

# Clustering of behavioural risk factors and their association with subjective health

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(Agregación de factores de riesgo ligados al comportamiento y su relación con la salud subjetiva)

## Abstract

**Objectives:** To describe the clustering of behavioural risk factors in the adult population of the Autonomous Community of Madrid (Spain), and to evaluate the association between the level of aggregation of such factors and suboptimal subjective health.

**Methods:** Data were drawn from the Non-communicable Disease Risk-Factor Surveillance System (Sistema de Vigilancia de Factores de Riesgo asociados a Enfermedades No Transmisibles - SIVFRENT). We studied the relationships between tobacco use, high-risk alcohol consumption, leisure-time inactivity and unbalanced diet in 16,043 people aged 18-64, comparing observed against expected proportions. Logistic regression was used to estimate the association between aggregation of risk factors and suboptimal health (fair, poor and very poor health).

**Results:** Almost 20% of subjects had 3 or 4 risk factors. Most combinations of three risk factors exceeded expectations and, in particular, 4-factor clustering yielded observed/expected quotients of 2.15 (95% confidence interval [CI], 1.93-2.38) in men and 2.96 (95% CI, 2.46-3.46) in women. In both sexes, smoking was the individual factor most frequently associated with the remaining risk factors. Aggregation of risk factors was more frequent among men, in younger age groups and among subjects with low educational level. Compared to people with none of the 4 risk factors, those with 3 or four reported suboptimal subjective health more frequently (OR = 2.49; 95% CI, 1.59-3.90 for men and OR = 1.96; 95% CI, 1.29-2.97 for women).

**Conclusions:** Behavioural risk factors tend to aggregate, and this clustering is higher among men, in younger age groups and among subjects with a low educational level. A greater level of clustering is associated with a higher frequency of suboptimal self-rated health.

The Spanish version of this manuscript can be downloaded (PDF format) from the web ([www.doyma.es/ga](http://www.doyma.es/ga)).

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**Key words:** Behavioural risk factors. Clustering. Subjective health.

## Resumen

**Objetivos:** Describir la agregación de factores de riesgo relacionados con el comportamiento en la población adulta de la Comunidad de Madrid y evaluar la asociación del grado de agregación de dichos factores con la salud subjetiva subóptima.

**Métodos:** Los datos proceden del Sistema de Vigilancia de Factores de Riesgo asociados a Enfermedades No Transmisibles (SIVFRENT). Las relaciones entre el consumo de tabaco, el consumo de alcohol de riesgo, el sedentarismo en tiempo libre y la dieta desequilibrada fueron estudiadas en 16.043 personas de 18 a 64 años, y se compararon las proporciones observadas respecto a las esperadas. Mediante un análisis de regresión logística se estimó la asociación entre la agregación de factores de riesgo y la salud percibida subóptima (regular, mala y muy mala).

**Resultados:** Cerca del 20% de los sujetos presentan 3 o 4 factores de riesgo simultáneamente. La mayoría de combinaciones de 3 factores de riesgo son superiores a las esperadas, destacando la agregación de los 4 factores con un cociente observado/esperado de 2,15 (IC del 95%, 1,93-2,38) en varones y de 2,96 (IC del 95%, 2,46-3,46) en mujeres. En ambos sexos, el factor individual que más se asocia al resto de factores de riesgo es el tabaco. La agregación de factores de riesgo es más frecuente en varones, en edades jóvenes y en el nivel educativo bajo. En comparación con los que carecen de los 4 factores de riesgo, los que presentan simultáneamente 3 o 4 de ellos tienen con mayor frecuencia una salud percibida subóptima (OR = 2,49; IC del 95%, 1,59-3,90 en varones y OR = 1,96; IC del 95%, 1,29-2,97 en mujeres).

**Conclusiones:** Los factores de riesgo ligados al comportamiento se agregan, y esta acumulación es superior en varones, en personas jóvenes y con bajo nivel de estudios. Un mayor grado de agregación se asocia a mayor frecuencia de salud percibida subóptima.

**Palabras clave:** Factores de riesgo asociados al comportamiento. Agregaciones. Salud percibida.

## Introduction

Several behavioural risk factors such as smoking, excessive alcohol consumption, inactivity and an unbalanced diet are responsible for most of the burden of disease in developed societies, expressed in terms of general mortality<sup>1</sup>, or premature mortality and disability<sup>2</sup>.

The simultaneous occurrence of several factors in the same individual has been associated with a greater risk of general mortality, and more specifically with mortality from cancer, heart disease and stroke<sup>3-6</sup>. Furthermore, the accumulation of several factors increases the risk of suboptimal perceived health<sup>7</sup>, although most of this effect might be due to the health disorders they induce<sup>8</sup>. It has also been shown that the clustering of classic risk factors (low physical activity, unbalanced diet, smoking, and excessive alcohol consumption) is associated with an atherogenesis lipid high and blood pressure profile<sup>9</sup>.

Although lifestyle is treated as a one-dimensional structure, an approach employing diverse methodological options has demonstrated their multidimensionality<sup>10-14</sup>. This means that completely healthy or unhealthy patterns of behaviour are infrequent: most people show various combinations of healthy and unhealthy habits. For example, the relationships between smoking and alcohol consumption<sup>15</sup>, between smoking and diet<sup>16</sup>, and between physical activity and other factors are well known<sup>17</sup>. A wider-range of combinations in which a higher than expected frequency of 3- and 4-factor clustering has been observed has also been evaluated<sup>18-20</sup>.

Risk-factor clustering analysis can contribute towards designing improved public health interventions<sup>21</sup>. In particular, it can be used to identify lifestyle-related risk factors which lead to other unhealthy habits. Furthermore, it can improve the efficiency of interventions by directing them at the sectors of the population who exhibit the highest aggregation of risk factors. This approach may also be used to stimulate research into the underlying influences responsible for the observed risk-factor clusters. Nevertheless, earlier studies have shown that the prevalence of multiple behavioural patterns differs between socio-demographic groups and regions<sup>22,23</sup>. This study therefore focuses its attention on describing the composition and aggregation pattern of the main behaviour-related risk factors for the adult population of the Community of Madrid. In addition, it evaluates the degree of clustering of these factors with respect to suboptimal subjective health.

## Methods

### *Data source and study population*

The information source used was the Non-communicable Disease Risk Factor Surveillance System (SIVFRENT), which was based on continuous telephone surveys on health behaviour and preventive practices among the non-institutionalised population aged 18-64 years, living in the Community of Madrid. The study sample was selected from a telephone directory listing homes with landline telephone: in Madrid, this currently covers 94.8% of homes<sup>24</sup>. The interview was carried out using a CATI (Computer Assisted Telephone Interviewing) system<sup>25</sup>. The questionnaire consisted of a central core of questions which have remained unchanged since 1995, the year in which the survey was first conducted. The methods of this system have been described in detail elsewhere<sup>26</sup>. For this study, data analysis focussed on 16,043 interviews carried out from 1996 through 2003.

### *Study variables*

The behavioural factors analysed were: smoking, alcohol consumption, physical activity at leisure time and food habits. State of health was assessed as self-rated health during the previous twelve months. The following socio-demographic variables were also considered: age, educational level and social class.

Smokers were defined as people who had smoked more than 100 cigarettes in their lives and who still smoked at the time of completing the questionnaire. Risk-drinkers were defined as men who consumed a daily average of  $\geq 50$  ml of pure alcohol and women who consumed  $\geq 30$  ml per day, or men who consumed  $\geq 80$  ml and women who consumed  $\geq 60$  ml over a short period of time, such as during an afternoon or a night («binge drinking»). Estimation of average daily consumption was based on recall of the type, frequency and quantity of consumption of different alcoholic drinks during the previous week. Allocation of «binge drinking» pattern was based on recalled consumption of 8 units of pure alcohol («drinks») in men and 6 in women over a short period of time in the course of the previous 30 days. Leisure time inactivity was defined as not undertaking activities involving at least moderate-intensity activity for 30 minutes at a time at least 3 times a week. To estimate free-time physical activity, metabolic equivalents (METs)<sup>27</sup> were calculated from the frequency and duration of sporting activities during the previous 2 weeks. The CDC (Centers for Disease Control and Prevention) recommendation of

carrying out at least moderate-intensity activities was used: these were defined as activities whose assigned METs<sup>27</sup> were at least three times greater than those associated with resting<sup>28</sup>. Finally, an unbalanced diet was considered as consumption of less than 2 servings of fruit, juice or vegetables in the previous 24 hours.

State of health was assessed as perceived health over the previous twelve months: the categories were very good, good, fair, bad and very bad, with the categories fair, bad and very bad being considered as indicators of suboptimal health. Finally, the following socio-demographic variables were considered: age in 9 groups (18-24 years old and subsequent 5-year groupings up to the age of 64); education: higher (university studies), medium-high (second degree secondary studies), medium-low (first degree secondary studies), and low (primary studies or lower); social class<sup>29</sup>: class I (professionals and management positions in companies with 10 or more employees), class II (management positions in companies with fewer than 10 employees and intermediate professions), class III (qualified non-manual workers), class IVa (skilled manual workers), class IVb (semi-skilled manual workers), class V (unskilled manual workers).

### Analysis

All the possible risk factor combinations were studied, estimating each factor's prevalence and comparing observed and expected proportions. The expected probability was calculated assuming the independence of the different factors and multiplying the individual prevalence of each factor. The observed/expected ratios measured the direction and degree of behavioural clustering, and their 95% confidence interval was calculated assuming a Poisson distribution, as described by Breslow and Day<sup>30</sup>.

To identify population subgroups with the greatest probability of factor clustering, a logistic regression model was built adjusting for age, educational level, social class, and the year of the interview. Similarly, a logistic regression model was used to summarize the relationship between the number of risk factors present and the frequency of suboptimal subjective health, adjusting for age, educational level, social class, body mass index (weight in kg/square of the height in m<sup>2</sup>), and year of interview. The study years included in this analysis were 2000-2003, as subjective health was recorded from 2000 on. Analyses were done for each sex separately.

Statistical analysis was performed with the Stata v.7.0 (StataCorp, College Station, 2001).

## Results

The average response rate for the period 1996-2003, measured as the number of completed interviews, divided by the number of complete and incomplete interviews plus the number of interviews not performed (including negative responses and non-contacts)<sup>31</sup>, was 66.1%. Response rates ranged from 61.7% in 1999 to 69.5% in 1996.

Table 1 shows the socio-demographic characteristics of the study sample and the frequency of each factor presented both individually and by cluster. In total, 9.5% of men and 8.3% of women showed no risk factors, while 69.0% of men and 77.8% of women had only one or two factors. High levels of aggregation, with the accumulation of 3 and 4 factors, were respectively present in 17.2% and 4.4% of men, and 12.2% and 1.6% of women.

The different combinations of risk factors are shown in table 2. The greatest difference between observed and expected frequencies was evidenced for the si-

**Table 1. Socio-demographic characteristics and prevalence of behavioural risk factors, by sex**

	Men, n (%)	Women, n (%)
Total numbers of subjects	7794 (48.6)	8249 (51.4)
Age (years)		
18-29	2604 (33.4)	2582 (31.3)
30-44	2600 (33.4)	2794 (33.9)
45-64	2590 (33.2)	2873 (34.8)
Educational level		
High	2349 (30.1)	2201 (26.7)
Medium-high	2754 (35.3)	2633 (31.9)
Medium-low	1947 (25.0)	2245 (27.2)
Low	744 (9.6)	1170 (14.2)
Social class <sup>a</sup>		
Class I	1322 (18.3)	911 (13.0)
Class II	1049 (14.5)	736 (10.5)
Class III	1860 (25.9)	2059 (29.3)
Class IVa	1574 (21.8)	915 (13.0)
Class IVb	817 (11.3)	1378 (19.6)
Class V	586 (8.1)	1016 (14.5)
Risk factors		
Smokers	3252 (41.7)	3018 (36.6)
Risk drinkers	1448 (18.6)	603 (7.3)
Leisure time inactivity	5976 (76.7)	6932 (84.0)
Unbalanced diet	2668 (34.2)	2027 (24.6)
Number of risk factors		
0	737 (9.5)	688 (8.3)
1	2794 (35.8)	3815 (46.2)
2	2580 (33.1)	2608 (31.6)
3	1342 (17.2)	1003 (12.2)
4	341 (4.4)	135 (1.6)

<sup>a</sup>Class I: highest level; class V: lowest level.

**Table 2. Observed and expected values for combinations of behavioural risk factors, by sex**

Number of factors	T	A	S	D	Men			Women		
					Observed	Expected	O/E (CI 95%)	Observed	Expected	O/E (CI 95%)
0	-	-	-	-	9.5	7.3	1.30 (1.20-1.39)	8.3	7.1	1.18 (1.09-1.27)
1	+	-	-	-	3.1	5.2	0.60 (0.52-0.67)	3.4	4.1	0.84 (0.74-0.93)
1	-	+	-	-	1.4	1.7	0.84 (0.68-1.00)	0.5	0.6	0.87 (0.60-1.14)
1	-	-	+	-	27.6	23.9	1.15 (1.10-1.20)	40.9	37.3	1.10 (1.06-1.13)
1	-	-	-	+	3.8	3.8	1.00 (0.88-1.11)	1.5	2.3	0.64 (0.52-0.75)
2	+	+	-	-	1.5	1.2	1.25 (1.02-1.48)	0.6	0.3	1.99 (1.46-2.53)
2	+	-	+	-	15.5	17.1	0.90 (0.85-0.95)	18.3	21.5	0.85 (0.81-0.90)
2	+	-	-	+	1.8	2.7	0.67 (0.56-0.78)	1.2	1.3	0.88 (0.71-1.06)
2	-	+	+	-	3.2	5.5	0.59 (0.52-0.67)	1.2	2.9	0.40 (0.32-0.48)
2	-	+	-	+	1.1	0.9	1.23 (0.97-1.50)	0.2	0.2	0.87 (0.40-1.34)
2	-	-	+	+	10.0	12.5	0.80 (0.75-0.86)	10.1	12.1	0.83 (0.78-0.89)
3	+	+	+	-	4.0	3.9	1.03 (0.92-1.15)	2.2	1.7	1.27 (1.09-1.46)
3	-	+	+	+	1.7	2.8	0.61 (0.51-0.72)	0.8	1.0	0.81 (0.61-1.01)
3	+	-	+	+	10.2	8.9	1.15 (1.07-1.22)	8.9	7.0	1.28 (1.19-1.37)
3	+	+	-	+	1.2	0.6	1.97 (1.57-2.36)	0.3	0.1	2.66 (1.57-3.74)
4	+	+	+	+	4.4	2.0	2.15 (1.93-2.38)	1.6	0.6	2.96 (2.46-3.46)

T: tobacco smoking; A: alcohol risk drinking; S: leisure time physical inactivity; D: unbalanced diet; O/E: observed/expected; CI: confidence interval; +: factor present; -: factor absent.

multaneous combination of 4 risk factors, with an observed/expected ratio of 2.15 for men and 2.96 for women. This indicates that the frequency with which these 4 factors simultaneously occur was 115% greater in men and 196% greater in women than the frequency that would be predicted if these factors were independent. The second combination worthy of comment was the clustering of current tobacco smoking, risk-drinking and people with unbalanced diets, with an observed/expected ratio of 1.97 in men and 2.66 in women. All 3-factor combinations showed higher values than expected (except risk-drinking, inactivity and an unbalanced diet in men). The same is true for the relationship between simultaneous smoking and drinking, particularly

in women, who showed a frequency almost twice as that expected. There was also a group of people who have a relatively healthy profile, in which all of the factors are negative: this combination appears to be 30% more prevalent than expected in men and 18% more in women.

Table 3 shows the relationship between the presence of a specific risk factor and the aggregation of the remaining behaviours. The individual factor most associated with this clustering was tobacco smoking; in fact, as compared to non-smokers, men and women who smoke had, respectively, odds ratios (OR) = 3.72 (IC 95%, 2.98-4.66) and 3.15 (IC 95%, 2.25-4.42) for having the other 3 risk factors. In second place comes high-risk alcohol consumption, followed by an unbalanced diet.

**Table 3. Association of each behavioural risk factor and the simultaneous clustering of the remaining risk factors by sex**

Risk factors	Men		Women	
	Crude % (L)	OR <sup>a</sup> (CI 95%)	Crude (%)	OR (CI 95%)
Non-smokers	3.0	1	1.2	1
Smokers	10.5	3.72 (2.98-4.66) <sup>c</sup>	4.5	3.15 (2.25-4.42) <sup>c</sup>
Non-risk drinkers	12.5	1	9.6	1
Risk drinkers	23.6	2.06 (1.76-2.41) <sup>c</sup>	22.4	2.16 (1.71-2.73) <sup>c</sup>
Leisure time active	5.2	1	1.7	1
Leisure time inactive	5.7	1.39 (1.08-1.79) <sup>b</sup>	1.9	1.49 (0.90-2.44)
Balance diet	6.1	1	2.9	1
Unbalanced diet	12.8	1.87 (1.57-2.22) <sup>c</sup>	6.7	1.88 (1.46-2.42) <sup>c</sup>

<sup>a</sup>From logistic regression, adjusted for age, educational level, social class and year of interview. <sup>b</sup>p < 0.05. <sup>c</sup>p < 0.001.

**Table 4. Association of age, educational level and social class with the simultaneous presence of 3-4 behavioural risk factors, by sex**

	Men		Women	
	Crude (%)	OR <sup>a</sup> (CI 95%)	Crude (%)	OR (CI 95%)
Total	21.6	1.74 (1.59-1.90) <sup>b</sup>	13.8	1
Age (years)				
18-24	25.5	1	24.2	1
25-29	26.0	1.03 (0.84-1.25)	21.5	0.73 (0.59-0.90) <sup>b</sup>
30-34	28.5	1.06 (0.86-1.31)	17.2	0.54 (0.43-0.69) <sup>c</sup>
35-39	23.1	0.81 (0.66-1.01)	13.8	0.40 (0.32-0.52) <sup>c</sup>
40-44	21.1	0.70 (0.56-0.88) <sup>b</sup>	10.9	0.31 (0.24-0.41) <sup>c</sup>
45-49	18.2	0.58 (0.46-0.74) <sup>c</sup>	9.4	0.27 (0.20-0.37) <sup>c</sup>
50-54	18.9	0.55 (0.43-0.71) <sup>c</sup>	6.7	0.21 (0.15-0.30) <sup>c</sup>
55-59	11.9	0.31 (0.23-0.42) <sup>c</sup>	3.7	0.11 (0.07-0.18) <sup>c</sup>
60-64	8.9	0.20 (0.14-0.28) <sup>c</sup>	2.3	0.06 (0.03-0.11) <sup>c</sup>
Educational level				
High	16.4	1	13.6	1
Medium-high	21.4	1.19 (1.00-1.41) <sup>b</sup>	17.2	1.21 (0.99-1.46)
Medium-low	28.0	1.90 (1.57-2.28) <sup>c</sup>	14.4	1.39 (1.11-1.74) <sup>b</sup>
Low	21.6	2.03 (1.57-2.63) <sup>c</sup>	5.5	1.11 (0.77-1.60)
Social Class				
Class I	16.2	1	11.7	1
Class II	19.3	1.03 (0.83-1.29)	10.5	0.83 (0.60-1.14)
Class III	19.3	1.02 (0.83-1.25)	15.6	1.20 (0.93-1.54)
Class IVa	26.7	1.28 (1.02-1.60) <sup>b</sup>	12.6	0.92 (0.67-1.26)
Class IVb	27.0	1.20 (0.94-1.53)	20.1	1.38 (1.04-1.82) <sup>b</sup>
Class V	28.0	1.22 (0.93-1.60)	11.4	1.07 (0.77-1.49)

<sup>a</sup>From logistic regression, adjusted for age, educational level, social class and year of interview. <sup>b</sup>p < 0.05. <sup>c</sup>p < 0.001.

The factor with the lowest tendency for clustering was leisure time inactivity. Except for tobacco smoking, where the association was greatest in men, the relationship was very similar for both sexes.

The presence of 3 or 4 risk factors occurred almost as twice as often in men as in women (table 4). The aggregation of 3 or 4 factors was also more frequent in the younger age groups (18 and 34 year olds in men and 18-24 year olds in women). In men, the frequency of clustering decreased with age after the age of 34. A similar pattern was shown for women, with the frequency of clustering decreasing from the 25-29 year old age group, with subsequent reductions being more pronounced than in men. The frequency of factor clustering in men also increased with a decreasing educational level. This gradient was not observed in women, although in comparison with women with university studies the probability of aggregation was always greater in groups with lower educational level. With regard to social class based on occupation, men exhibited greater accumulation of factors in the manual classes (IVa, IVb and V) in comparison with men in class I, although this was only statistically significant in category IVa. For women, there was no clearly observable pattern, although those of class IVb showed an OR of 1.39 (IC 95%, 1.04-1.82)

with respect to members of the highest social class (table 4).

Finally, the frequency of suboptimal health increased with the accumulation of behavioural factors (table 5). As compared to people with none of the risk factors studied, those with only one risk factor showed an OR for suboptimal subjective health of 1.90 (IC 95%, 1.24-2.93) in men, and 1.44 (IC 95%, 1.00-2.08) in women. In people with 3 or 4 factors these OR increased to 2.49 (IC 95%, 1.59-3.90) and 1.96 (IC 95%, 1.29-2.97) for men and women, respectively.

## Discussion

The results of this study suggest that an important percentage of the population, about 20%, shows 3 or 4 important risk factors simultaneously: smoking, high-risk drinking, leisure time inactivity and having an unbalanced diet. These factors cluster on a multidimensional structural base, with tobacco smoking being the factor most closely related with the accumulation of other factors. The existence of high levels of aggregation was more common in men, in younger age groups and in

**Table 5. Association of the number of behavioural risk factors with suboptimal subjective health, by sex**

Number of risk factors	Men		Women	
	Crude (%)	OR <sup>a</sup> (CI 95%)	Crude (%)	OR (CI 95%)
0	7.2	1	14.1	1
1	17.0	1.90 (1.24-2.93) <sup>b</sup>	24.7	1.44 (1.00-2.08) <sup>b</sup>
2	16.5	2.07 (1.34-3.20) <sup>b</sup>	20.1	1.50 (1.03-2.19) <sup>b</sup>
3-4	17.2	2.49 (1.59-3.90) <sup>c</sup>	20.3	1.96 (1.29-2.97) <sup>b</sup>

<sup>a</sup>From logistic regression, adjusted for age, educational level, social class, body mass index and year of interview. <sup>b</sup>p < 0.05. <sup>c</sup>p < 0.001.

the case of lower educational level, and was associated with a suboptimal subjective health. These results are consistent with those observed in previous studies<sup>19,20,23,32</sup>.

The frequency and distribution of the indicators studied, both individually and as a cluster, depends on the definition employed. In this work, the definition of tobacco smoking was the same as that regularly used in other health surveys<sup>33</sup>. The definition for risk-drinking was partly established in relation to average daily intakes in line with criteria proposed by the Programme for Preventive Activities and Health Promotion (PAPPS) of the *Sociedad Española de Medicina de Familia y Comunitaria* (Spanish Society for Family and Community Medicine)<sup>34</sup>, and also took into consideration «binge drinking», whose relationship with an increase in mortality is now well-known and documented<sup>35</sup>. The definition of leisure time inactivity was also elaborated according to the recommendations of the PAPPS<sup>34</sup>. Finally, insufficient consumption of fruit and vegetables, as an indicator of an unbalanced diet, was limited to the consumption of less than 2 rations per day. This frequency is situated in the lower quartile of quintile, and is a reference category used to calculate the risk of cardiovascular diseases and cancer<sup>36,37</sup>.

A limited number of people (about 9%) have a very healthy profile, having none of the indicated risk habits, and another minority (3%) has a very unhealthy profile, with all of the positive risk factors being present. These data are coherent with the absence of a one-dimensional structure<sup>10,13</sup>, according to which there should be 2 majority groups within the population; one with completely healthy habits and the other with unhealthy habits. In our case most people exhibit 1 or 2 risk factors, although the proportion of people with three or four factors is also high (close to 20%), but it is distributed with different frequencies for different combinations of aggregation, according to the multidimensional concept of these behavioural habits<sup>11,14</sup>. Our results are very similar to those reported in the studies of Schuit et al.<sup>19</sup> for Germany and Laaksonen et al.<sup>20</sup> for Finland, in which the same risk factors were investigated. Of the 4 indicators studied, tobacco smoking is the one that presents the gre-

atest probability of clustering with other risk factors. This is followed by excessive alcohol consumption and an unbalanced diet, while inactivity exhibits a much weaker relationship. This important role for tobacco in clustering has been described by Prättälä et al.<sup>32</sup> as the «gateway» to other risk factors, and Burke et al.<sup>18</sup> and Laaksonen et al.<sup>23</sup> have reached similar conclusions. Moreover, the weakest association—that of inactivity with the other risk factors—is also in line with observations based on other studies<sup>17,38</sup>.

The simultaneous existence of several unhealthy habits is more common in men than in women, and in younger people as opposed to older people. This age-related distribution probably reflects the higher survival rate of subjects who have maintained healthier habits and lifestyles, since—as many studies have shown—the presence of these risk factors is responsible for a significant incidence of premature mortality<sup>1-6</sup>. This situation could also be due to improvements in diet and the abandoning of addictive habits such as smoking or excessive alcohol consumption<sup>39</sup> by older subjects. As well as being associated with abandoning unhealthy habits and/or differential survival, the more pronounced age-related differences associated with women could express a certain cohort effect in the adoption of risk factors<sup>23</sup>. This has, for example, occurred in our geographical area in the case of tobacco smoking<sup>40</sup>.

People with lower socio-economic status generally exhibit less healthy behaviour<sup>41</sup>. From comparisons among different indicators, it seems that education rather than income or occupation is the factor most consistently associated with different behavioural habits<sup>42</sup>. In our study, a greater aggregation of unhealthy behaviour was observed in people with low educational levels, while the relationship with occupation appeared less pronounced when the 2 variables were modelled simultaneously. This relationship with educational level has also been described by other authors considering similar risk factors.<sup>9,19,23,33</sup> Our data showed this association as being greater for men than for women, with the difference being greater than that observed by Laaksonen et al.<sup>23</sup>. These results can be explained by a differential degree of incorporation of women into un-

healthy and particularly addictive habits. For example, it is well documented that in the early stages of the development of epidemic tobacco addiction, the people who start smoking first belong to higher socio-economic levels, while in later stages, the greatest frequency of consumption occurs in the lower social class categories<sup>43</sup>. This effect can be clearly seen in our region, where – until recently – tobacco smoking was most prevalent in women from the highest socio-economic groups and the same was true of alcohol consumption. However, in recent years a change in this pattern has been observed, with a tendency towards similar frequency in all strata. In men, however, all of the risk indicators are most frequent in the lowest socio-economic categories<sup>44</sup>.

Subjective health is considered a valid indicator of the state of health and is an important independent predictor of morbidity and mortality<sup>45,46</sup>. Many investigations have detected an association between various individually assessed risk factors and a worse state of health<sup>8,46-50</sup>. This situation is also repeated with factor clustering<sup>9,19</sup>; as in our study, previous works show that as simultaneous risk factors accumulate, state of health worsens. This relationship could reflect the effects of both physical health problems and the functional limitations arising from these risk factors, because the physical symptom component tends to be related to perceived health<sup>51</sup>. When the model considers chronic diseases related to these factors, such as diabetes or known obstructive respiratory diseases (data not shown), this relationship is less marked. Indeed, it would be expected to diminish even further if other health problems were taken into account. This could be interpreted as the potential effect on perceived health being measured by the existence of chronic health problems, which would act as an intermediate step between the risk factors and the subjective state of health<sup>8</sup>. Even so, it is also likely that there is another direct relationship with these unhealthy habits that is independent of the existence of other health problems<sup>49</sup>.

The 4 indicators have been aggregated with each receiving a similar weighting. Several authors have criticised the construction of these additive indices in which each factor is given equal treatment<sup>52,53</sup>, despite the fact that their contribution to the development of chronic health problems is different. Nevertheless, such indices have been successfully employed to explain the risk of morbidity and mortality<sup>3,4,54</sup>. Furthermore, as this is a cross-sectional study, it is not possible to make causal inferences on the relationships detected. For example, a person with health problems is likely to modify his/her behaviour by giving up smoking or excessive alcohol consumption, or by making health-favouring changes in diet or physical activity. This change in lifestyle would subsequently lead to this person being placed in a different category in the current classification,

with little or no consequent factor clustering. Because recent ex-smokers<sup>49</sup> and ex-drinkers<sup>50</sup> have a worse state of health, the magnitude of the observed relationship would tend to decrease.

In conclusion, a high percentage of the population, almost one in five people, simultaneously exhibits 3 or 4 of the following risk factors: smoking, high-risk drinking, leisure time inactivity and an unbalanced diet. These factors cluster in a multidimensional fashion, with smoking being the risk factor with the highest frequency of clustering. Clustering varies among socio-demographic strata, being most common in men, in younger age groups and in people with low educational level. The accumulation of factors is associated with suboptimal perceived health.

The tendency for these risk factors to cluster, the description of the pattern of combinations, and the identification of population groups with high clustering frequencies may have important implications for the design of population health promotion strategies, and also for the elaboration of preventive strategies for primary health care, largely based on the detection of individual risk factors.

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