

Life-Styles of Spanish School-Aged Children: Their Evolution over Time¹. Use of Multiple Correspondence Analysis to Determine Overall Trends over Time in a Sequential, Cross- Sectional Study

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Abstract

In using usual univariate and bivariate analyses of a population's life styles researchers will encounter major limitations because these phenomena are essentially complex. This article uses multivariate statistical analysis, specifically Multiple Correspondence Analysis, with a two-fold purpose. First of all, it aims to analyse the general evolution of life styles in 11,13 and 15-year old Spanish schoolchildren between 1986 and 1994. Secondly, it evaluates the usefulness of MCA in studying this evolution.

The study uses the data collected within the framework of the Spanish study "Conductas de los escolares relacionadas con la salud", which is part of the study "Health Behaviour in School-Age Children", a WHO Cross-National Study. These data stem from three surveys of Spanish schoolchildren in 1986, 1990 and 1994. All three surveys used a similar sampling method (random, proportional, stratified and multi-stage) and data collection procedure (a questionnaire filled in anonymously by the

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This research is part of the international study on "Health Behaviour in School-Aged Children: A WHO Cross-National Study". Dr. Candace Currie, University of Edinburgh (Scotland) is the current international co-ordinator. The WHO official in charge of this study is Dr. Erio Ziglio (Regional Office for Europe, Copenhagen).

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children in their classrooms). The analysis was based on 57 variables which were common to all three surveys. Forty-seven of these variables are related to various features of life styles, adaptation to school and integration in the family circle. The remaining ten are socio-demographic. The resulting matrix included data on these 57 variables collected from 10,603 subjects.

Research findings suggest that 11 and 13 year old Spanish schoolchildren's life styles have evolved positively over the years studied. However, there was scarcely any positive evolution in 15 years olds' life styles. Indeed, 15 year old girls apparently registered no improvement at all. In an attempt to explain this, the article explores several hypotheses in detail.

MCA proved very useful in obtaining a global view of the evolution of a population's life styles. Using a procedure similar to the one described in this paper, MCA allows researchers to simultaneously summarise evolution over time on the basis of the two most discriminatory dimensions. Nevertheless, the MCA technique has some fairly significant limitations: it only provides an overall view of evolution over time, does not go into details about particular variables and it is affected by the sizes of the successive samples or sub-samples. These problems are easy to control, which makes the technique very useful when studying the evolution over time of multi-variable phenomena such as life styles.

1 Introduction

The life-styles of adolescents are likely to have a decisive short term and long term impact on various aspects of their personal development. Life-styles are quite possibly an important factor in determining the type of social relations maintained by adolescents, the social skills they develop and the extent of their social isolation, or integration. Moreover, the life-styles of adolescents may influence the specific physical and intellectual skills they develop, their integration at school, their immediate and long-term job possibilities, their physical and psychological welfare and, ultimately, their very life expectancy.

The impact of life-styles on health and life expectancy is fairly well-documented. Since the Lalonde Report (1974), life-styles have been considered to be what most influence health in industrialised countries in times of peace. In Spain, for example, the death rate of young people is on the rise, due to traffic accidents, AIDS and drug abuse, all of which are linked to particular life-styles (Sanz and Pérez, 1997 (a) and (b); Ruiz et al., 1997; Sarasqueta and Zunzunegui, 1994). Smoking warrants separate mention as it is the single most important cause of disease and early death in developed countries (Peto and López, 1994; Harkin et al., 1997; Joosens et al., 1994). Indeed, smoking currently accounts for two million early deaths per year in industrialised countries as a whole. Most of these deaths occur before late middle age (before the age of 70). Smokers who die between the ages of 30 and 70 are estimated to lose an average of 22 years of life (Peto and López, 1994).

Although more research needs to be done on how physical activity and other features of life-style affect health (Biddle et al., 1998), there is already sufficient accumulated empirical evidence to conclude that it is well worth the effort to encourage children and adolescents to adopt healthy life-styles and avoid pathogenic behaviour (smoking, abuse of alcohol or other substances, dangerous driving or overexposure to the sun, to mention just a few examples).

The usual habits of adolescents (and adults and children too, for that matter) are not isolated from one another but tend to interrelate in such a way as to shape prevalent behaviour patterns. By "life-style" we mean precisely this: the set of behaviour patterns which characterises the general way in which an individual, group, or population lives (Mendoza et al., 1994a). Values, attitudes, beliefs and other variables of this type are closely related to life-style, but are not, strictly speaking, part of it. The "life-style" concept refers only to behaviour patterns which prevail in the way the daily life of the subject is organised.

Assuming then that everyone has a particular life-style rather than a series of isolated habits, we can deduce that it is advisable to promote the acquisition or maintenance of *healthy life-styles* rather than simply warning against pathogenic habits or encouraging isolated healthy practices.

For similar reasons similar to those indicating the need to encourage healthy life-styles, one can also conclude that it is important to stimulate life-styles which are *educational* (i.e. facilitate full development of the intellectual, physical and affective capabilities and social integration of the subject) and *ecological*, or compatible with sustainable development. Likewise, it is important to encourage life-styles which promote social support or at least respect the needs, interests and values of other people.

Any strategies adopted with the aim of influencing life-styles should be based on a thorough understanding of the factors determining these life-styles (Mendoza, 1991). As far as the life-style of adolescents is specifically concerned, it is essential to start by determining the most prevalent styles and trying to understand the reasons for their prevalence. It would also be interesting to know which time trends are present and to establish reasons for this evolution. Moreover, we need to know whether the adolescent life-style is becoming increasingly standardised or if a considerable heterogeneity exists and to understand the reasons for this standard or varied life-style. In addition, the short- and long-term implications of different life-styles for adolescent development should be studied in terms of their effects on education, health care, ecological awareness, social support and other conceivably relevant perspectives.

Any phenomenon can be better understood by observing the way it evolves. Research on how adolescent life-styles evolve over time helps pinpoint the origin of these life-styles and estimate their immediate and longer-term effects. Moreover, research of this type can prove useful when assessing the impact of measures that aim to protect adolescents or any other measures that affect them.

Researching life-styles requires a different approach than studying isolated behaviours. Data on many aspects –those more relevant in life-style shaping- have to be gathered and analysed, which necessarily calls for a multivariate approach. Traditional univariate or bivariate statistics are not suitable for studying patterns of behaviour because they analyse the relations in a fragmented, partial and less than systematic way. Furthermore, they are more focussed on analysing dependence than on interdependence (see Hair et al., 1996 or Tack, 1997). In addition, as the capability of the human mind for processing and extracting information from much data is limited, multivariate statistics become a powerful tool for understanding complex phenomena. Within a more realistic statistical approach, multivariate methods help to strike a balance between ease of interpretation (underscoring what is essential) and completeness of description (sacrificing non-vital information).

When research is focussed on studying life-styles of adolescents in a particular country or region over time, data that can be compared throughout the time period is needed. This can be obtained by using a simple longitudinal design (tracking the evolution of a particular sample of adolescents) or with a sequential cross-sectional study in which information about the same variables is periodically collected from equivalent samples of adolescents in the same age group. Sequential cross-sectional studies enable researchers to identify which particularities are linked to age, which to generation, and which to the year or point in time at which the information is collected. This can all be additionally achieved through a sequential longitudinal study, but it would require considerably more effort on the part of the researchers (Baltes et al., 1977).

In short, tracking the evolution of adolescent life-styles implies the availability of data that can be compared over time. If not, it will be impossible to track how these life-styles evolve. Sequential cross-sectional studies may provide them, but require stability in the research teams undertaking these studies, as well as stability in their lines of research and sources of funding. This is rarely the case, which explains why sequential studies of adolescent life-styles are quite rare and relatively recent.

One of the pioneer sequential cross-sectional studies in this field is the Finnish *Adolescent Health and Lifestyle Survey*, which bianually collects information from a random sample of adolescents aged 14, 16 and 18 (Ahlström et al., 1979; Rimpelä et al., 1983; Karvonen and Rimpelä, 1996; Honkala et al., 1997).

European-wide research on *Health Behaviour in School-aged Children (HBSC)* started in 1983. An international project sponsored by the European regional office of the World Health Organisation studies various facets of the life-styles of schoolchildren aged 11, 13 and 15, with particular emphasis on health-related behaviour. The number of countries taking part in the study has grown steadily and more than 25 are currently regularly surveying representative samples of schoolchildren in these age groups (500 boys and 500 girls in each of the three age groups, i.e. 3000 schoolchildren per country). The children are surveyed in their

classrooms, where they are asked to fill in a standard questionnaire, which is then put into an envelope and sent to the institution in charge of the study in that particular country, usually a university (WHO, 1997; Wold et al., 1993; Mendoza et al., 1994b; King et al., 1996; Currie and Watson, 1998). In some countries the questionnaires and envelopes are mailed to the schools. In others, like Spain, they are administered by specially trained professional survey-takers (Mendoza et al., 1998; Mendoza et al., 1994a). Although it was initially planned to collect the data once every two years, in 1986 researchers decided to facilitate the organisation of the survey by extending the period to once every four years. Since 1993/1994 the sample for each country has been increased to 1300 children per age group (3900 per country), which means that the overall sample for each period amounts to more than 100,000 schoolchildren of the three above-mentioned age groups. Since 1985/86 Canada has also taken part in the study and the USA has recently joined the group.

Since 1990 the United States has been regularly carrying out the *Youth Risk Behavior Survey*, co-ordinated by the CDC (Center for Disease Control and Prevention, 1997-1998; Kolbe, 1990; Pate et al., 1996). The points studied are very similar to those included in the HBSC surveys. The sample population consists of children in the 9th to 12th grades from throughout the country (in the 1997 edition, n=16,262). Some states also survey state or local samples. As in the case of the HBSC study, information is collected through classroom-administered questionnaires.

Spain has been taking part in the HBSC study since 1986 (Mendoza et al., 1994a; Mendoza et al., 1994b; Mendoza et al., 1998; Mendoza et al., 1988; Mendoza and Sagrera, 1990). The findings and analyses discussed in this article are based on data from the 1986, 1990 and 1994 surveys. Prior to 1986, there had never been a Spanish survey that used a representative sample of the schoolchildren of the country in order to collect information on a broad range of health-related behaviour or on specific behaviour such as smoking or drinking.

Once the pre-requisite of having comparable data on the life-styles of schoolchildren has been met, the relevant question of which is the best method for analysing the overall evolution of life-styles over time arises.

As mentioned earlier, using a multivariate approach to analyse data from a single life-style study (for a single year) has definite advantages over a bivariate approach. However, when studying the evolution of life-styles over time, a bivariate approach is almost invariably used. Why not study the evolution of life-styles over time from a multivariate perspective as well?

Admittedly, using a bivariate approach to study how the life-styles of a population evolve over time offers some interesting possibilities. It is useful to know whether a particular type of behaviour is or is not increasingly widespread among adolescents of a certain age and gender. Thus, for example, it has been observed that the percentage of 15 year old Spanish girls who smoke registered a significant increase between 1990 and 1994, which should have implications for

the health care and education systems (Mendoza et al., 1998). But does this mean that the importance of the role of smoking in the definition of adolescent life-styles has also changed between 1990 and 1994? It is unlikely that a bivariate approach when studying time trends would provide the answer to this question.

Nonetheless, it is useful to see whether or not bivariate associations remain unchanged over time. This would make verification of our hypotheses more consistent. Otherwise, they can be suspected of simply reflecting particular socio-cultural conditions or the specific features of a particular step in the evolution of a phenomenon that is gaining or losing popularity among adolescents. In social sciences, associations between variables are not necessarily universal or stable. This can be verified within the limits of a strictly bivariate approach.

When it comes to analysing the evolution of life-styles over time, a bivariate approach is therefore undeniably useful. However, it also has considerable limitations, precisely as attempting to carry out a bivariate study of an intrinsically multivariate phenomenon is so tedious and the results so incomplete.

Multiple correspondence factor analysis (MCA) is one of the techniques that enables researchers to use a multivariate approach in life-style studies, although it has scarcely been used for this purpose. As we all know, this technique is commonly used to analyse responses to surveys containing ordinal or nominal variables. With MCA, information about the set of original variables (survey items) can be summed up in a limited number of latent synthetic variables (factorial axes or factors) which allow us to quickly and easily interpret the interdependency of all the survey variables (Lebart et al., 1984; Lebart et al., 1995; Greenacre and Blasius, 1994; Blasius and Greenacre, 1998). The underlying factors obtained operationalise concepts which are common to the observed variables and therefore synthesise, explain or help to understand the relations observed between the various indicators; in other words, they characterise the structure of their interdependence. "When analysing the interdependence between two or more nominal variables with multiple categories, we are usually concerned with the overall nature of this relationship. It is not so much a matter of learning whether a particular category of variable is associated with another category of variable as of being able to succinctly explain the underlying structure of the relationship. How many concepts or dimensions responsible for these associations can be observed among the various categories? In other words, what is their true structure? What is their specific nature? Which categories relate to each of these dimensions?" (Batista and Sureda, 1998).

The purpose of all multivariate analysis techniques is to synthesise a large amount of data in order for the information to be shown in graphic form. This geometry-based approach makes it a great deal easier to interpret data: a chart enables readers to comprehend relations that would be more difficult to understand in algebraic terms. The perception of graphs –visual decoding of geometrically codified information– enables our sophisticated information processing system to quickly and easily capture a large volume of information and immediately store it.

This allows us to concentrate our intellectual efforts on critically evaluating the information perceived. This makes it more likely that our understanding of the subject under study will significantly increase. Moreover, the ease with which we can retrieve the information stored in our brains facilitates the subsequent use of this information where relevant, and this further enhances our knowledge. "The usefulness of multivariate techniques in general, and Multiple Correspondence Analysis (MCA) in particular, is that what is gained in interpretability far exceeds what is lost in terms of information" (Greenacre, 1993).

In order to be able to use MCA to describe evolution over time, the construction of a single matrix should be previously carried out. This matrix should contain the data for the successive waves and include the year in which the information was collected as a variable. The process we used to do this will be described at a later point in this paper. Earlier on, Morineau (1992) used factor methods to assess evolution over time, although he did not use them to evaluate life-styles' evolution over time.

This paper has three objectives. The first is to analyse how the life-styles of Spanish schoolchildren between 11 and 17 years of age differ according to age and gender. The second is to create a general picture of how life-styles of Spanish schoolchildren aged 11,13,15 evolved between 1986 and 1994. The third and last objective involves determining the extent to which MCA is a useful technique for studying the overall evolution of time trends in the life-styles of a population.

The paper does not aim to examine the evolution of each of the different types of behaviour on which information has been collected within the framework of the Spanish HBSC. This has been done in other papers (Mendoza et al., 1998; Mendoza et al., 1994a). Neither do the authors attempt to pinpoint the particular factors that determine the evolution of the life-styles of Spanish school-aged children, although the information presented here could certainly shed some light on the subject.

2 Methodology

In order to meet the mentioned objectives, the authors used the data collected for the study Health-Related Behaviour in Spanish Schoolchildren, or ECERS as the Spanish acronym. The data is taken from surveys carried out in 1986, 1990 and 1994.

This research is part of the European study on Health Behaviour in School-Aged Children mentioned in the introduction. The main objective of this cross-national research is to regularly collect comparable data about various features of the life-styles of schoolchildren (particularly those related to health) and other variables which are closely related to their life-styles, such as how they adapt to school life (WHO, 1997; Wold et al., 1993; Mendoza et al., 1994b). It is hoped

that the resulting information will provide a clearer knowledge of the life-styles of European schoolchildren and contribute towards shaping a better understanding of the determining factors as well as encouraging health promotion measures, especially those focussed on enhancing the health of young people (Currie and Watson, 1998).

The methodology used in the cross-national study was briefly described at the outset of this article. More detailed descriptions have been published in a variety of journals and working papers (WHO, 1997; Wold et al., 1993; Mendoza et al., 1994b; King et al., 1996; Aarö et al., 1986; Aarö and Wold, 1989).

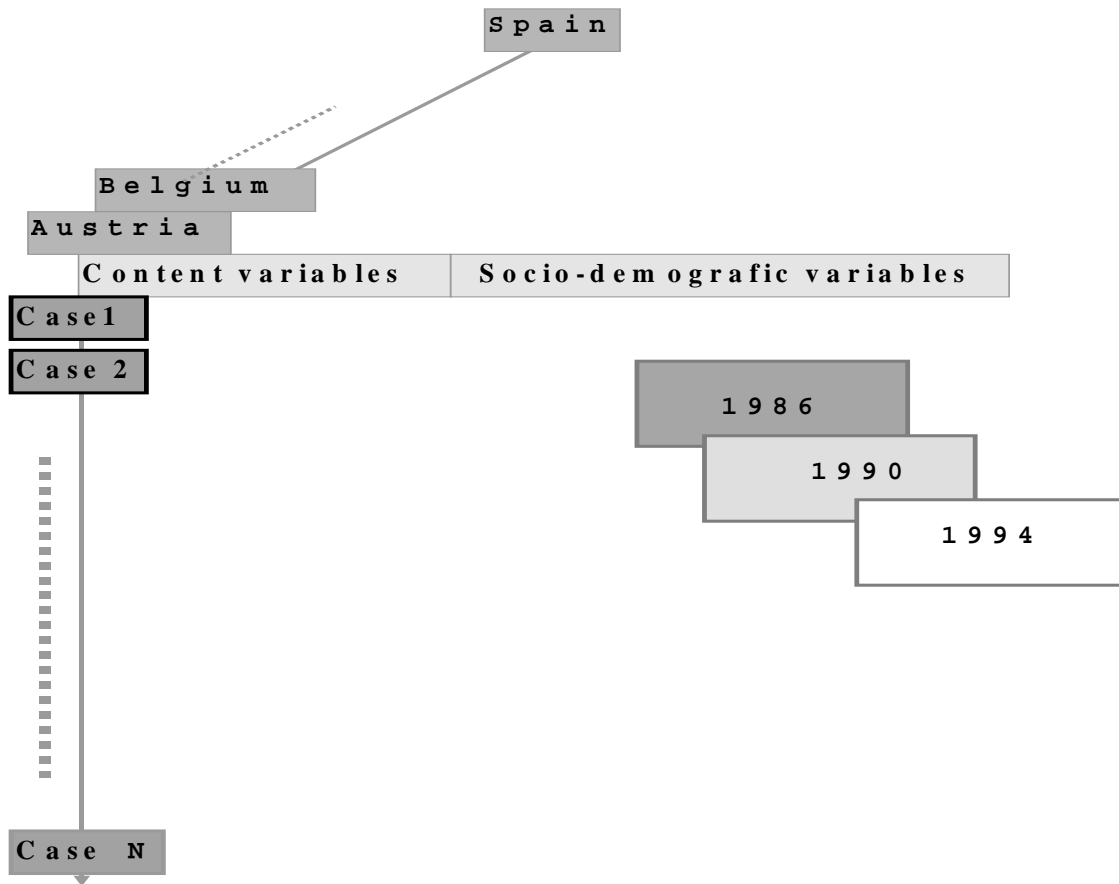


Figure 1: Data cube (Schoolchildren x Variables x Country) including the three waves (1986, 1990 and 1994).

2.1 The questionnaire

It should be pointed out that the questionnaire constructed for this study consists of one part which is common to all the participating countries and a second part which is specific to each country. The common part is, in turn, divided into two

parts: a) a series of set questions, which are repeated in all editions of the survey (core questions), and b) questions which vary from one edition to the next, addressing a particular issue or issues (see Figure 1).

The core questions deal with approximately sixty variables referring to the socio-demographic characteristics of the subjects and particular facets of their life-styles: their television and video viewing habits, use of tobacco and alcohol, physical activity, oral hygiene, food and the use of safety belts. This part of the survey also includes items referring to the subjects' perception of their own health, their moods and a variety of psychosomatic ailments. The survey also contains three set questions on the subject's integration in school life (Wold et al., 1993).

All editions of the international survey are originally written in English. In order to ensure maximum comparability with the data collection, the survey is subsequently translated into each one of the national languages. Another translator then translates it back to English. After correcting any inconsistencies, the questionnaire is administered in a pilot study in each country before being used in the final fieldwork.

The questionnaires used in Spain included questions on a broad variety of subjects, all of which referred to the objective of the study: school life, life outside the school, social and family relations, oral hygiene, eating habits, use of tobacco and alcoholic beverages, self-perception, psychosomatic disorders, medication, accidents, accident prevention behaviour, risk-seeking behaviour, sources of information on health matters, use of illegal drugs (only for children aged 13 and over), sexuality and contraception (usually only for children 15 and older), AIDS and sexually transmitted diseases (starting with children aged 13 or 15). The questionnaires also included questions about socio-demographic features and family structure. Moreover, at the end of the survey, pupils were asked to state their opinions of the questionnaire (perceived length, interest, questions that were confusing or irritating).

The variety of subjects addressed led us to use more than one questionnaire model for the 1990 and 1994 surveys. Certain questions were asked of the entire sample and others were asked of only a part of it. Six different questionnaire models were used in 1990 and four in 1994. Age was the basic criterion used to determine the sub-samples and select the questions to be included in each model of the questionnaire.

A total of 144 variables was included in the 1986 questionnaire, while the 1990 questionnaire included 265 variables, and the 1994 survey included 250 variables. Taking all three surveys together, 244 variables were the same in at least two of the editions. A smaller number (57) appeared in all the questionnaire models used in the three Spanish surveys. These 57 core variables (10 of which are socio-demographic) are the basis of the analysis described in this article.

2.2 The sample

The international protocol of each HBSC survey contains clear instructions about collecting data, codifying questionnaires and other methodological details in order to ensure that data from different countries can be compared over time. In addition, international co-ordination meetings aim to encourage joint discussion of the findings, with the aim of reducing information errors and helping situate the information obtained within the framework of the corresponding socio-cultural context.

Several particularities can be observed in the Spanish target population. In 1986, only schoolchildren aged 11 and 13 were surveyed because at the time schooling was not compulsory for 15 year olds. In the following survey (1990), 15 year olds were surveyed along with their 11 and 13 year old counterparts, since in the framework of Spanish education reform, it was obvious that schooling would soon be compulsory until the age of 16. Lastly, the 1994 survey also included 17-year old schoolchildren in order to get a broader view of Spanish school-aged children. Moreover, in 1994 the sample was increased to 1500 for each of the four age groups.

In addition, the methodology used in all three studies was basically the same in order to ensure that data would be as comparable as possible and to reduce sources of bias in the sample, as well as various types of non-sample errors.

The same system was used to select the sample for each of the three surveys, and was guided by the idea that all Spanish schoolchildren enrolled in the grades being studied would have an equal likelihood of being selected, regardless of where they lived. Therefore, the sample system was designed to be stratified (by grade and by geographic area), proportionate (in which every town is fairly represented in the sample in accordance with its population and every school is represented in accordance with the number of pupils enrolled), random and multi-stage (towns, schools and classes were successively selected). The final sample unit is the class and not individual students, as in the rest of the participating countries in the study. This guarantees the anonymity of the students and also reduces the cost of gathering data. In order to ensure that the sample was random and proportionate to the size of the population, it was not necessary to have a list of all the schools in the country and the number of students enrolled. Instead, we needed only a list of schools and enrolments in those towns which were previously selected (Mendoza et al., 1998; Mendoza et al., 1994a).

Finally, after following the same process for all three editions of the survey, the resulting sample for each year was 2142 in 1986, 2476 in 1990 and 5985 in 1994 (Table 1). In all three editions the sample was almost evenly divided between boys and girls.

The details of the sampling system used in the 1986 and 1990 Spanish surveys are explained in the general report for both editions (Mendoza et al., 1994a).

In the 1994 edition, the objective was to randomly select 1500 schoolchildren in each of the four age groups mentioned above (11,13,15 and 17), including children who were repeating the same grade or had failed a previous one. Risky behaviour is more frequent in these children than in those who keep up with the rest of their age group. We therefore opted to survey 12,000 schoolchildren from the ages of eleven to eighteen (1500 in each age group). After administering the survey in the grades corresponding to each age, only the questionnaires completed by schoolchildren in the target ages (a total of about 6000) were codified regardless of which grade they were in. This ensured that pupils repeating a grade were not left out, but it did, however, significantly increase the cost of our field work. See Table 1.

Table 1: Sample composition in the three waves (1986, 1990 and 1994) of the study in Spain breakdown by age.

Wave Year\Age	Eleven	Thirteen	Fifteen	Seventeen	Total
1986	1,109	1,033			2,142
1990	812	847	817		2,476
1994	1,510	1,578	1,492	1,405	5,985
Total	3,431	3,458	2,309	1,405	10,603

In the 1994 survey 232 schools from throughout Spain were selected in the sample. Earlier surveys had indicated the student/class ratio to be expected. In each of these schools, two classes belonging to two consecutive grades were surveyed. The average size of the schools was 644.4 students and 27.6 students per class. However, the field work revealed an average of 2.9 absences per class. The average time it took to fill in the questionnaire was 42 minutes, with a minimum of 30 and a maximum of 54 minutes. Seventeen (7.3%) of the schools approached refused to collaborate and replacements with the same characteristics were selected at random. Only 39 students (0.33%) of those present in the classrooms when the questionnaire was administered refused to fill it in, for reasons not related to the content.

2.3 Monitoring the fieldwork

In all three surveys (1986, 1990 and 1994) a variety of measures was systematically applied in an attempt to reduce non-sample errors (Groves, 1989).

Each questionnaire model was tested in a pilot study aimed at verifying whether the questions were clearly worded and acceptable. The length of time required to fill in the questionnaire was also assessed. Confusing or irritating questions were then restated or eliminated.

The fieldwork for all three surveys was co-ordinated by the same team. They were given very detailed instructions on how to make contact with the selected schools in order to encourage them to participate and assure them that the surveys would be completely anonymous. The research director first sent a letter to the schools selected, enclosing a brochure containing a summary of the previous survey findings (except in 1986). This was then followed by a visit from a member of the team responsible for the fieldwork.

In order to avoid creating expectation among the pupils, the school directors were asked not to tell the students about the survey in advance. On the scheduled day, a duly trained and supervised professional survey-taker carefully introduced the theme of the survey, encouraging the pupils to give honest replies and guaranteeing that they would remain anonymous. Pupils were also given envelopes for completed questionnaires. This material was then sent to the university co-ordinating the fieldwork, without passing through the hands of school staff.

Before the questionnaire itself was given out, students were encouraged to take part and to give honest replies. The fact that the questionnaire consisted of closed questions to be answered on paper also helped contribute to a feeling of confidentiality. It is worth noting here that an overwhelming majority of pupils took part in the three surveys.

Each survey-taker drafted a brief report about the particularities involved in administering the questionnaire in the various classrooms selected (minimum and maximum times, unusual incidents, etc). The questionnaires were reviewed by the fieldwork co-ordinators prior to codification. Of the 12,000 questionnaires collected for the 1994 survey, 96 were rejected due to failure to answer essential questions such as gender and age, systematically omitted replies or because the questions were not taken seriously.

A standardised procedure was used to codify responses to all three surveys in order to safeguard data comparability. The work of the codifiers was regularly subjected to quality controls. The only two questions that constituted open information (mother's and father's occupations) were always codified by the same duly trained and supervised individual.

Regular controls were also carried out to ensure the quality of data recordings. An independent re-recording of a sample of 100 questionnaires from the 1994 survey was performed. Comparison of both recordings revealed an error index of 0.32%, which was considered acceptable.

Once recorded, the data were searched to detect inconsistencies in logic and missing values.

2.4 Stages of the analysis and variables involved

Every survey generated a data matrix with its own particular characteristics. In order to be able to use MCA to study how life-styles evolved over time, we began

by producing a single matrix with data from all three surveys. This data matrix (the three slices corresponding to 1986, 1990 and 1994 data for Spain in data cube of Figure 1) was based on the recurrent variables mentioned above. It thus contains data for 10,603 school-children of 11, 13, 15 and 17 years of age who were surveyed in 1986, 1990 or 1994.

Nine new variables were then defined and included in the matrix. The first was the year of the survey. The other eight are combinations of some of the original socio-demographic variables and the year of the survey: gender-year, age-year, age-gender-year, father's occupation-year, mother's occupation-year, father's employment status -year, geographic area-year and region-year.

With a view to meeting our stated objectives, we analysed the data in three separate stages.

The first, or preliminary, stage thoroughly studied the missing values and their effect. For reasons of space, and because is not relevant to the aims of this paper, this stage has been excluded.

The second stage aimed to meet the first objective of the study: to determine which overall variations were presented by the life-styles of Spanish school-children in accordance with age and gender throughout the period from 1986-1994. The 3-survey matrix including all respondents between the ages of 11 and 17 was used as the basis for the data analysis, although each wave of the survey addressed slightly different age ranges: 11-13 in 1986; 11-15 in 1990 and 11-17 in 1994 (see Table 1).

The third stage in our analysis was aimed at meeting our second objective (analysing the evolution of the life-styles of 11, 13 and 15 year old Spanish schoolchildren between 1986 and 1994). We did this by dividing the respondents into two groups and carrying out two separate MCA. One group consisted of the youngest subjects (ages 11 and 13), information about whom had been collected in all three waves of the survey. The other group studied the evolution over time of 15 year olds, using only the data collected in the 1990 and 1994 surveys. As readers will recall, 15 year olds were not included in the 1986 survey, and there is therefore no data available for that first edition. We did not analyse the evolution of the 17 year olds because this age group was studied for the first time in 1994.

In all the foregoing steps, variables were separated according to the role they were to play in the subsequent MCA. Some were classified as *active* - i.e. variables used to define the underlying factors that structure the questionnaire. These consisted of recurrent (core) variables dealing with subject matter or content. Variables were discarded only when there was a very large number of missing values. Active variables amounted to 47, referring to different subject matters: means of transportation to and from school, adaptation to school life, television and video viewing habits, family relationships, oral hygiene, smoking and drinking habits, medication, strenuous physical exercise, eating habits and self-perception.

The second group consisted of *supplementary* variables – those which were not involved in determining the underlying factors but could be used to illustrate them. Here we essentially included socio-demographic variables, both those that appeared in all versions of the questionnaire administered in the three surveys and the nine questions specifically formulated once the data from the three waves were considered altogether in the same data matrix⁵.

The main statistical package used was SPAD-N (version 2.5).

3 Results

3.1 Evolution of the life-styles of schoolchildren in accordance with age and gender

In the MCA performed with 10491 schoolchildren between the ages of eleven and seventeen, the first ten factors accounted for 15.08% of the total inertia⁶. The first four factors in particular accounted for a total of 8.49% of the inertia of the active variables.

The first factor essentially revolved around smoking and drinking, although it is also related to coffee intake, integration in school, communication with parents and morning tiredness. See Table 2.

Response categories which indicate pupils who do not smoke or drink coffee, have never tried alcoholic beverages and have never become inebriated appear at the end of the dimension which could be classed as “healthiest”. These categories also include a high degree of satisfaction with school, a good perception of the academic performance of each individual and easy communication with parents. Moreover, these respondents reported no morning tiredness on school days and claimed to feel very happy.

At the opposite extreme were the response categories denoting frequent smoking and intake of alcoholic beverages, including some incidents involving becoming inebriated.

When illustrating this factor using supplementary variables, the use of medication and physical exercise are situated at opposite extremes. Categories revealing almost no use of medicine and frequent sports activity were situated at

⁵ This strategy permitted better interpretation of the questionnaire’s factors. As these variables had not been used to obtain factors, they acted as external criteria which enabled us to validate them. In addition, active variables are sometimes considered as explanatory and supplementary variables as variables to be explained in a regression model.

⁶ This percentage of inertia is relatively low due to the fact that MCA takes into account the diagonal submatrices of the Burt matrix. This apparently poor fit can be improved by the Benzecri-Greenacre approach (see Greenacre,1993).

the healthiest extreme while categories indicating a sedentary life-style and frequent use of medicines were at the opposite end of the dimension. As far as continuous variables are concerned, we observed that this factor is closely correlated with age (0.53). When age was projected along the axis, the youngest children were tended to be situated at the healthiest extreme, whilst the older children were at the opposite end of the dimension.

Table 2: Absolute contributions (AC), co-ordinates and number of pupils in the categories which most contributed to building the first factor.

MCA ON THE JOINT MATRIX 1986-1994 (1st FACTOR INTERPRETATION)

Variable	AC	Category	Co-ordinate	Weight
LICO: Present intake of liquor	9.4	Weekly	1.57	797
CERV: Current intake of beer	8.5	Weekly	1.39	1097
ESBO: Pupils who have ever got drunk	7.7	> 10 times	1.82	307
FUMA: Pupils who have smoked	7.0	Yes	0.69	4448
VINO: Current intake of wine	6.9	Weekly	1.35	400
ACFU: Currently smoke	6.4	Daily	1.53	816
XOAL: Pupils who have ever drunk alcohol	4.6	No	-1.02	1757
SIDR: Currently drink cider	3.4	Never	-0.37	4796
CAFE: Currently drink coffee	3.3	Never	-0.31	4151
HAPA: How easy it is to talk to father	3.2	Very easy	-0.52	2528
PIEN: Self-assessment of school performance	3.0	Very good	-0.64	1341
HAMA: How easy it is to talk to mother	2.6	Very easy	-0.31	4751
SENT: Satisfaction with school	2.5	Very satisfied	-0.74	1330
CAMA: Trouble getting up in the morning	2.3	Never	-0.44	2796
SEVI: Happiness	2.2	Very happy	-0.39	3995

The first factor offers the best synthesis of the information obtained and provides a very clear picture of the differences in life-styles of Spanish schoolchildren in accordance with age. It also revealed that older children are less integrated in certain aspects of school and family life. Thus, the healthy behaviour of the youngest children (11 and 13), who do not smoke, drink alcoholic beverages or coffee, who frequently do sports, communicate easily with their parents, display a high rate of satisfaction with school and their scholastic performance, gradually deteriorates to the less healthy behaviour characteristic of schoolchildren in their mid-teens (15 and 17). Moreover, the second group find it difficult to discuss their concerns with their parents and display a high level of dissatisfaction with school and their own academic performance.

The *second factor* was not easy to interpret due to the considerable number of nonanswered questions, in particular those related to eating habits. Two extremes were also observed here: pupils who spent little time studying and had no desire to go to university were to be found at one end of the dimension, and pupils who spent more time studying and planned to go to university at the other. Once gender was projected on to the factor, it was observed that females tended to be closer to this latter extreme while males found to be at almost the opposite end.

The *third factor* essentially dealt with how frequently certain food types were consumed.

Daily or very frequent consumption of hamburgers, potato crisps, pulses, eggs, meat or fish and nuts was located at one end of the dimension. The frequent, though not necessarily daily, consumption of sweets, soft drinks and vegetables was also located at this end of the dimension. Together with this range of responses related to a frequently consumed range of foods, this end of the dimension was further characterised by daily or very frequent strenuous exercise (four or more days per week).

When supplementary variables were projected on this factor, we observed that children at this end of the dimension were in lower grades (where 11 and 13 year olds are usually enrolled), male, and with parents classified as “non-skilled labourers”. This extreme was further characterised by frequent extra-curricular physical exercise (not necessarily strenuous) and a high degree of satisfaction with school physical education classes.

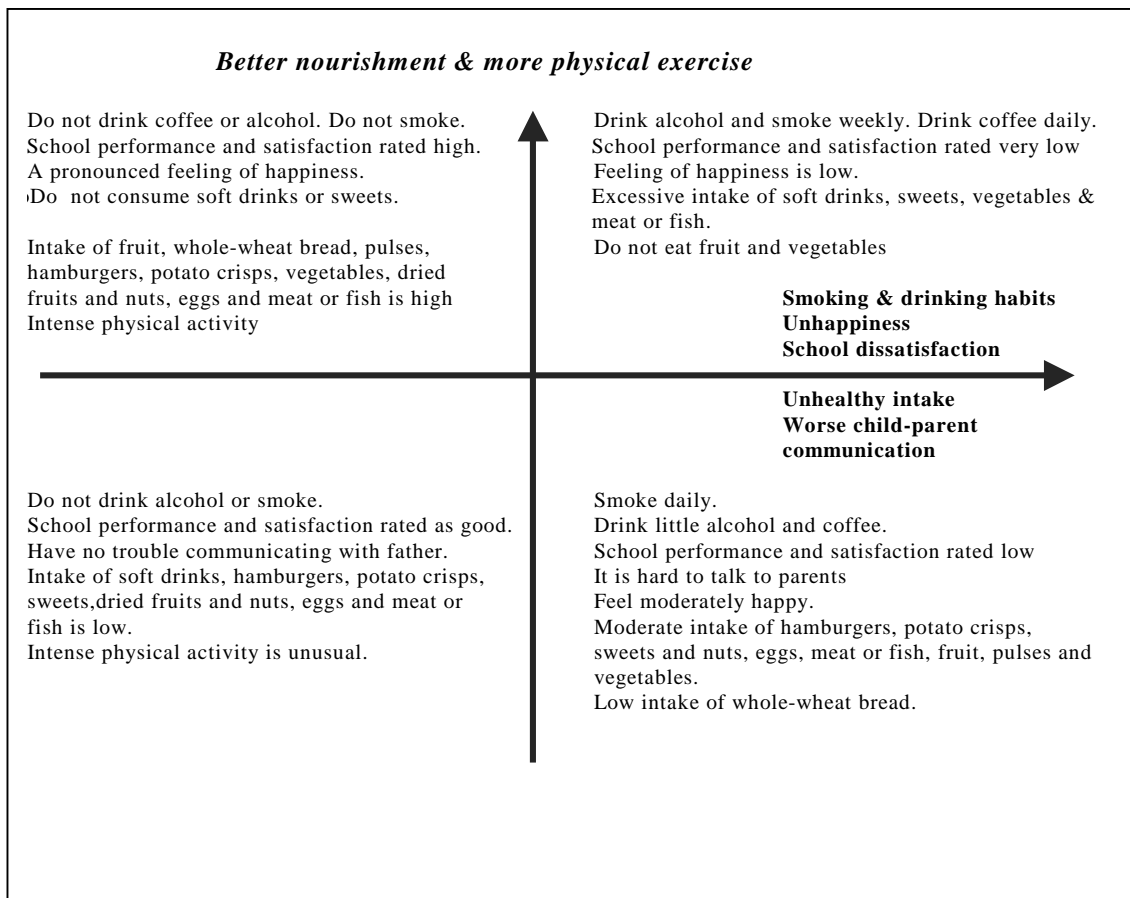


Figure 2: Schoolchildren's health-related habits in the 1st and 3rd factor space (n =10491).

At the other end of the dimension, respondents were characterised by a low consumption of the foods listed above and less frequent strenuous exercise, or even none at all. Supplementary variables projected on this extreme indicated that respondents were largely female, older (15 and 17) and with parents ranked as highly skilled technicians.

This factor is essentially related to eating habits and participation in sports, and reveals a difference between schoolchildren in terms of their grade (which is logically closely related to age) and gender. Older schoolchildren, particularly girls, tend to have different habits in terms of eating and sports than do younger children, particularly the youngest boys.

The *fourth factor* is defined by physical activity vs. a sedentary life, feelings of unhappiness and loneliness, self-perception regarding their state of health, ease in family relations, oral hygiene habits and also by intake of fruit and milk.

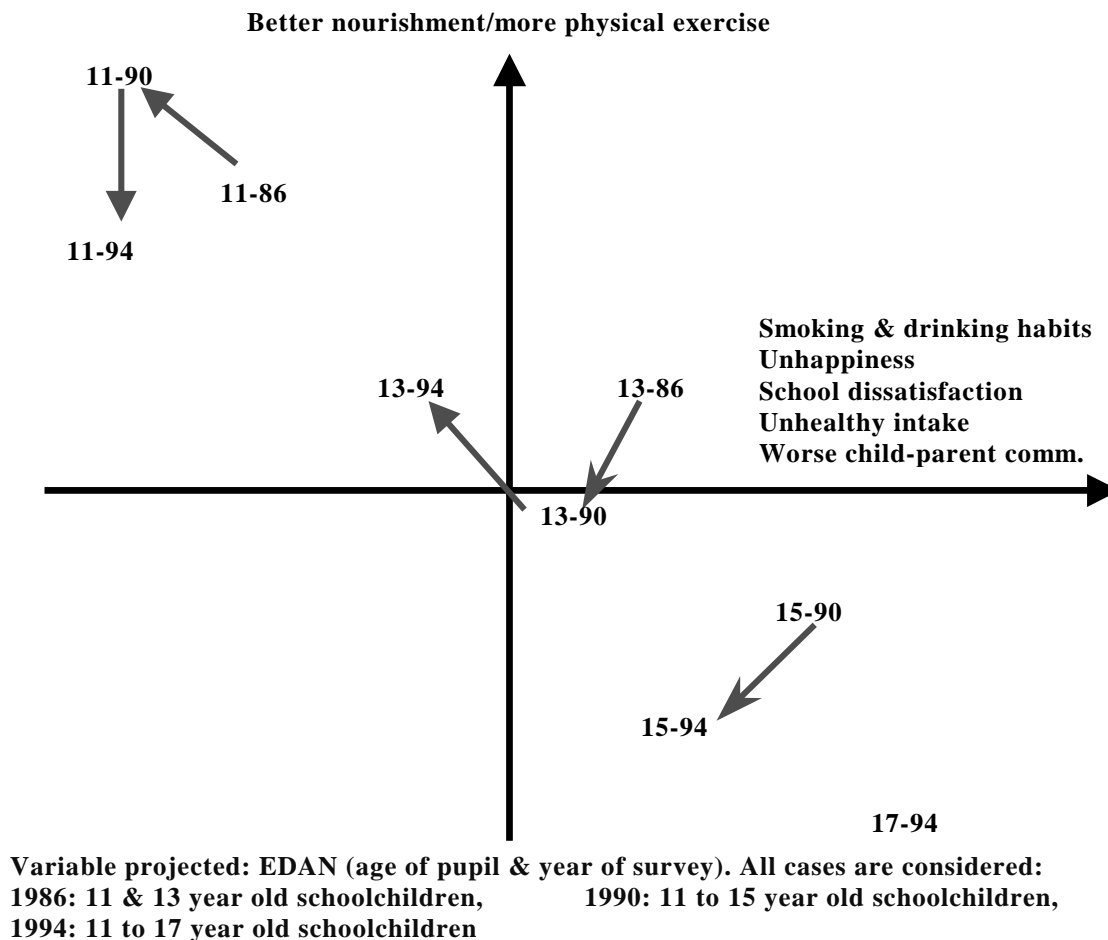


Figure 3: Evolution over time of the life-styles of Spanish schoolchildren aged 11, 13, 15 and 17 years old (1986, 1990 and 1994). Projection of the “age-survey year” variable on the 1st and 3rd factor spaces resulting from the MCA.

Responses indicating loneliness, feelings of unhappiness, problems relating to the family, a sedentary life and a poor self-perception regarding their state of health are situated at one extreme of this factor, along with a low intake of milk and fruit. Girls were located at this end of the dimension. Boys were at the opposite extreme and displayed diametrical characteristics.

Having briefly described the first four factors, we proceeded to interpret the variety of responses projected on a two-factor space. As is well-known, one of the objectives of this multivariate technique is presenting findings in graphic form so that relations can be interpreted in terms of proximity. These relations are shown in the space defined by the *first and third factors*. The second factor was omitted due to a considerable number of missing values.

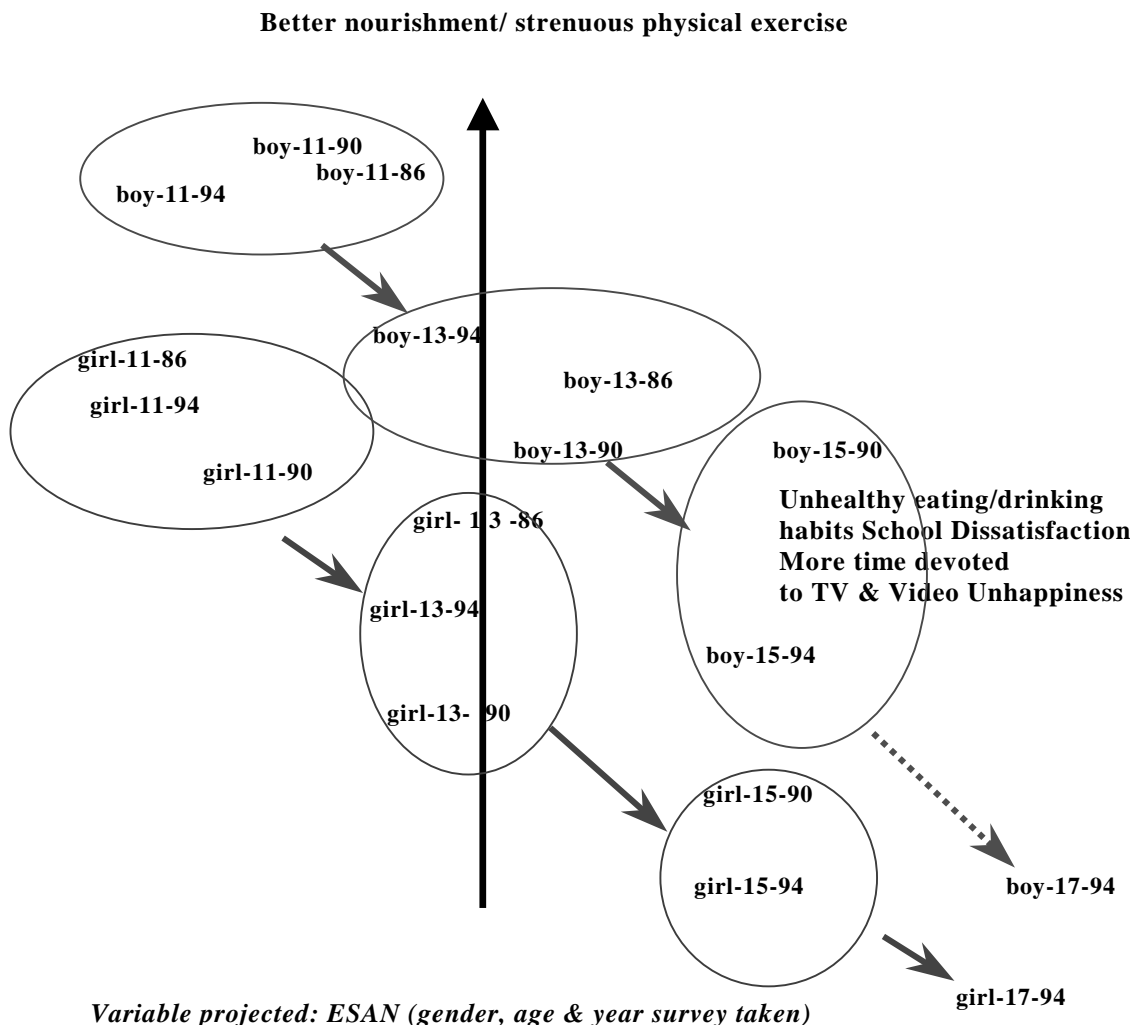


Figure 4: Evolution over time of the life-styles of Spanish schoolchildren aged 11, 13, 15 and 17 years old in terms of age and gender (1986, 1990 and 1994). Projection of the “gender, age and survey year” variable on the 1st and 3rd factor space resulting from the MCA.

Because the inertias projected in the first and third factors are relatively close together (2.68, 1.90), the factor space represents a more stable structure than when each factor is shown separately. Customary practice involves globally studying the plane made up of the two most relevant factors. For purposes of simplification, we will interpret only the two quadrants which show the most sharply contrasting behaviour (Figure 2).

Frequent intake of socially accepted habit-forming drugs (alcoholic beverages, tobacco and coffee), low intake of various types of food, greater morning tiredness and difficult communication with parents are all situated in the lower right quadrant. Dissatisfaction with school and low perception of one's own academic performance are also placed in this area. The oldest school-children, and in particular girls, are to be found in this quadrant.

The upper left quadrant is characterised by abstention from tobacco, alcoholic beverages and coffee and an abundant intake of food. Good communication with parents and older brothers and sisters, satisfaction with school life, and feeling happy are further to be found in this area. Children in this quadrant do not suffer from morning tiredness and tend to do physical exercise and extra-curricular sports. Eleven and thirteen years olds fall into this category, with boys slightly outnumbering girls.

Figure 3 shows how the information from the three surveys was used to project *age-survey year*' variable on this factor space. In both genders, life-style variables (and the other variables studied) appear to develop along very similar lines, depending on age: healthy habits and close integration in school and family life are characteristic of the youngest schoolchildren. The exact opposite is true of the oldest schoolchildren. As they get older boys and girls seem to "progress" in parallel towards the most troublesome quadrant. Furthermore, a more sedentary existence and poorer diet are more characteristic of 15 and 17-year old Spanish girls than of their male counterparts (See Figure 4).

3.2 Lifestyles of Spanish schoolchildren: Evolution over time

The foregoing section, above all Figure 3, revealed the great variety of lifestyles of Spanish schoolchildren to be found according to their ages. If we want to study how these lifestyles have evolved from one survey year to the next, age should therefore be monitored. In other words, the behaviour of each age group should be analysed separately over time.

A great deal of difference between the behaviour patterns of eleven and thirteen year olds cannot be found. However a clear difference exists between their behaviour patterns and those of fifteen and seventeen year olds (Figure 3). Inasmuch as we only have data on 17 year olds from one survey (1994), this group cannot be included in our analysis over time. Data for 11 and 13 year olds were collected in all three surveys and are analysed jointly in a single factor analysis,

which is presented below. The evolution of 15 year olds will be discussed somewhat further on.

3.3 Evolution of 11 and 13 year old children

The useful sample consisted of 6802 eleven and thirteen year old school-children. The criteria explained in the foregoing section were used to determine which variables would be considered active and which supplementary.

The percentages of inertia projected on the first factors are similar to those in the analysis of all schoolchildren (the first ten factors account for 15.05% of the inertia).

The first factor is essentially defined by missing responses to certain questions (especially those relating to eating habits). Missing responses were most frequent among the youngest children (11 years old), probably due to their finding the survey questions presented in matrix form more difficult to answer.

The characteristics of the second and third factors are discussed below. These factors are considered to be the most relevant in terms of synthesising the rich variety of responses given by the youngest children to questions regarding the active variables.

The second factor is quite similar to the first factor in the MCA performed with subjects of all ages. It is essentially defined by schoolchildren's habits in terms of smoking and drinking. Television and video viewing hours, morning tiredness on school days, satisfaction with school, ease of communication with parents and the intake of certain types of food also contribute to shaping this variable, albeit to a lesser extent.

A full range of conduct related to smoking and drinking is situated at the least favourable end of this factor. Because children in this age group do not usually smoke and drink, negative conduct ranges all the way from simply having tried smoking or sporadically drinking cider to smoking daily and regularly drinking beer or distilled liquor, and/or having been inebriated on repeated occasions. This factor dimension is also characterised by a clear rejection of school, a feeling that it is extremely difficult to talk to parents about worrying subjects, and television viewing totalling over four hours a day, or ten hours a week of videos. Intake of certain kinds of food (potato crisps, sweets and hamburgers) is also associated with this end of the factor. Thirteen year olds are more likely to be situated at this end, although the behaviour of the majority of 13 year olds is such that they are placed at the opposite end.

The opposite end of the factor is defined precisely by never having tried alcoholic beverages, not drinking beer, never having smoked and not feeling tired on school mornings.

The third factor (second relevant dimension) largely coincides with the third factor in the overall analysis of subjects of all ages (as readers will recall, it was

also the second-ranking relevant dimension there). In both cases, it is a factor that deals principally with eating habits, but it is also related here to ease of communication with parents and older sisters and brothers, with feeling happy and with dental hygiene.

Daily intake of pulses, eggs, nuts, meat or fish, vegetables, hamburgers or hot dogs and bags of potato crisps are situated at one end of the dimension. Eating fruit several times a day is also in this zone, as is brushing one's teeth more than once a day, and finding it very easy to talk about one's worries with parents and older brothers and sisters.

As far as supplementary variables are concerned, frequent use of different types of medicine and, to a certain extent, frequent physical exercise and sports activity are projected on this end of the factor.

The opposite end of this dimension is characterised by non-daily or sporadic intake of the various types of food mentioned above. Fruit is an exception inasmuch as eating it only once a day is placed in this factor zone. Moreover, categories indicating poor dental hygiene, lack of confidence in family relationships and not feeling very happy are also located in this area. As far as supplementary variables are concerned, this end of the factor has a certain association with a sedentary life-style.

Age has little to do with the second and third factors of the MCA (correlations lower than -0.22 in both cases). Indeed, findings reveal that older children tend to be closer than their younger counterparts to the extreme that is least favourable to personal development.

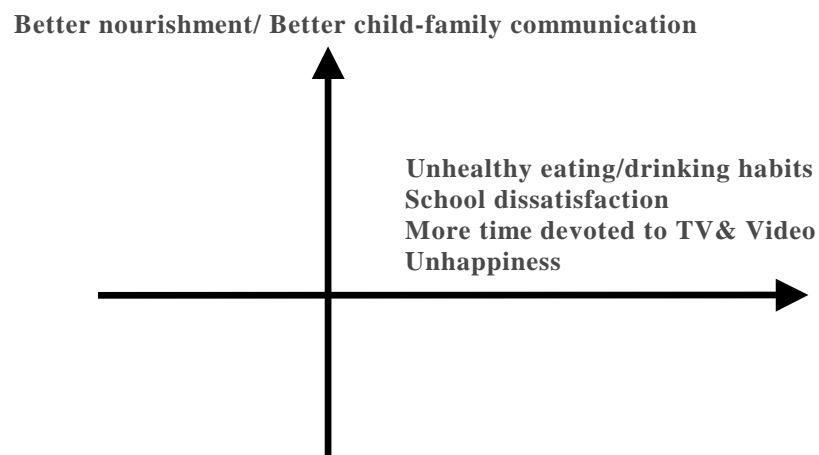


Figure 5: Health-related habits in the 2nd and 3rd factor space for 11 & 13 years old (n = 6,802).

Generally speaking, there was no indication that the socio-professional status of either parent was situated at either extreme in any of most relevant factors defined in the MCA.

The fourth factor basically deals with strenuous physical activity.

The factorial plane used to study how the lifestyles of Spanish schoolchildren aged eleven and thirteen evolved over time is defined by the second and third factors, which are considered the most relevant to this MCA. The most positive quadrant (in the sense that it denotes healthier habits and better integration at school and in the family) is the upper left; the most negative, the lower right (see Figure 5).

The year of the survey (Figure 6), and the “gender-age-survey year” variable (Figure 7) were successively projected on these dimensions.

The findings suggest that schoolchildren aged 11 and 13 registered a positive evolution in life-styles and in adaptation to school and family life in the period between 1986 and 1994. The tendency over time is the same in both figures, registering a shift from the lower right quadrant (the least favourable) to the upper left (the most favourable).

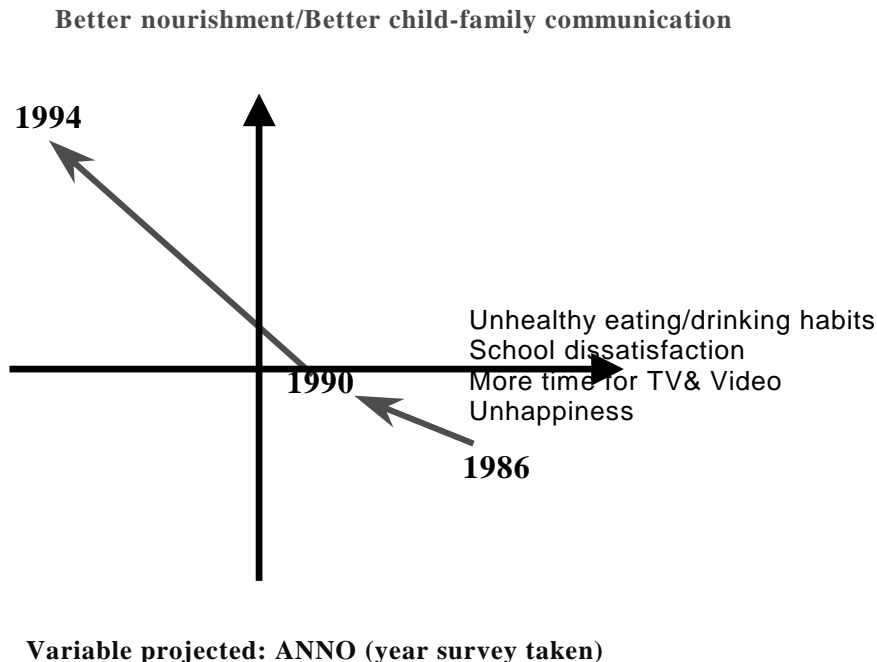


Figure 6: Lifestyles of Spanish Schoolchildren aged 11 and 13 (1986, 1990 and 1994): Evolution over time. Projection of survey year on 2nd and 3rd factors of the MCA.

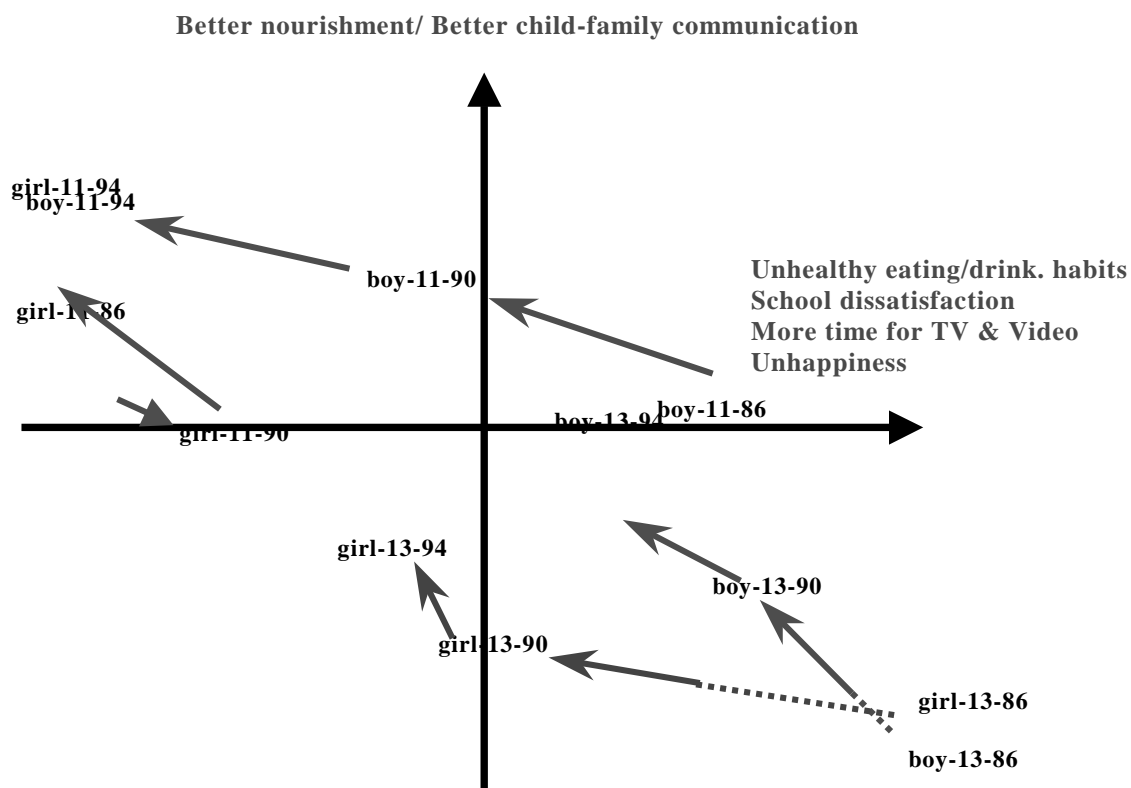
Thus, Figure 6 suggests a somewhat positive evolution in the three survey years. Figure 7 then reveals the same tendencies, although broken down by age and gender. The ages are situated in a perfect diagonal and in each quadrant move towards the most favourable position. Essentially, Figure 7 corroborates what was

indicated by Figure 3: the youngest children (11 years old) generally tend to have more healthy habits and are better integrated in school and family than their older counterparts (13 years old).

Moreover, in Figure 7 one observes that the behaviour of girls is more stable over time (in the 1986-1994 period), at least among 11 year olds.

Figure 7 is a more detailed presentation of the information contained in Figure 6, which is more synthesised. Thus, in the first of these figures (Figure 6), the centroid for each year is a weighted average of the gender-age categories for that survey year.

We can sum up this section by concluding that both genders and both ages reveal an identical time trend, moving towards healthier habits, better communication with parents and greater satisfaction with school between 1986 and 1994.



Variable projected: ESAN (gender, age & year survey taken)

Figure 7: Lifestyles of Spanish Schoolchildren aged 11 and 13 (1986, 1990 and 1994): Evolution over time. Projection of the “gender-age and survey-year” variable on 2nd and 3rd factors of the MCA.

3.4 Evolution of 15 year old schoolchildren

The useful sample for our purpose consisted of 2293 15 year olds, after first excluding 16 students who did not answer any of the questions about use of medication and eating habits.

The percentages of inertia projected on the first factors are similar to those in the two previously described MCAs. The first ten dimensions account for 15.2% of the inertia. Indeed, the percentages of inertia projected on the first two factors amounted to 4.4%. In this age group missing values are not an important characteristic in these first factors, probably because 15 year olds are better able to interpret the questionnaire than the younger schoolchildren.

The first factor is very similar to the one that proved most significant in the MCA carried out with all schoolchildren and the MCA applied to data about 11 and 13 year olds. Once again, it is a factor that is closely related with smoking and drinking.

One of the extremes of this dimension is weekly or daily intake of liquor or beer and having been inebriated on repeated occasions. Weekly intake of wine is also situated in this factor zone as is smoking daily, or at least several times a week. Together with these things there is also tremendous dissatisfaction with school –“I do not like school at all”–, poor self-perception of their own academic performance, and morning tiredness on almost all school days. The consumption of soft drinks and sweets more than once a day also came into this factor zone. In this same zone was the idea of going out to work as soon as compulsory schooling ended or else having no definite plans about possibly continuing to study. As to the supplementary variables, never doing physical exercise or playing sports and not having physical education classes (or not attending these classes) were projected on this zone.

The other extreme is characterised by never having drunk alcoholic beverages or smoked or by not smoking and drinking even after trying both. Logically, never having been inebriated is also characteristic of this factor zone. Never drinking coffee similarly falls into this extreme.

The second factor is related to eating habits and is also similar to the second factor in the analysis of all the schoolchildren and the equivalent factor in the 11 and 13 year old groups. Children who eat a great deal (daily intake of hamburgers, pulses, potato crisps, nuts, eggs and meat or fish) are offset by children who said they ate pulses, eggs and meat or fish less frequently (several times a week or rarely).

The third factor essentially characterises in one pole very sedentary lives, communication problems with their families (mother, father, older brothers and sisters) and having experienced feelings of loneliness or unhappiness. The other pole is defined for the opposite categories.

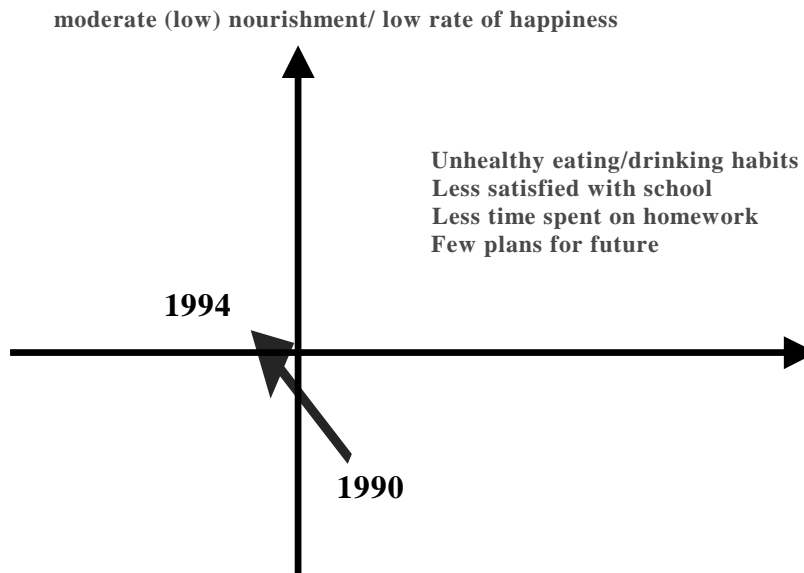


Figure 8: Health-related habits in the 1st and 2nd factor space for 15 year olds (N=2,293). Evolution over time. Projection of survey year (1990 and 1994).

The strategy applied to determine the evolution over time of health-related behaviour in 15 year old schoolchildren is much the same as was used in the previously described cases. Thus, the variable “year of survey” was also projected on the dimensions defined by the two most relevant factors (Figure 8). When this was done, we observed no major differences between the two years (1990 and 1994) in terms of the behaviour that is characteristic of these two factors (no year is located significantly far from the centroid). This appears to indicate that considered globally the life-style of 15 year old schoolchildren in 1994 is not very different from the life-style of 15 year olds in 1990.

When gender-survey year is projected, the results are somewhat different (Figure 9). In this case, boys seem to have moved towards the healthiest extreme of factor 1 between 1990 and 1994. Girls in general are in a healthier position than boys in both years but in 1994 did not register an improvement over 1990. As regards factor 2, both sexes remained fairly stable between 1990 and 1994. Girls continue to be characterised by a smaller intake of food while boys are characterised by eating habits which include daily intake of high calorie, high protein foods, such as pulses, eggs, meat or fish and nuts.

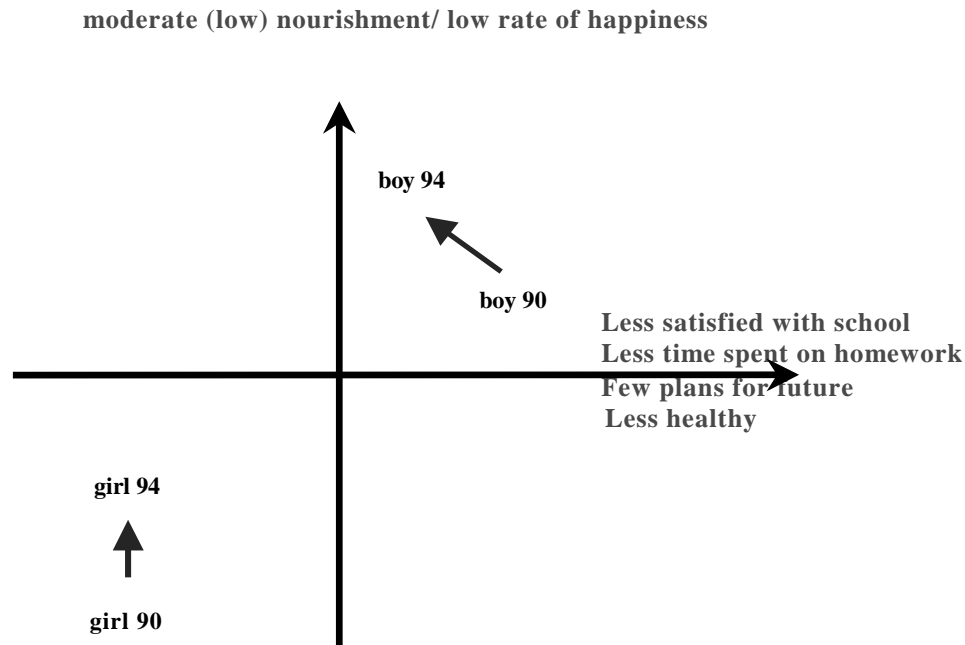


Figure 9: Lifestyles of 15 year old Spanish Schoolchildren (1990 and 1994): Evolution over time. Projection of “gender-survey year” variable on factors 1 and 2 of the MCA.

4 Discussion and conclusions

Throughout this paper we have repeatedly used the MCA technique, applying it to a data matrix resulting from three editions of a sequential cross-sectional study. Before attempting to evaluate the results and the extent to which this technique proved useful in meeting our objectives, it is worth taking a look at the potential and the limitations of the data to which the technique was applied.

ECERS (the Spanish version of the *HBSC*) is a very unusual study in that it is the outcome of more than a decade of on-going research. It uses representative samples of adolescent Spanish schoolchildren and it gathers information about features of adolescent lives, such as their adaptation to school life, integration in family life, social relations, self-perception and lifestyle-related behaviour patterns.

The variety of subjects on which information is collected is one of the principal limitations of the study as, generally speaking, the subjects addressed are not explored in depth. Yet it is also a source of great potential as it enables us to interrelate highly varied aspects of adolescent life-styles rather than considering them separately.

Each of the questions included in the various versions of the questionnaire was carefully formulated and tested. The questionnaire was administered in conditions that encourage honest response. The quality of data codification and recording was systematically monitored. All this means that the information collected can be assumed to be of good quality.

Nevertheless, the study has several clear limitations which should be taken into account when interpreting our research findings.

Other limitations are inherent to all types of research: one studies certain variables and not others; certain age groups and not others; the survey takes place at a certain time of the calendar or school year, and not at any other. However, there is another limitation which is not automatically inherent to this type of research, yet judging from our preliminary findings would appear to be significant. This concerns various types of matrix-based questions (about intake of food and, particularly, medication) included in the questionnaire, which result in a considerable number of missing values, particularly in the youngest age group. Although this problem has been partially solved by taking certain methodological decisions which were described above, it should be avoided as far as possible in future surveys carried out within the framework of this study. This could be done by presenting the questions in a non-matrix-based form, by eliminating these questions in the version of the survey intended for the youngest age group, or by giving more detailed instructions on how to answer these questions.

The fact that not all the age groups included in the study (11,13,15 and 17) were surveyed in all editions of the study could also be viewed as a problem. Firstly, as we were not able to study the evolution over time of the 17 year olds and the 15 year old group was studied on only two occasions (1990 and 1994). Secondly, because this disparity in the ages studied precludes the possibility of applying a complementary methodology as an alternative to the methodology used. This would have involved studying the evolution of the children over time on the basis of an overall MCA which includes all age groups in all survey waves. However, as we will see at a later point, the strategy used in this study (see particularly the evolution of 11 and 13 year olds on the one hand, and the evolution of 15 year olds on the other) offers certain advantages over the overall MCA technique on the whole sample.

The time has now come to critically assess the preliminary methodological decisions made prior to repeatedly applying the MCA technique. There were essentially four such decisions: 1) to merge the data from all three studies in a single data matrix which also included new variables generated by combining the original socio-demographic data with survey year; 2) to use all the non-socio-demographic variables common to all three questionnaires as active variables when performing the MCA, rather than applying only behavioural variables (those which, strictly speaking, could constitute life-styles); 3) to eliminate some subjects for which there were a considerable number of missing values in the questionnaires.

The first decision was the key to the subsequent success of the entire strategy. Had we not created these generated variables (age-survey year, gender-survey year, age-gender-survey year, etc.) we would have been unable to subsequently study the evolution over time for each specific group of adolescents. We would only have been able to project survey year on the plane formed by two of the most relevant factors revealed by the MCA. If the samples for every survey are of a similar age and size, this might have been useful in approaching the issue of evolution over time – it allows all the people surveyed in one edition to be globally compared with all the people surveyed in another – but the option we chose (studying the evolution of each specific age group and gender) is far more interesting and reliable. We thus avoided major errors in interpretation which would probably take place if, for example, boys evolved in one way and girls in another. In this case, the overall mixed-gender findings would indicate that there was no evolution when, in fact, there was, but in opposite directions (ecological fallacy).

Let us now evaluate the second decision. If you want to see how the life-styles of schoolchildren evolve in accordance with age or survey year, why include non-behavioural variables as active variables in the MCA? Would it not be more logical to consider as active only those variables which really could constitute life-styles?

There is no one simple answer to these questions. There are advantages and drawbacks to both options. From the standpoint of strict theoretical coherence, the second option appears most logical: first the factors underlying behaviour variables are identified and then non-behavioural variables (dealing with self-perception, quality of family relations, integration in school, etc.) are projected as supplementary. This option means that the first factors are exclusively defined by the behavioural variables that most discriminate the subjects and which are most associated with one another. The relations of these factors with the other variables (relegated to the role of supplementary variables) should be subsequently studied.

Although the second option seems less coherent from a theoretical point of view, it has several advantages over the first one. To begin with, it directly shows the close relationship that can exist between certain non-behavioural variables (for example, those that indicate personal well-being) and behavioural variables (for example, those relative to physical exercise). If they are closely related, both types of variables are grouped in a single factor and moreover, the subjects are polarised (for example, sedentary and troubled subjects on the one hand, and active subjects with a feeling of well-being on the other). The link between behavioural and non-behavioural variables that comes from considering them all as active variables is also coherent if we are trying to get to know and understand human beings, who are not simply machines but individuals whose lives are a rich tapestry of feelings, perceptions, beliefs and behavioural decisions.

Moreover, the second option facilitates the subsequent construction of a typology which immediately includes behavioural and non-behavioural traits in defining subject categories. This is extremely useful and illustrative when

attempting to obtain a realistic view of the different types of adolescents that exist in a particular country and at a particular point in time, always within the limits inherent to the type of information collected in the study. In our particular case, we did not classify the subjects after any of the MCA, although we could have done so, for example, after the first overall MCA. We would then have obtained a synthesised vision of the different types of Spanish adolescents that existed in the years between 1986 and 1994. This was done in other MCA performed in earlier studies (Mendoza et al., 1994a; Mendoza et al., forthcoming) that dealt with a single edition of the HBSC. An MCA was first performed and the subjects subsequently classified. One class of subjects that usually emerged was “sedentary, isolated girls with psychosomatic disturbances”. Had non-behavioural variables been excluded from the factor definitions, the subsequent typological classification would have been different and probably less illustrative.

In conclusion, both options are acceptable and both have their advantages and drawbacks. In the particular case of the HBSC, where the majority of non-socio-demographic variables are behavioural, the issue is not very important. In any case, the first factors are preferably defined by behavioural variables that clearly discriminate between adolescents of different ages, genders, habitats or social level.

The third preliminary methodological decision (excluding 112 subjects with too many missing values, out of a total of 10,603 or 1% of the sample) appears to have been a wise one. It helped us obtain factors that were more closely defined in accordance with the active variables. If the object of the MCA had been to study to what missing values are related, our decision would have been incorrect, but that is not the case.

Up to here we have discussed the consequences of the preliminary decisions we made regarding our research methodology. We will now see to what extent the three main objectives of this paper have been met.

As will be recalled, the first objective of this study is to identify the principal age-related variations in the life-styles of Spanish schoolchildren between the ages of 11 and 17. We employed an MCA using all the subjects included in the joint data matrix (3 editions of the survey, used simultaneously).

Using MCA with this purpose also appears to have been a good decision. If the objective is to get an overall vision of how life-styles vary in accordance with age, it is helpful to see how age relates to the principal salient dimensions, i.e. those that best reveal the heterogeneity of the subjects. Indeed, the first factor obtained (relative to smoking, drinking coffee and alcoholic beverages; adaptation to school and communication with parents) is inextricably linked to age (0.53). This led to three very significant findings: 1) the aforementioned variables are closely related to one another (in Spanish adolescent schoolchildren and in the period between 1986 and 1994); 2) there are enormous differences among adolescents from 11 to 17 in terms of these variables; 3) these differences are partly linked to age inasmuch as older students are more likely to smoke, drink coffee and wine, are

more poorly integrated in school and have a harder time communicating with their parents.

An additional finding is that schoolchildren's lifestyles differ less by gender than by age (at least in Spain). Gender is polarised around the second, third, and particularly, fourth factors, but gender polarisation is always less pronounced than age polarisation in terms of the first factor.

So what then is the significance of our findings? What is the significance of the fact that the life-styles of adolescents vary tremendously depending on their ages? Why is their evolution negative? Why is gender less discriminating than age?

All human beings go through puberty. It is a time of rapid biological change and ever faster progress towards adulthood. Its psychological connotations are essentially positive because awareness that one is growing and reaching biological maturity (with the physical autonomy, fertility, potential to work and co-operate with others, the neuronal capacity to handle more information, and the other achievements this entails) is in itself a source of satisfaction. Reaching biological adulthood solves a number of problems (essentially related to dependence) and is by nature gratifying.

Nonetheless, society and micro-social contexts can cause an essentially satisfying experience to be viewed as unsatisfactory and, in short, a problem. If a particular society causes adolescents to be obsessed with the idea of having a "perfect" body –due to arbitrarily imposed aesthetic standards which are presented in a convincing and attractive way – most adolescents will probably express dissatisfaction with their bodies. Moreover, and paradoxically enough, it can happen that the older these adolescents are (in other words, the more mature and developed their bodies) the greater their dissatisfaction. This is precisely what is happening in Europe, particularly among girls (King et al., 1996).

However adolescence is not just puberty. It is essentially a non-universal social phenomenon that has its own particular traits in every country. It is basically a period of transition from childhood to adulthood. In many societies it is a conflictive and difficult stage. Adolescents are under a great deal of stress: there are increasing demands on them and they are often required to choose between alternatives that are complex and insufficiently thought out.

Although conflict is not inherent to adolescence, vulnerability is. Adolescents are exceptionally vulnerable, particularly to social risks. The explanation for this is very simple: adolescents combine a great deal of curiosity (in this way they continue to be children) with burgeoning independence (which enables them to increasingly discover new features of the world) and they do not yet have much personal experience (although they have considerably more than pre-adolescents). As they are not physically and psychologically protected by adults as they were in childhood, the combination of these three factors makes them extremely vulnerable.

Although Spanish adolescents tend to acquire particularly unhealthy habits as they reach the end of puberty (smoking and regularly drinking alcoholic beverages), this has nothing to do with puberty as a stage in their physical development (their lungs do not require smoke in order to grow nor do their livers need to be watered with alcohol). If the origin of this negative evolution is not natural, then it is social. There is every indication that it is the result of prolonged exposure to environmental risk factors (such as cigarette and liquor advertising). As children grow older their accumulated exposure to risk is greater, which makes it more likely that they will start smoking or drinking on a regular basis. As both cigarettes and drink are addictive, these habits tend to become a permanent part of their personal life-styles.

Were smoking and drinking inexorably linked to puberty, they would affect all subjects in this life stage. If they were a consequence of adolescence, they would be practices indulged in by adolescents in all societies where there exist adolescence. But this is not the case. There are tremendous differences between countries in the number of adolescents who smoke, just as there are differences within the same country but in different decades. In conclusion, smoking and drinking are social habits and acquiring these habits is precisely one of the most characteristic features of present adolescent development in a country like Spain. Inasmuch as two of the major causes of disability and premature death in Spain are smoking and drinking, the fact that these are the two features which most distinguish older adolescents from children in the earliest years of puberty (in terms of the variables studied) is quite simply tragic. We need to halt this trend, which has no biological logic and is neither a necessary nor desirable correlation of adolescent development.

As mentioned earlier, boys and girls “move” in parallel throughout the first factor, which is sensitive to differences in age but not to differences in gender. This suggests that in a country like Spain boys and girls suffer the same extent of accumulated exposure to these environmental risks and therefore end up by developing these unhealthy habits (smoking, drinking alcohol or coffee) to a similar extent. This may also be due to the fact that society has lost (or fortunately overcome, depending on your point of view) the protective mechanisms of a culture that made smoking and drinking particularly undesirable behaviour in girls (Mendoza et al., 1998). If boys and girls have similar amounts of pocket money, if cigarettes and alcoholic beverages are relatively inexpensive and heavily advertised products, and if there are no longer any cultural barriers to dissuade girls from using these noxious and addictive products, there is no reason whatsoever to expect that the two genders will evolve differently in relation to smoking and drinking throughout their adolescent years.

Unlike the first factor, the third factor does polarise the genders. As readers will recall, girls are situated at the extreme of sedentary life-styles and a limited consumption of food. Boys generally tend to be less sedentary and eat more.

The fact that more physical activity is associated with a greater intake of food (and vice-versa) is fairly logical from a strictly biological standpoint and does not require further comment. Nonetheless what is worth analysing is the fact that there are differences in gender behaviour, although we are in all cases addressing adolescent schoolchildren who essentially use the same amount of energy and should therefore have similar nutritional needs. Likewise, both boys and girls need physical exercise in order to fully develop, and therefore there should not be any significant differences in the amount of physical exercise they engage in.

However, these differences exist and they do not appear to be natural in origin. They therefore must once again be social. Indeed, girls face considerably more obstacles than boys when it comes to doing physical exercise or sports, and they are under special pressure to eat little. Judging from HBSC findings (King et al., 1996), this is the case not only in Spain, but in many other European countries as well. These findings reveal that in almost all the countries studied, girls are more sedentary than boys and a much larger proportion of them are dieting (or believe they should be).

It is not hard to imagine the origin of this tendency for European girls to perceive themselves as fat and believe that they should be dieting. Advertising and, with few exceptions, the media in general subtly or blatantly transmit a single aesthetic standard for women: only slender women are attractive. It is no wonder then that, consciously or unconsciously, adolescent girls accept this aesthetic standard and attempt to conform to it. In fact, it would be odd if they did not.

The information summarised in factors one and three of our MCA provide a particularly sobering view of the evolution of Spanish girls in accordance with their ages. In the same way as boys, they tend to use socially acceptable drugs (essentially alcoholic beverages and cigarettes) as they grow older. Likewise, their adaptation to school is increasingly poor and they have more and more difficulties communicating with their parents. Unlike boys, they become increasingly sedentary and tend to eat little.

If, in addition, the information provided by factor 4 is taken into account, the outlook in terms of girls' development is even more worrying. Girls are generally situated in the factor extreme characterised by a poorer perception of their own health, greater social isolation, feelings of unhappiness and a sparse intake of milk and fruit. Like the origin of other abovementioned problems, these differentiating characteristics do not have a biological explanation nor are they an inherent feature of adolescence (because they do not affect all adolescent girls nor do they apply to adolescent boys). This means then that they must necessarily be social in origin.

As regards the second objective of our research (see the evolution of the lifestyles of children over time), the two MCA performed for each age group are fairly consistent with the overall MCA performed with all the subjects. The first resulting factors are essentially the same, which in itself provides an important piece of information: general findings are not contaminated by age. When age is

controlled and a specific MCA performed for each age group, the associations among variables summarised by the first factors are essentially the same.

For the years studied, both MCA reveal a globally positive evolution of the life-styles of schoolchildren in terms of these two factors. However, there are two particularly disturbing points. The first is that schoolchildren aged eleven and thirteen register a more positive overall evolution than their 15 year old counterparts, where scarcely any evolution was noted between 1990 and 1994. This may be due only to the fact that the youngest children were compared in three surveys (embracing 8 years of evolution: 1986-1994) while fifteen year olds were compared in only two (4 years of evolution). However it might also indicate that health-related policies are more effective in improving the life-styles of 11 and 13 year olds than the life-styles of 15 year olds. In other words: the improvements made when successive generations of the youngest schoolchildren are compared disappear when comparing their older counterparts.

The other worrisome point is that when the survey findings from 1990 and 1994 are compared, 15 year old girls do not reveal any improvement over time. When this is taken in conjunction with the previously described trends in girls' life-styles, the prospects are still more disturbing.

It is difficult to interpret these findings about girls because there are a number of different explanations. One of them, and perhaps the most probable, is that girls are being subjected to high speed cultural changes which are placing increased demands on them (in terms of studies, work, social life and their own bodies) and are more prone to consume socially accepted drugs. In a process of rapid cultural change it is very possible that the adult figures which should serve as role models are disoriented or undervalued, and this makes adolescents even more vulnerable. Moreover, in a social context which is changing at a dizzying rate, measures aimed at encouraging healthy life-styles might prove ineffective unless they are exceptionally well-designed and consistently applied in the appropriate spheres of action

Whatever the reasons that explain the lack of positive evolution in 15 year old girls, it is clear that the situation revealed by the study is particularly serious and the agents involved need to think about and discuss it thoroughly. Researchers, in turn, could carry out additional studies in order to shed more light on the subject.

The third objective now remains to be clarified. Is MCA an appropriate technique for globally analysing the evolution over time of the life-style of a given population?

If our aim is to actually obtain an overall view of this evolution, then the technique would appear to be appropriate. It quickly detects the factors which most discriminate the subjects, identifying groups of variables which are closely related to one another and which, at the same time, provoke very different responses from the subjects. By using a procedure similar to the one described herein, MCA enables evolution over time to be simultaneously summarised in terms of two (or more) of the most discriminating dimensions.

This approach is not incompatible with a variable-by-variable analysis of evolution over time. Indeed, it is complementary, although much more appropriate if the aim is to obtain an overall view of how life-styles evolve. If researchers hope to be able to present this overall vision to politicians, journalists, university students, or care personal or school teachers not interested solely in a particular type of behaviour, using this technique has definite advantages over the uni- or bivariate approach. One can opt to present the evolution of adolescents over time in terms of each variable, but it is unlikely that the audience will continue to pay attention after the first dozen or so variables have been discussed. And even if they should, it will not be easy for them to shape an overall vision or digest the wealth of information supplied.

Therefore, for people who are interested in life-styles and not just in a few specific types of behaviour, the approach presented here could be the most useful. Once one acquires an overall view of how behaviour evolves over time, there is no reason why a more detailed analysis of the most interesting forms of conduct cannot be carried.

To sum up, there are basically two advantages to using the MCA technique to study the evolution over time of a multivariate phenomenon: First, it highlights which multivariate relations are most consistently stable over a certain period of time. In other words, it tends to omit those associations which are more transitory and appear in some years but not in others or else express contradictory behaviour. In contrast, it underscores those which consistently reveal a pronounced disparity among the subjects studied. Secondly, it enables combinations of variables that visualise the evolution of one or more specific groups to be projected on the different factor planes.

What are the drawbacks of this methodological approach to studying the evolution over time of a multi-variate phenomenon such as life-styles?

The first drawback is an inevitable consequence of what is actually the strongest point of the methodology: it only offers an overall view. It does not go into details about any particular variable.

Moreover, if the variables produced are projected only on the plane defined by the first two factors (the most discriminatory), a particular vision of the evolution of the subjects is obtained. If planes formed by other pairs of factors are used, another, and perhaps very different, view of evolution over time will logically be reached. Yet this drawback is not inherent to the technique itself. Indeed, the most sensible thing would be to view evolution precisely in terms of the two most discriminatory factors. The process could then be repeated with other factors if so wished.

There are two other serious drawbacks to using this technique to study evolution over time. The first is that associations between the variables must have a certain degree of stability in successive editions of the study. If these associations are radically different at different points in time, they are liable to

cancel out one another and will not appear among the most relevant factors for the entire period under study.

The second stems from the fact that MCA is sensitive to sample or sub-sample sizes. If the size of the sample varies from one edition of the survey to the next, the inertia can be falsely affected, not by the actual associations between the variables but by the very fact that a certain type of subject might be over-represented in a particular edition. Any set of traits that is characteristic of this over-represented subject group will tend to define a factor. The opposite will occur if any group is under-represented: although the behaviour patterns of this group might be very characteristic and radically different from those of the other subjects, the first factors are unlikely to refer to these traits.

The solution to this second problem is easy: either the study is carefully designed so that the samples are always more or less the same size or else homogeneity is subsequently ensured by randomly eliminating cases of over-represented groups.

Although very simple, we did not apply this latter solution in our research, and this is, in fact, yet another of the limitations of our study. However, this does not invalidate our findings because the sizes of the successive samples were relatively similar.

The methodology used would seem to be suitable for our purposes, and this is the most important thing. In addition, it offers many possibilities that have not been used in this first MCA analysis of how life-styles evolve over time. We plan to explore these other possibilities in subsequent papers. One will globally compare how life-styles evolve over time in different countries or regions. As mentioned earlier, a further paper will compare this evolution in terms of social status, habitat or other relevant socio-demographic variables. Any suggestions offered by readers will of course be most welcome.

References

- [1] Aarö, L.E., et al. (1986): Health behaviour in school-children. A W.H.O cross-national survey: research protocol for the second survey (1985-86). Bergen: University of Bergen, Department of Social Psychology. (mimeo)
- [2] Aarö, L.E. (1989): Wold B. Health behaviour in school-children. A WHO cross-national survey: research protocol for the 1989-90 study. Bergen: University of Bergen, Research Center for Health Promotion. 97 (mimeo)
- [3] Ahlström, S., Eskola, A., Honkala, E., Kannas, L., and Paronen O. (1979): The juvenile health habit study: study design, methods and material. Kansanterveystieteen laitokset Helsinki. Kuopio, Oulu, Tampere ja Kurtu. Kansanterveystieteen julkaisuja M 48 79. Tampere. In Finnish. English summary 104-6.

- [4] Baltes, P.B., Reese, H.W., and Nesselroade, J.R. (1977): *Life-span Developmental Psychology: Introduction to Research Methods*. Monterey: Cole Books.
- [5] Batista-Foguet, J.M. and Sureda, J. (1998): Análisis de Correspondencias. In J. Renóm (Ed.), *Tratamiento informatizado de datos*. Masson.
- [6] Blasius, J. and Greenacre, M.J. (1998): *Visualization of Categorical Data*. Academic Press.
- [7] Biddle, S., Sallis, J., and Cavill, N. (1998): *Young and Active? Young People and Health-enhancing Physical Activity - Evidence and Implications*. London: Health Education Authority.
- [8] Center for Disease Control and Prevention. Youth risk behaviour surveillance – United States, 1997. CDC Surveillance Summaries, August 1998, 1998. MMWR 1998, **47** (No. SS-3).
- [9] Currie, C. and Watson, J. (Ed.) (1998): *Translating Research Findings into Health Promotion Action: Lessons From the HBSC Study*. Edinburgh: Health Educational Board for Scotland.
- [10] Greenacre, M.J. (1993): *Correspondence Analysis in Practice*. Academic Press.
- [11] Greenacre, M.J. and Blasius, J. (Eds.) (1994): *Correspondence Analysis in the Social Science*. Academic Press.
- [12] Groves, R.M. (1989): *Survey Errors and Survey Costs*. New York: Wiley & Sons.
- [13] Hair, F.J., Anderson, R.E., Tatham, R.L., and Black, W.C. (1996): *Multivariate Data Analysis with Readings* (4th Ed.). Prentice Hall.
- [14] Harkin, A., Anderson, P., and Goos, C. (1997): *Smoking, Drinking and Drug Taking in the European Region*. Copenhagen: World Health Organization.
- [15] Honkala, E., Kuusela, S., Rimpelä, A., Rimpelä, M., and Jokela, J. (1997): Dental services utilization between 1977 and 1995 by Finnish adolescents of different socioeconomic levels. *Community Dent. Oral Epidemiology*, **25**, 385-390.
- [16] Karvonen, S. and Rimpelä, A. (1996): Socio-regional context as a determinant of adolescent's health behaviour in Finland. *Social Science and Medicine*, **43**, 1467-1474.
- [17] King, A., Wold, B., Tudor-Smith, C., and Harel, Y. The health of youth: a cross-national survey. Copenhagen: World Health Organization, 1996.
- [18] Kolbe, L. (1990): An epidemiological surveillance system to monitor the prevalence of youth behaviours that most affect health. *Health Education*, **21**, 44-48.
- [19] Joosens, L., Naett, C., Howie, C., and Muldoon, A. (1994): *Tobacco and Health in the European Union*. Brussels: BASP.

- [20] Lalonde, M. (1974): *A New Perspective on the Health of Canadians*. Ottawa: Office of the Canadian Minister of National Health and Welfare.
- [21] Lebart, L., Morineau, A., and Warwick, K. (1984): *Multivariate Descriptive Statistical Analysis. Correspondence Analysis and Related Techniques for Large Matrices*. J.Wiley.
- [22] Lebart, L., Morineau, A., and Piron, M. (1995): *Statistique Exploratoire Multidimensionnelle*. Dunod.
- [23] Mendoza, R., Batista-Foguet, J.M., Rodríguez, et al.: Los adolescentes españoles en el cambio de siglo: relaciones sociales, adaptación escolar y conductas relacionadas con la salud. Submitted for publication.
- [24] Mendoza, R., Sagrera, R., and Batista-Foguet, J.M. (1994): *Conductas de los Escolares Relacionadas con la Salud (1986-1990)*. Madrid: Consejo Superior de Investigaciones Científicas.
- [25] Mendoza, R.: *Concept of healthy lifestyles and their determinants*. Invited paper at the Second European Conference on Health Education (Warsaw, 7-9 June 1991), organised by the European Union for Health Education. (Mimeo).
- [26] Mendoza, R., Blanco, J., Martín de la Concha P., Morales, E., Ruiz, J., Sagrera, R., and Batista-Foguet, J.M. (1988): *Los escolares y la salud: estudio de los hábitos de los escolares españoles en relación con la salud*. Madrid: Ministerio de Sanidad y Consumo.
- [27] Mendoza, R. and Sagrera, M.R. (1991): *Los escolares y la salud: avance de los resultados del segundo estudio español sobre conductas de los escolares relacionadas con la salud (1990)*. Madrid: Ministerio de Sanidad y Consumo.
- [28] Mendoza, R., Batista-Foguet, J.M., and Oliva, A. (1994): Life-styles of European School-children: Findings of the WHO Cross National Study on Health-related Behaviour. En: Dauwalder JP (Ed.), *Psychology and promotion of health*. Bern: Hogrefe & Huber Publishers: 8-20.
- [29] Mendoza, R., Batista-Foguet, J.M., Sánchez, M., and Carrasco, A. (1998): El consumo de tabaco, alcohol y otras drogas en los adolescentes escolarizados españoles. *Gaceta Sanitaria*, **12**, 263-271.
- [30] Morineau, A. (1992): Le themascope ou analyse structurelle des donnees d'enquete. Ecole Modulad, Strasburg.
- [31] Pate, R.R., Heath, G.W., Dowda, M., and Trost, S.G. (1996): Associations between physical activity and other health behaviours in a representative sample of US adolescents. *American Journal of Public Health*, **86**, 1577-1581.
- [32] Peto, R., López, A.D., et al. (1994): *Mortality from Smoking in Developed Countries 1950-2000*. Oxford: Oxford University Press.

- [33] Rimpelä, M., Rimpelä, A., Ahlström, S., Honkala, E., Kannas, L., Laakso, L., et al. (1983): Health habits among Finnish youth. The juvenile health habit study 1977-79. Tampere: Publications of the National Board of Health. Health Education, Series Original Reports 4/1983. In Finnish. English summary 209-18.
- [34] Ruiz, M., Blanes, A., and Viciano, F. (1997): La mortalidad en jóvenes y su impacto sobre la evolución de la esperanza de vida en Andalucía durante el período 1980-1992. *Revista Española de Salud Pública*, **71**, 139-148.
- [35] Sanz, C. and Pérez, J. (1997): Mortalidad por accidentes de tráfico en España 1962-1992 (I). *Boletín Epidemiológico Semanal*, **4**, 289-300.
- [36] Sanz, C. and Pérez, J. (1997): Mortalidad por accidentes de tráfico en España 1962-1992 (II). *Boletín Epidemiológico Semanal*, **4**, 301-312.
- [37] Sarasqueta, C. and Zunzunegui, M. (1994): Principales causas de mortalidad entre los jóvenes de la Comunidad de Madrid: 1990-1991. *Gaceta Sanitaria*, **42**, 117-121.
- [38] Spad, N., Lebart, L., Morineau, A., and T. Lambert. CISIA (1 Avenue Herbillon, 94160 Saint-Mandé - France)
- [39] Tacq, J. (1997): *Multivariate Analysis Techniques in Social Sciences Research*. Sage.
- [40] Todd, J, Currie, C., and Smith, R. (1999): Health behaviours of Scottish schoolchildren: Technical report 1: Smoking, drinking and drug use in the 1990s. Edinburgh: University of Edinburgh, Medical School, Research Unit in Health and Behavioral Change,
- [41] World Health Organization (1997): Terms of reference: Health Behaviour in School-Aged Children: A WHO cross-national study. Copenhagen: WHO.
- [42] Wold, B., Aarö, L.E., and Smith, C. (1993): Health behaviour in school age children: a W.H.O cross- national survey: research protocol for the 1993-94 study. Bergen: University of Bergen, Research Center for Health Promotion.