# Millon´s Personality Model and ischemic cardiovascular acute episodes: Profiles of risk in a decision tree[1]

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**ABSTRACT.** Detection of people at risk enables development of specific psychological interventions for patient populations. The main purpose of this study consisted in finding statistical associations between personality characteristics – traits and disorders- and ischemic cardiovascular acute episodes. Following Theodore Millon's personality model, we use data mining procedures to identify association patterns between personality scales and clinical and control groups. Statistical analysis was founded on data from a sample of 313 women and men, 31 to 80 years old. Participants were divided into two groups: a clinical group of 143 in-patients who suffered from acute episodes of ischemia, and a control group of 170 from a normal population. The results of our research show four personality profiles associated to risk of ischemic cardiovascular acute episodes, allowing clinical psychologists to carry out tailored interventions for people at risk.

**KEYWORDS.** Personality disorders. Ischemic cardiovascular acute episodes. *Ex post facto* study.

**RESUMEN.** La identificación de subgrupos de riesgo permite a los psicólogos clínicos desarrollar intervenciones específicas para esos subgrupos. El principal propósito de este trabajo fue encontrar asociaciones estadísticas entre características de personalidad –rasgos y trastornos- y la existencia de episodios isquémicos cardiovasculares agudos según el modelo de personalidad de Theodore Millon. Los análisis del presente estudio se fundamentaron en una muestra de 313 mujeres y hombres entre 31 y 80 años de edad, divididos en dos grupos: un grupo clínico formado por 143 participantes internados a causa de episodios isquémicos cardiovasculares agudos y un grupo control constituido por 170 personas sin antecedentes de enfermedades cardiovasculares. Los resultados mostraron cuatro perfiles de riesgo de personalidad asociados con la existencia de episodios isquémicos agudos y, por tanto, esto posibilita a los psicólogos clínicos el diseño de intervenciones específicas para aquellos subgrupos.

**PALABRAS CLAVE.** Trastornos de personalidad. Episodios isquémicos cardiovasculares agudos. Estudio *ex post facto.*

Scientific literature shows that psychological factors have a significant influence on the course and treatment of cardiovascular diseases. Cardiovascular diseases are the most frequent cause of death in Argentina, with a prevalence of 2.50% (World Health Organization, 2005), being the acute myocardial infarction one of its most aggressive forms (Hirschson Prado *et al.,* 1998). It seems that the medical model is no longer sufficient to explain cardiovascular diseases and, for this reason, nowadays also psychological factors are taken into account. Specifically, personality traits and disorders are the risk factors that increase the probability of suffering from ischemic cardiovascular acute episodes –ICAE- (Carpi, Zurriaga, González, Marzo, and Buunk,2007).

A large number of studies have found some evidence about the relationship between depression, anxiety and personality characteristics and the increase of cardiac mortality and morbility for patients who suffer from ischemic pathologies (Brunckhorst, Holzmeister, Scharf, Binggeli, and Duru, 2003; Buceta and Bueno, 1996; Davidson, Rieckmann, and Lesperance, 2004; Denollet, 2000; Denollet and Brutsaert, 1998; Denollet, Vaes, Dirk, and Brutsaert, 2000; Follath, 2003; Friedman *et al.,* 2001; Guerrero and Palmero, 2006; Kristofferzon, Lofmark, and Carlsson, 2003; Lesperance and Frasure-Smith, 1996; Marusic, 2000; Myrtek, 2001; Newman, 2004; Urquijo, Giles, Richard´s, and Pianzola, 2003; Welin, Lappas, and Wilhelmsen, 2000; Yusuf *et al.,* 2004; Zellweger, Osterwalder, Langewitz, and Pfisterer, 2004). Nevertheless, there is no agreement on the traits, profiles, patterns or personality styles that are associated to the cardiovascular disorders.

Throughout many years, it has been thought that cardiovascular diseases are related to specific behavioral patterns. These individuals' profiles are characterized by searching for successful outcomes and high competitiveness, which was denominated by Friedman and Roseman (1959) as Type A Behavior Pattern (TABP). Although many studies sustained the relationship between the Type A personality and the cardiovascular diseases (Coelho, Ramos, Prata, Maciel, and Barros, 1999; Del Pino Pérez, Borges del Rosal, Díaz del Pino, Suárez Santana, and Rodríguez Matos, 1990; Del Pino Pérez, Gaos Meizoso, Díaz del Pino, Díaz Cruz, and Suárez Santana, 1992; Kawachi *et al.,* 1998; Munakata *et al.,* 1999), recently others have questioned this association (Espnes and Opdahl, 1999;

Friedman *et al.,* 2001; Myrtek, 2001; Rozanski, Blumenthal, and Kaplan, 1999; Schroeder *et al.,* 2000). On the other hand, several researchers (Denollet, 2000; Denollet and Brutsaert, 1998; Denollet, Sys, and Brutsaert, 1995; Denollet *et al.,* 1996; Lesperance and Frasure-Smith, 1996; Pedersen and Denollet, 2003) have proposed a new personality profile, called type D -from distress, as a risk factor for cardiovascular disease. Type D personality is defined as a personality trait characterized by negative affect and social inhibition (Denollet and Brutsaert, 1998; Denollet *et al.,* 1995; Denollet *et al.,* 1996; Pedersen and Denollet, 2003).

The different methods and theoretical models used to define and assess personality characteristics, are some reasons that enable understanding of the lack of agreement on traits, profiles, patterns, styles or personality disorders associated to cardiovascular episodes. Thus, Millon's position (Millon, 1969, 1981, 2002; Millon and Everly, 1994; Millon and Klerman, 1986) seems to be adequate since it is a theoretical approach that explains why people behave as they do and why, in some cases, their behavior becomes dysfunctional. Millon considered the basic dimensions used to elaborate the personality typologies: activity-passiveness, pleasure-pain and subject-object. On the basis of this triple system, Millon derived the personality patterns which correspond to each personality disorder from the Diagnostic and Statistical Manual of Mental Disorders III (DSM III; American Psychiatric Association, 1980).

The aim of this study is to identify and analyze the personality characteristics included in Millon Clinical Multiaxial Inventory -second version (MCMI-II; Millon, 1999)- that are associated to the risk of suffering from ICAE. In order to achieve this objective, we used an algorithm that is often included in Data Mining procedures and based on entropy reduction to elaborate decision trees. From a statistical point of view, it has been pointed out that other similar algorithms to the used in our study allow lesser misclassification rates than the logistic regression (Kiernan, Kraemer, Winkleby, King, and Taylor, 2001). Regarding this, note that researchers should not make decisions about the number and the order of interactions that should be included in exploratory studies. The hypothesis of this work states that certain indicators, which are associated to personality characteristics – traits and disorders –, enable to classify individuals into the studied groups, the clinical or the control one. The identification of these personality indicators among the members of the clinical and control group is an advance in the detection and treatment of psychological risk factors, which were not totally considered until some years ago, for ICAE.

The coronary syndrome is a pathological process that implies permanent or transitory deficit of blood flow in sectors of the cardiac muscle (myocardium). This circulatory deficit causes syndromes and may also cause cellular death of parts of the myocardium (ischemia). The coronary syndromes can be divided into acute and chronic; the acute ones include unstable angina (UA) and acute myocardial infarction (AMI). The present article considers a group of ischemic cardiovascular acute episodes that includes the unstable angina and the acute myocardial infarction (Marso, Griffin, and Topol, 2002).

Personality is a complex pattern of psychological characteristics that are profoundly rooted, mainly unconscious and difficult to change. They are automatically expressed in almost all areas of individual's behavior (Millon, 1969, p.12). According to the Millon's functional-interpersonal theory, a trait can become a personality disorder when

the following two components can be distinguished: scarce flexibility of adaptation (desadaptative and rigid behavior) and tendency to repeat the same behavioral patterns (misadjusted personality patterns).

This study is an *ex post facto* one with a cuasi-control group (Montero and Leon, 2007) edited according to Ramos-Alvarez, Valdés-Conroy, and Catena (2006).

## Method

*Participants*

A data set of 313 adult people with no antecedents of psychiatric pathology and with a level of comprehension equivalent to 8 years of education in Argentina was assessed. The sample was divided into two groups: a) a clinical group (*n* = 143) that consisted of 31 to 80 years old (*M* = 55.95; *SD* = 10.53) randomly selected men and women who had suffered from ICAE and were admitted in the Coronary Unit of Interzone General Hospital of Acute Patients (IGHA) of Mar de Plata city in Argentina. The patients were clinically diagnosed by the Cardiology Service of IGHA according to Marso, Griffin and Topol´s criteria (2002); and b) the control group (*n* = 170) that consisted of 31 to 72 years old participants from general population who did not fulfill any of the diagnostic criteria and did not have any antecedents of cardiovascular diseases. The participants of the control group were matched to those of clinical group in age, socioeconomic and education level.

The criteria of inclusion in the clinical group was the Unstable Angina and/or the Acute Myocardial Infarction diagnosed by the Cardiology Service of IGHA, following the criteria established by Marso *et al.* (2002). The participants who suffered from other cardiovascular pathologies, for example valve pathology or arrhythmia, and those who could not be interviewed due to their severe state (respiratory assistance, shock, denied responding) were excluded.

Table 1 shows the distribution by gender and the evidence (clinical group) or no evidence (control group) of ischemic cardiovascular acute episodes and the corresponding marginal distributions. As it can be seen in Table 1, the number of women who suffer from ischemic cardiovascular acute episodes is less than the number of men, at least in this sample, that represents the population of Mar del Plata city, Argentina.

**TABLE 1**. Individuals' distribution by gender and groups (clinical or control).

|  | *Clinical group* | *Control group* | *Marginal rows* |
|---|---|---|---|
|  | *Number of individuals (percentage)* | *Number of individuals (percentage)* | *Number of individuals (percentage)* |
| Women | 39 (12.46%) | 95 (30.35%) | 134 (42.81%) |
| Men | 104 (33.23%) | 75 (23.96%) | 179 (57.19%) |
| Marginal column | 143 (45.69%) | 170 (54.31%) | 313 (100%) |

*Instruments and procedure*

The Spanish adaptation of Millon Clinical Multiaxial Inventory-II was used to measure personality characteristics (traits and disorders) and therefore to classify the participants. The MCMI-II consists of 175 dichotomic *true-false* items. The application time is relatively short (20 to 40 minutes) and it measures 10 basic personality patterns scales (*Schizoid, Avoidant, Dependent, Histrionic, Narcissistic, Antisocial, Aggressive-sadistic, Compulsive, Passive-aggressive, and Self-defeating –masoquist-*), 3 pathological personality scales (*Schizotypal, Borderline and Paranoid*), 6 moderate clinical syndrome scales (*Anxiety, Somatoform, Hypomania, Dysthymia, Alcohol dependence and Drug dependence*) and 3 severe clinical syndrome scales (*Psychotic thought, Major Depression and Delusional disorder*). Additionally, there are four scales that measure the reliability and validity (*disclosure, desirability, debasement and validity*). The total number of scales is 26 (Millon, 1999).

The second version of the MCMI (MCMI-II) was administrated to avoid the controversy about the unsuitable use of the third version to measure the theoretical constructs, as most of the items were rewritten to represent the diagnostic criteria of Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV; American Psychiatric Association, 1995) instead of the Millon's theory constructs (Widiger, 1999). Therefore, MCMI-II was used in the present study since there is no controversy regarding this version.

The Millon Clinical Multiaxial Inventory-II – MCMI-II – (Millon, 1999) was administrated to each participant, either from the control or clinical group. The participants from the clinical group were assessed two days after their admission to the Coronary Unit, taking into account their circumstances when it was possible. The purpose of the work was given to each subject. Additionally, the agreement of each patient was obtained and the confidentiality was ensured. To control the differences in cultural levels and the states of patients, the items were read by the administrators. The same procedure was used for the control group.

The input variables of the classification system consisted of the abovementioned 22 scales (excluding the 4 scales that measure *reliability* and *validity*) and the individuals' gender. The output variable was the group, which values were clinical and control. Although the research focused on the possible association between the scores in the clinical scales and ICAE, the participants' gender was included as a control variable since it could influence the decision patterns.

*The data analysis*

With the purpose of generating a decision tree that could classify the participants into the clinical or control group, an analysis by means of the C5.0 algorithm, included in *Clementine V 6.0* (SPSS Inc., 2001), was carried out. This algorithm is based on entropy reduction and enables to identify logical decision rules to assigning individuals to one of the output values as a function of input variables. We do not denominate the variables as independent or dependent since this study is not intended to establish

causal relationships. Our purpose is only to identify homogeneous conglomerates of individuals who can be classified into groups. That is, it is an exploratory study. It should be emphasized that the usefulness of this classification system for applied purposes depends on its precision.

The C5.0 algorithm requires some technical decisions before carrying out data analysis. First, it is needed to decide whether obtaining a decision tree or induced rules. The first option was chosen because it assigns each individual to an only terminal node, also called extreme node or leaf, while individuals' profile may be associate to more than one induced rule. For this reason decision trees are more useful than induced rules to make decisions in the clinical field. Another issue is the minimum number of cases required for each terminal node. Note that an important requirement is to establish a sufficient number of cases to prevent from extracting terminal nodes without any significance. It was decided that none of the terminal nodes would have a number of individuals less than 3% of sample size. That is, the minimum number of cases in each terminal node was set equal to 9.

The procedure carried out in the current study has a significant constraint, as all individuals from the sample were used to make the decision tree. As a consequence, a higher level of accuracy than in reality was obtained in this study, as the same cases were used to build the decision tree and to estimate the reliability of the decision rules. In order to obtain a better estimation of the reliability, a cross validation should have been carried out. That is, half of the cases of the sample could have been used to build the decision tree and the remaining to estimate the reliability of the decision rules. This limitation does not only refer to the analytic procedure followed here, but also to those studies in which regression models or discriminate analysis is used. The reason for which a cross validation could not be carried out is founded on the sample size. Note that a large number of cases is often needed to determine statistical models in classification techniques. As a large enough data base was not available in the current study, if half of the sample had been used to build the decision tree, the number of participants would have been absolutely insufficient to build the decision tree.

## Results

The decision rules have been specified in a simpler and integrated way in Table 2. A significant result is that most of the decision rules show an acceptable reliability level. Hence, clinical psychologists could make use of the decision rules shown in Table 2 to decide whether a person is at serious risk of developing ischemic cardiovascular acute episodes. However, it is must be mentioned that the rules 5 and 6 are inaccurate enough to properly classify individuals into the clinical group, in the same way as rules 6 and 7 are unsuitable for the control group. Regarding the rules 5 and 6, these lead to some false positives, but it could be convenient from a preventive perspective since it only means to carry out intensive explorations. With respect to the rules 6 and 7 for the control group may mean undesirable consequences since these lead to frequent false negatives. As a rule of thumb, clinical psychologists should carry out an intensive exploration if individuals were assigned to any of the four above mentioned rules.

A propensity value equal or higher than .80 was required to consider any decision rule to be sufficiently reliable for being applied in the clinical field. That is, it was established that rules for which their error rates were greater than 20% would be unacceptable for practical purposes. Note Table 2 provides the propensity values, that is, the accuracy, $p$, for the rules.

**TABLE 2.** Set of rules for deciding wheter an individual should be assigned to the clinical or the control group.

| Rule | Specification of the decision rules | $n$ | $p$ |
|---|---|---|---|
| *Clinical group* | | | |
| 1 | If ($22 \leq$ Dysthymia $\leq 73$) & ( $32 \leq$ Dependent $\leq 84$) & (Gender = 'Male') & (Drug abuse $\geq 73$), then (Group = 'Clinical') | 10 | .900 |
| 2 | If (Dysthymia $\leq 73$) & (Dependent $\geq 32$) & (Gender = 'Female') & (Sadistic-aggressive $\leq 75$) & (Delusional-disorder $\geq 61$) & (Anxiety $\geq 56$), then (Group = 'Clinical') | 9 | .889 |
| 3 | If (Dysthymia $\geq 74$) & (Delusional-disorder $\geq 48$), then (Group = 'Clinical') | 91 | .857 |
| 4 | If ($22 \leq$ Dysthymia $\leq 73$) & (Dependent $\geq 85$) & (Gender = 'Male'), then (Group = 'Clinical') | 22 | .818 |
| 5 | If ($22 \leq$ Dysthymia $\leq 73$) & ( $32 \leq$ Dependent $\leq 84$) & (Gender = 'Male') & (Drug abuse $\leq 72$) & (Sadistic-aggressive) $\leq 56$), then (Group = 'Clinical') | 12 | .667 |
| 6 | If ($22 \leq$ Dysthymia $\leq 73$) & ( $32 \leq$ Dependent $\leq 84$) & (Gender = 'Male') & (Drug abuse $\leq 72$) & (Sadistic-aggressive) $\geq 57$) & (Anxiety $\geq 79$, then (Group = 'Clinical') | 10 | .600 |
| *Control group* | | | |
| 1 | If (Dysthymia $\leq 73$) & (Dependent $\leq 31$), then (Group = 'Control') | 38 | 1.000 |
| 2 | If (Dysthymia $\leq 73$) & (Dependent $\geq 32$) & (Gender = 'Female') & (Sadistic-aggressive $\geq 76$), then (Group = 'Control') | 24 | 1.000 |
| 3 | If ($22 \leq$ Dysthymia $\leq 73$) & ( $32 \leq$ Dependent $\leq 84$) & (Gender = 'Male') & (Drug abuse $\leq 72$) & (Sadistic-aggressive $\geq 57$) & (Anxiety $\leq 78$, then (Group = 'Control') | 21 | .905 |
| 4 | If (Dysthymia $\leq 73$) & (Dependent $\geq 32$) & (Gender = 'Female') & (Sadistic-aggressive $\leq 75$) & (Delusional-disorder $\leq 60$), then (Group = 'Control') | 39 | .872 |
| 5 | If (Dysthymia $\leq 21$) & (Dependent $\geq 32$) & (Gender = 'Male'), then (Group = 'Control') | 19 | .842 |
| 6 | If (Dysthymia $\geq 74$) & (Delusional-disorder $\leq 48$), then (Group = 'Control') | 9 | .667 |
| 7 | If (Dysthymia $\leq 73$) & (Dependent $\geq 32$) & (Gender = 'Female') & (Sadistic-aggressive $\leq 75$) & (Delusional-disorder $\geq 61$) & (Anxiety $\leq 55$), then (Group = 'Control') | 9 | .667 |

*Note*. & represents the operator $\grave{U}$ from the formal logic, which means the conjunction and.

The antecedents specified in parenthesis correspond to different subgroups of values of the input variables, and the consequences correspond to one of the values of the output variable. *n* is the number of individuals in the sample for whom different statements which compose each antecedent are fulfilled, whereas the propensity is represented by *p*. The propensity quantifies the accuracy of the decision rules, being the proportion of the individuals from the sample who fulfill the conditions of the antecedents associated to a value of the consequence.

If the decision rules for the clinical group are considered, apart from the rules 5 and 6 for the reasons above mentioned, it is possible to identify some risk profiles for the incidence of ICAE. It should be mentioned that not all of these profiles have the same level of clinical relevance, which is here understood as the number of people who match each profile. There is no doubt that the profile associated to the third decision rule for the clinical group stands out (see Table 2), where $n = 91$ and $p = .857$. This profile includes 54.55% of the participants from the sample who have suffered from ischemic cardiovascular acute episodes. This result is derived from $78/143 = .54$, 78 being obtained if $91 \times .85$ is rounded up. According to this profile, the individuals with scores in the clinical syndrome of dysthymia and delusional personality disorder equal or higher than 74 and 48, respectively, have frequently shown ischemic cardiovascular acute episodes, being remarkable that this profile is independent of gender. In the other three profiles (rules 1, 2 and 4 for the clinical group from Table 2) the *dependency* scale plays a relevant role, although the profiles are always moderated by gender. In fact, for the rule 2, which corresponds to one of the three abovementioned profiles, there are eight cases ($9 \times .88$) in which ischemic cardiovascular acute episodes have been detected and they approximately represent 20.51% of the total number of women in the clinical group. It can be determined through similar calculations that the rules 1 and 4, associated to the male gender, include almost 25.96% of the total number of participants who have suffered from ischemic cardivascular acute episodes. Thus, exists a clear dominant personality profile, while women and men manifest other profiles less frequently. It should be mentioned that the profile that corresponds to the rule 4, associated to the male group, is the one that corresponds to the range of specific values for the scales of *dysthymia* and *dependency*, whereas the rule 1, linked as well to the men, only adds the *drug abuse* to the previous one (see Table 2). The profile corresponding to the rule 2, associated to the female group, shows a more complex pattern of participation of other psychological properties, such as *anxiety, aggressive-sadistic and delirious.*

As for those measures of the scales that seem to be associated to the risk profiles of ICAE, dysthymia and the one related to delusional personality disorders should stand out clearly. Complementary, the scales of *dependency, aggressive-sadistic and anxiety* are added, apart from the *drug abuse* scale and gender. All in all, only six of the 22 scales that were initially considered in this exploratory study seem to be associated to risk profiles for ICAE.

As to the validation of the decision rules for all the cases of the sample, 86.26% were correctly classified. However, this absolute result, which without doubt is significant enough for the implementation of the classification system in clinical assessment, should be compared with the expected rate of success under random assignment. Note that

50% of correct classification is expected if a complete random procedure is used. Therefore, it is suitable to obtain a relative percentage of gain, that is, to compare what is expected by chance with the efficiency of the classification system. Here this relative measurement equals 72.52%, which means that the classification system allows a relative improvement equal to (86.26-50)/50= .72 in comparison with chance. It should be noted that the maximum value of the relative measurement equals 1. Table 3 shows that, for the whole group of individuals in the study, the reliability of the classification system does not significantly depend on the groups, as there is a no significant difference of 4% in favor of the clinical group. Other indices about the precision of the classification system can be obtained from the available data in Table 3, such as sensitivity and specificity. Sensitivity and specificity values of the classification system are .88 and .84, respectively. These values suggest, in relative terms, that a smaller number of false negatives is expected in comparison with false positives, a better result than the opposite from an applied point of view.

**TABLE 3.** The classification matrix shows the reability of the classification system for total sample. It also refers to the predictive accuracy of the decision rules.

| Reality | Clinical group Number of individuals (percentage) | Control group Number of individuals (percentage) | Total |
|---|---|---|---|
| Clinical group | 127 (88.81%) | 16 (11.19%) | 143 |
| Control group | 27 (15.88%) | 143 (84.12%) | 170 |

*Note.* The percentages correspond to sensibility and specificity.

The accuracy of the classification system depends on gender (see Tables 4 and 5). In the case of women, the absolute percentage of participants correctly classified by means of the classification algorithm is equal to 81.34%, which represents a relative gain equal to .62 in comparison with random assignment. However, women in the control group are clearly better classified than those in the clinical group.

**TABLE 4.** The classification matix shows the reability of the classification system for women.

| Reality | Clinica groupl Number of individuals (percentage) | Control group Number of individuals (percentage) | Total |
|---|---|---|---|
| Clinical group | 29 (74.6%) | 10 (25.64%) | 39 |
| Control group | 11 (11.58%) | 84 (88.42%) | 95 |

*Note.* The percentages correspond to sensibility and specificity.

**TABLE 5.** The classification matrix shows the reliabitiy
of the classification system for men.

| Reality | Clinical group Number of individuals (percentage) | Control group Number of individuals (percentage) | Total |
|---|---|---|---|
| Clinical group | 98 (94.23%) | 6 (5.77%) | 104 |
| Control group | 16 (21.33%) | 59 (78.67%) | 75 |

*Note*. The percentages correspond to sensibility and specificity.

Regarding men, the results are more satisfactory than those for women. While the absolute percentage of participants correctly classified is almost 87.71%, the relative measurement is practically equal to .75. It is not possible to know if this differential result for gender is caused by, on one side, the fact that in the sample there is a smaller number of women than men and therefore the extracted rules resulted in being less efficient for women, or, one the other side, the inexistence of a larger homogeneity of the risk profiles for women.

## Discussion

In the present study we have used algorithms based on the reduction of entropy in order to find profiles associated to the presence of ischemic cardiovascular acute episodes. Due to the fact that nonlinear relations frequently exist between variables, statistical techniques that require linear relations were not useful for the detection of existing patterns in our study. The algorithm allows identifying nonlinear relations between variables and therefore it has enabled us to extract some profiles associated to ischemic cardiovascular acute episodes. The results of our study will enable clinical psychologists to identify people with high risk of developing ischemic cardiovascular acute episodes, though, without a doubt, our results should need to be replicated in future studies

The main hypothesis of this study stated that some indicators associated to personality characteristics, such as traits and disorders, can be useful to discriminate between the two studied groups, clinical and control. This hypothesis has been verified, as four profiles have been detected, one of them independent of sex, whereas the less frequent other profiles were associated to gender. It is expected that these profiles may be used in the primary and secondary prevention of ischemic cardiovascular acute episodes and also may serve as a guide for a psychological intervention. This study also makes possible the reduction of the large number of characteristics that have been associated to the incidence of ischemic cardiovascular acute episodes. In fact, of the 22 initially considered scales, only 6 have been identified as possible factors associated to the incidence of the aforementioned episodes. This result, although it should be considered as a preliminary outcome, can guide future research since some of the most significant variables have been detected.

Regarding the specific results, the risk profile corresponding to the rule 3 stands out, as indicates that delusional personality disorder and clinical dysthymia are highly associated to the occurrence of ischemic cardiovascular acute episodes, independently of gender. According to Millon, people who suffer from delusional disorders show interconnected irrational deliriums, a hostile state of mind, feelings of being treated inadequately, constant tension, suspicions, awareness, and alertness for possible betrayals. On the other hand, patients with dysthymia show discourage or guilt feelings, lack of initiative and apathy in their behavior, weeping, suicidal or pessimistic thoughts, chronic agitation, eating disorders, poor concentration, diminished efficacy in performing daily tasks, and low self-esteem, frequently accompanied by self-devaluing comments. Both profiles correspond to personalities with difficulties in experiencing pleasure (Millon and Davis, 1998, 2000).

With respect to the other three profiles –rules 1, 2 and 4–, we must emphasize that the dependent personality disorder and the clinical syndrome of dysthymia always appear in the three decision-making rules associated to the clinical evidence. In accordance with Millon's circumplex model, these personality scales have similar characteristics, which are defined by a pattern of dependent affiliation and a pattern of indifferent expression. Individuals with dependent personality disorder have learned to treat others as a source of protection and safety. This people can be characterized as searching for relations where they can get support and obtain affect, safety and advice. An analysis with respect to the gender show that the male risk profile adds the syndrome of drug abuse, which includes people who are unable to control their impulses and without abilities to manage the consequences of such behaviours, to the two previous scales (*dependency* and *dysthymia*). The female risk profile is more complex and diverse, taking into account the aggressive-sadistic personality and the clinical anxiety syndrome. These people are not seen as antisocial by others, but they find satisfaction and personal pleasure in behaviors that humiliate other individuals and violate their rights and feelings. As their personalities are characterized by high competitiveness, they are associate to the A type personality. According to Millon's classification and the results of this study, the risk profile for men should correspond to personalities with interpersonal problems in the same way as the profile for women corresponds to the personalities with intrapsychic problems.

In general terms, the abovementioned ischemic cardiovascular acute episodes profiles that have high propensity values show theoretical similarities to the Type D personality. The concept of Type D personality refers to a homogenous and stable subgroup of personality traits that are undoubtedly founded on psychological theories, unlike the Type A personality, which is based on an additive and heterogeneous definition of behavioral symptoms (Denollet, 2000; Pedersen and Denollet, 2003). The evidence accumulated until nowadays suggests that cardiac patients with Type D personality have a significant increased risk of cardiovascular morbidity and mortality, independently of the traditional risk factors (Pedersen and Denollet, 2003). It should be mentioned here that the implicit distress, or negative stress, in Type D personalities causes unpleasant emotions (such as anxiety, depression, dysthymia, and hostility), no adaptive psychological tendencies (such as difficulties in interpersonal relations and intrapsychic conflicts –

*e.g.* dependent personality disorder, aggressive-sadistic and delusional – or in the perception of available social support), and dysfunctional behavioral tendencies (such as the development of damaging habits for health, *e.g.* drug abuse). These characteristics are congruent with our results and similar studies on Argentinean clinical samples (Richard's and Urquijo, 2006), which indicates that the incidence of personality disorders or no adaptive patterns is associated to the augmented probability of suffering from clinically significant ischemic cardiovascular acute episodes, independently of gender.

The most important limitation of this study is that the cross-validation of the decision rules has not been carried out. Therefore, it seems reasonable to propose further future research, perhaps as a result of the collaboration among different research groups, in which a larger sample could be drawn and analyzed. In addition to this technical aspect, a study with a higher number of cases would allow a higher level of certainty in generalizing the results, especially if the study was international.

To sum up, the present study had two purposes. The first one was to show how an algorithm based on the reduction of entropy, or if preferred, on the increase of information, enables to obtain a group of decision rules. It stands out that these rules are expressed in a very natural way for clinical psychologists, in the sense that the information is presented in a very similar manner as the communication among professionals in the clinical field. Secondly, assuming that the personality characteristics – traits and disorders – could be linked to ischemic cardiovascular acute episodes, the objective was to empirically determine those psychological profiles that are associated to them. With the empirical evidence about those risk profiles available, clinical psychologists can carry out a preventive strategy in their practice.

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