: odds ratio. *Teste de tendência.

in the adjusted model. Despite the prevalence difference of almost 5 percentage points, there was no association between employment status and outcomes. Women displayed a strong correlation with age ranges from 25 years onwards, with greater likelihood of exhibiting clustering of risk behaviors. Moreover, women with less schooling tended to have a higher prevalence of clustered risk behaviors.

Table 5 shows the factors associated to simultaneous risk behaviors according to multinomial regression. Men were twice as more likely to exhibit three or four risk behaviors than women. Younger individuals with less schooling and employed were more likely to simultaneously display risk behaviors for chronic noncommunicable diseases.

Discussion

The present study investigated health risk behaviors in a representative sample of adults from Florianópolis, in order to identify specific behavior combinations that tended to cluster and possible variables associated to these combinations. According to the literature, men show higher prevalence in both individual and simultaneous risk behaviors. However, women tended to cluster behaviors more, smoking being the common factor in the five combinations that were higher than expected. The combination pattern that exceeded the expected prevalence was associated to advanced age and lower schooling.

As in studies that assessed individual risk behaviors¹⁴⁻¹⁷, simultaneous behaviors

Table 5 - Factors associated with the number of behavioral risk factors in adults, according to multinomial logistic regression. Florianópolis, SC, SIMTEL, 2005.

Tabela 5 - Fatores associados à simultaneidade de comportamentos de risco à saúde em adultos segundo regressão logística multinomial. Florianópolis, SC, SIMTEL, 2005.

Variable	Number of risk factors ¹		
	1 factor	2 factors	3 or 4 factors
Sex (women) men	1.17 (0.92-1.49)	1.55 (1.18-2.04)**	2.20 (1.58-3.06)**
Age range (55 or older)			
18-24	1.43 (0.96-2.14)	2.80 (1.73-4.55)**	1.86 (1.03-3.38)*
25-34	1.22 (0.82-1.81)	2.22 (1.38-3.57)**	1.98 (1.12-3.49)*
35-44	1.20 (0.80-1.78)	2.12 (1.31-3.41)**	1.95 (1.10-3.45)*
45-54	1.09 (0.73-1.64)	1.50 (0.90-2.47)	1.93 (1.08-3.45)*
Skin color (white)			
Non-white	1.11 (0.85-1.46)	1.23 (0.91-1.65)	1.28 (0.90-1.81)
Schooling (12 or more years)			
0 to 4	3.05 (2.06-4.51)**	3.86 (2.48-6.00)**	5.19 (3.06-8.78)**
5 to 8	1.79 (1.25-2.55)**	2.18 (1.46-3.25)**	4.06 (2.52-6.53)**
9 to 11	1.12 (0.84-1.50)	1.23 (0.88-1.73)	1.63 (1.05-2.52)*
Employed (no)			
Yes	1.50 (1.15-1.97)**	1.91 (1.40-2.61)**	1.83 (1.25-2.70)**

¹Reference category: zero risk factor / ¹Categoria de referência: nenhum fator de risco

* $p < 0,05$; ** $p < 0,01$

and/or risk factors are associated to sociodemographic variables such as age, schooling, marital status, income, and employment status^{5,6,8-11,18}. The relationship between age and simultaneous risk factors is controversial. While some studies indicate that advancing age is accompanied by greater clustering of risk factors⁴⁻⁶, others find no such correlation¹⁰⁻¹², sometimes observing an inverse association⁸. This lack of consistency is due in part to the inclusion in some studies of clinical conditions such as high blood pressure and obesity, which are more frequent in older individuals. On the other hand, some behaviors are differentially associated to age range in adults of Florianópolis, such as low fruit and vegetable intake in adults under 34 years of age¹⁷ and low leisure-time physical activity levels with increased age¹⁴. VIGITEL data from 2011² showed that the distribution of risk factors in different age groups varied with the behavior investigated. Negative behaviors, such as excessive alcohol consumption in the previous 30 days and irregular fruit intake, were more prevalent in young adults. However, a higher proportion of smokers and inactive individuals was found among older subjects².

Thus, as in most studies that investigated associations between risk behaviors and schooling^{8,9,14,17}, our study confirmed that individuals with less schooling tend to cluster and accumulate more risk behaviors. Likewise, women from Salvador, Brazil with less schooling accumulated more cardiovascular risk factors (two or more and five or more) than their more schooled counterparts, but this association was less significant among men⁹.

The association with employment status was not significant when the clustering of specific behaviors is analyzed (tables 3 and 4); however, working individuals were more likely to accumulate risk factors (table 5). One hypothesis for this finding is that the employed lead an unhealthy lifestyle because they have less time to take care of themselves. This is confirmed by two other studies using SIMTEL data from

Florianópolis, which showed a tendency to lower fruit and vegetable intake¹⁷ and less leisure-time physical activity¹⁴ in working adults, even after adjusting for the other variables.

Considering simultaneous risk factors, that is, only their accumulation, our findings were similar to other studies conducted in Brazil^{4,5}, England⁸ and Denmark¹⁰. The direct comparison of prevalence must be carried out with caution due to the inclusion of different amounts and types of risk factors, as well as their operational definition. Investigating the same behaviors studied here, Poortinga⁸ reported that around 42% of English adults clustered two or more risk factors. In a study with adults from Pelotas, Brazil that also analyzed eating behavior, smoking and physical inactivity, one-third of individuals were also found to exhibit two or more risk factors, and the likelihood of accumulating more risk factors was greater in men and less-wealth groups¹². Although they provide important information on the extent to which individuals accumulate risk behaviors, these data did not explain if simultaneity was in fact the result of a relationship between behaviors.

The prevalence of different risk behavior combinations observed in the present study underscores the need for interventions in two important behaviors related to the development of chronic noncommunicable diseases¹⁹: low physical activity levels simultaneous to unhealthy eating habits. As in the findings obtained by Gálan⁹, in a telephone survey of adults from Madrid, approximately 11% of our sample exhibited two behaviors simultaneously, even though the most significant combination in the earlier study was smoking and leisure-time physical inactivity (17%)⁹. In another investigation in Holland using similar analysis, 17.4% of adults showed two risk behaviors simultaneously¹⁰. Irrespective of the criteria adopted to classify physical activity level and an unhealthy diet, studies that evaluated simultaneous risk factors found that these two behaviors were the

most prevalent^{4,8,10-12}. Another significant clustering pattern was smoking, which was present in all combinations that exceeded expected levels, especially in women. Specific actions for this population group are necessary, given that Southern Brazil was the only region showing a tendency to increased prevalence of smoking in women between 2006 and 2009, in contrast to women from other regions and men, who exhibited stabilized and reduced prevalence, respectively²⁰.

Unfortunately, we do not have national data on the profile of risk behavior clustering in the adult population. One of the few studies conducted was based on the "Household Survey on Risk Behaviors and Reported Morbidity of Noncommunicable Diseases", which, in addition to behavioral factors (physical inactivity, diet, smoking and alcohol consumption), included biological risk factors, such as central obesity and high blood pressure⁴. Results of this survey indicated that physical inactivity and inadequate diet were the most frequent risk factors present in simultaneity patterns, with one, two or three factors⁴. Another important source of information is the VIGITEL, whose published data is restricted to describing prevalence and factors associated to isolated behaviors^{15,16,18,20-22}.

Interpretation of our results must take into account a number of methodological limitations. One of the main limitations of telephone-based surveys is loss of representativeness in relation to socioeconomic level and other variables, as can be observed in our sample, which showed small differences in sex, age and schooling level when compared to the 2000 Census. To partially correct this limitation we applied post-stratification, as recommended¹³. Furthermore, in metropolitan regions in Southern Brazil, it is estimated that at least 70% of households have telephone lines, making telephone estimate biases negligible²³. A second limitation is the restricted number of sociodemographic variables included in analyses. Even though schooling

is considered a proxy of socioeconomic level, particularly in Brazil, recent economic and social advances have promoted greater social mobility in the population, with schooling level possibly not reflecting income level or access to health services. Another limitation is a result of stratifying analyses by sex, since some of the associations do not exhibit satisfactory statistical power, which could have increased the likelihood of type II errors.

Analyses conducted in the present study relied on data obtained from SIMTEL-Florianopolis. For VIGITEL only prevalence data are available, and therefore, we could not carry out these analyses with more recent survey data. Comparison between data from SIMTEL in 2005 and VIGITEL in 2011 for the city of Florianopolis, showed a decreased prevalence of smoking (25% versus 14%) and excessive alcohol consumption (32% versus 17%). This may affect the risk factor clustering profile, underscoring the importance of comparative studies and time series to investigate whether the same clustering tendencies persist.

In spite of its limitations, the present study gives a detailed analysis of the combination patterns of four of the main risk behaviors associated to the development of noncommunicable chronic diseases. The analyses conducted provide additional information to studies that explored simultaneous behaviors/risk factors with a quantitative focus, since we explored behaviors that seem to be interdependent, instead of only the extent to which factors cluster. Moreover, knowledge of the combination patterns of these risk behaviors and the main groups exposed to them may contribute to planning and developing interventions directed at multiple behaviors. Further studies are needed to enhance knowledge of the combination patterns of these and other risk behaviors in the Brazilian population, given that the city of Florianopolis exhibits traits that differ from those of other regions in Brazil, such as a high Human Development Index. These

studies may constitute the basis for developing more efficient health promotion programs and policies.

Conflicts of interest: nothing to declare.

Financing: Study financed by the National Council for Research and Technological Development (CNPq, Process No. 477272/2004-5)

References

1. World Health Organisation. *The world health report: reducing risks, promoting healthy life*. Geneva: WHO; 2002.
2. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Secretaria de Gestão Estratégica e Participativa. *VIGITEL Brasil 2011: Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico*. Brasília: Ministério da Saúde; 2012.
3. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Secretaria de Gestão Estratégica e Participativa. *VIGITEL Brasil 2010: Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico*. Brasília: Ministério da Saúde; 2011.
4. Pereira JC, Barreto SM, Passos VMA. Perfil de risco cardiovascular e autoavaliação da saúde no Brasil: estudo de base populacional. *Rev Panam Salud Pública* 2009; 25: 491-8.
5. Lessa I, Araújo MJ, Magalhães L, Almeida Filho N, Aquino E, Costa MCR. Simultaneidade de fatores de risco cardiovascular modificáveis na população adulta de Salvador (BA), Brasil. *Rev Panam de Salud Pública* 2004; 16: 131-7.
6. Duncan BB, Schmidt MI, Polanczyk CA, Homrich CS, Rosa RS, Achutti, AC. Fatores de risco para doenças não-transmissíveis em área metropolitana na região sul do Brasil: prevalência e simultaneidade. *Rev Saúde Pública* 1993; 27: 43-8.
7. Schlecht NF, Franco EL, Pintos J, Negassa A, Kowalski LP, Oliveira BV, et al. Interaction between Tobacco and Alcohol Consumption and the Risk of Cancers of the Upper Aero-Digestive Tract in Brazil. *Am J Epidemiol* 1999; 150: 1129-37.
8. Poortinga W. The prevalence and clustering of four major lifestyle risk factors in an English adult population. *Prev Med* 2007; 44: 124-8.
9. Galan I, Rodriguez-Artalejo F, Tobias A, Diez-Ganan L, Gandarillas A, Zorrilla B. Clustering of behavior-related risk factors and its association with subjective health. *Gac Sanit* 2005; 19: 370-8.
10. Schuit AJ, van Loon AJ, Tjhuis M, Ocke M. Clustering of lifestyle risk factors in a general adult population. *Prev Med* 2002; 35: 219-24.
11. Tassitano RM, Feitosa WMN, Santiago Júnior GL, Tenório MCM. Simultaneidade de comportamentos de risco a saúde e fatores associados em trabalhadores da indústria. *Rev Bras Ativ Fis Saude* 2010; 15: 42-9.
12. Muniz LC, Schneider BC, Silva IC, Matijasevich A, Santos IS. Accumulated behavioral risk factors for cardiovascular diseases in Southern Brazil. *Rev Saúde Pública* 2012; 46(3): 534-42.
13. Monteiro CA, Moura EC, Jaime PC, Lucca A, Florindo AA, Figueiredo ICR et al. Monitoramento de fatores de risco para doenças crônicas por entrevistas telefônicas. *Rev Saúde Pública* 2005; 39: 47-57.
14. Martins TG, Assis MAA, Nahas MV, Gauche H, Moura EC. Inatividade física no lazer de adultos e fatores associados. *Rev Saúde Pública* 2009; 43: 814-24.
15. Malta DC, Moura EC, Silva SA, Oliveira PPV, Silva VLC. Prevalência do tabagismo em adultos residentes nas capitais dos estados e no Distrito Federal, Brasil, 2008. *J Bras Pneumol* 2010; 36: 75-83.
16. Moura EC, Malta DC, Moraes Neto OL, Monteiro CA. Prevalence and social distribution of risk factors for chronic noncommunicable diseases in Brazil. *Rev Panam Salud Pública* 2009; 26: 17-22.
17. Campos VC, Bastos JL, Gauche H, Boing AF, Assis MAA. Fatores associados ao consumo adequado de frutas, legumes e verduras em adultos de Florianópolis. *Rev Bras Epidemiol* 2010; 13: 352-62.
18. Berto SJP, Carvalhaes MABL, Moura EC. Tabagismo associado a outros fatores comportamentais de risco de doenças e agravos crônicos não transmissíveis. *Cad Saúde Pública* 2010; 26: 1573-82.
19. World Health Organisation. *Global strategy on diet and physical activity*. World Health Assembly. Geneva: WHO; 2004.
20. Silva GA, Valente JG, Malta DC. Tendências do tabagismo na população adulta das capitais Brasileiras: uma análise dos dados de inquéritos telefônicos de 2006 a 2009. *Rev Bras Epidemiol* 2011; 14: 103-14.
21. Moura EC, Moraes Neto OL, Malta DC, Moura L, Silva NN, Bernal R et al. Vigilância de Fatores de Risco para Doenças Crônicas por Inquérito Telefônico nas capitais dos 26 Estados brasileiros e no Distrito Federal (2006). *Rev Bras Epidemiol* 2008; 11: 20-37.

22. Malta DC, Moura EC, Castro AM, Cruz DKA, Morais Neto OL, Monteiro CA. Padrão de atividade física em adultos brasileiros: resultados de um inquérito por entrevistas telefônicas, 2006. *Epidemiol Serv Saúde* 2009; 18: 7-16.

23. Bernal R, Silva NN. Cobertura de linhas telefônicas residenciais e vícios potenciais em estudos epidemiológicos. *Rev Saúde Pública* 2009; 43: 421-6.

Received: 13/12/11
Final version: 08/06/12
Approved: 10/07/12