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Association between completed suicide and environmental temperature in a Mexican population, using the Knowledge Discovery in Database approach

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ABSTRACT

Background and objective: Suicide is a worldwide health problem and climatological characteristics have been associated with suicide behavior. However, approaches such as the Knowledge Discovery in Database are not frequently used to search for an association between climatological characteristics and suicide. The aim of the present study was to assess the association between weather data and suicide in a Mexican population.

Methods: We used the information of 1357 patients who completed suicide from 2005 to 2012. Alternatively, weather data were provided by the National Water Commission. We used the Knowledge Discovery in Database approach with an *Apriori* algorithm and the data analyses were performed with the Waikato Environment for Knowledge Analysis software. One hundred rules of association were generated with a confidence of 0.86 and support of 1.

Results: We found an association between environmental temperature and suicide: days with no rain and temperatures between 30 °C and 40 °C (86–104 °F) were related to males completing suicide by hanging.

Conclusions: In the prevention of suicidal behavior, the Knowledge Discovery in Database could be used to establish climatological characteristics and their association with suicide. This approach must be considered in future prevention strategies.

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Abbreviations: KDD, Knowledge Discovery in Database; CONAGUA (initials in Spanish), Comisión Nacional del Agua, National Water Commission; PGJ (initials in Spanish), Procuraduría General de Justicia, Office for the General Procurement of Justice; INEGI (initials in Spanish), Instituto Nacional de Estadística, Geografía e Informática, National Institute of Statistics, Geography and Information Technology.

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1. Introduction

Suicidal behavior is a health problem worldwide, since one suicide is consummated every 40 seconds [1]. The nature of the suicidal phenomenon is complex and suicidal behavior varies in degrees of lethality and suicidal intent [2,3]. Suicidal behavior includes suicidal ideation, suicide attempt and completed suicide; factors such as age, gender, depressive symptoms, previous negative life events and medical complications are strongly correlated to suicide completion [4,5]. Those who attempt to commit suicide and survive are often seriously injured and present depression and other mental health problems [6,7]. In Mexico there has been an accelerated increase in suicide incidence in the past decades [8,9]. Tabasco State ranks third in suicide countrywide, and first in the southeast region [8]. The suicide rate in this entity is over the national average, and it has been so during the past 20 years [10]. In addition, suicide is one of the leading causes of death among young people in Tabasco [8,10].

Some studies indicate that climate changes may influence depression and anxiety, as well as increase addictions and suicide [11–13]. Furthermore, in recent years a link between climate change and mental health was found; however, this association has been little studied in Mexico [14]. Although most of the studies have reported seasonal variations in suicide rates during spring and summer, the literature indicates that suicide occurs more frequently in spring [15,16]. Humidity, atmospheric pressure, rainfall and sunshine have also been analyzed, although environmental temperature has been the most studied climatic variable in suicide [17,18].

The Knowledge Discovery in Database (KDD) is an approach which extracts useful information from databases [19]. It has been used in association with clinical databases for the prediction of lung cancer [20], strokes [21] and breast cancer [22]. However, to our knowledge only a few studies have used the Knowledge Discovery in Database approach to analyze suicide attempt data [23,24]. In the design of strategies to prevent suicide, it is necessary to identify the main risk factors in the population. The aim of this study was to assess environmental temperature, month, day of the week, age, gender and suicide methods, and their relation to the date of completed suicides in the population of Tabasco State, Mexico, using KDD.

2. Methodology

The first step in the Knowledge Discovery in Database (KDD) approach included **data collection and inclusion phase** (Fig. 1) using the historic data of completed suicides in the state of Tabasco, Mexico. Data were obtained from the Office of the General Procurator of Justice (PGJ, initials in Spanish) database provided by the Ministry of Health of Tabasco. We chose to study the suicides completed from 2005 to 2012 mainly because there was detailed information available during this period; we also considered it to be a period of study recent enough and long enough to give a significant overview. Data were reviewed, selected and integrated in a single plain file.

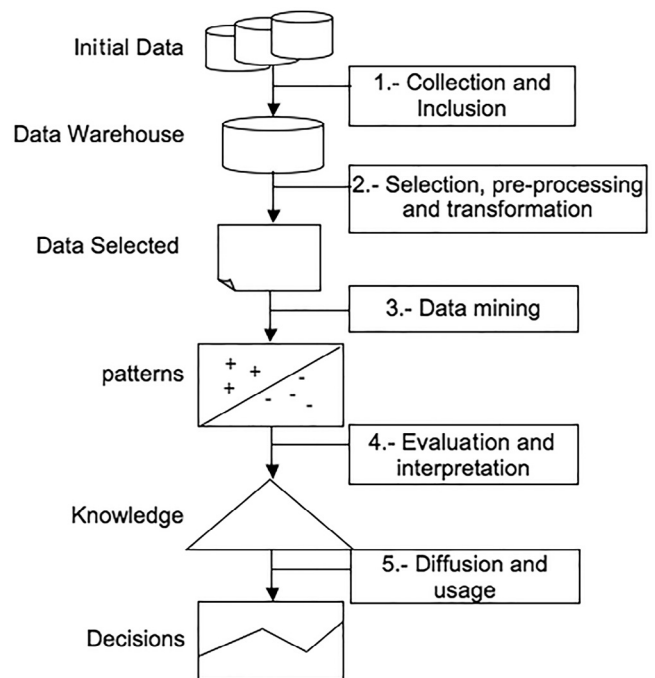


Fig. 1 – Flow diagram of the KDD process.

In this phase, we obtained 1468 records of completed suicides; this was the total of suicides in Tabasco, Mexico in the period of study.

Climatological data of the state of Tabasco were provided by the National Water Commission (CONAGUA, initials in Spanish). The information included every active weather station from 2005 to 2012. These weather stations are represented in the Google Maps® application. It was necessary to collect longitude and latitude data of every active weather station. Data were supplied in a txt. file. Calendar information including Mexican holidays was found free on the web using <http://www.cuandoenelmundo.com/>.

The second phase included **data selection, pre-processing and transformation**. Records with no date and/or place of suicide were eliminated, as well as those that were not from the state of Tabasco. To safeguard the subject privacy, personal information was deleted (including full name). With regard to the addresses, we only considered the neighborhood and municipality combining both in a single column and linked it with the place-code given by the National Institute of Statistics, Geography and Information Technology (INEGI, initials in Spanish), free from http://www.inegi.org.mx/geo/contenidos/geoestadistica/consulta_localidades.aspx.

The information was arranged in a uniform format according to the type of data: for the numeric data the empty spaces were assigned a zero value; for the string data the empty spaces were filled with the word “unknown”. Given that the information was retrieved by several users, we standardized suicide type and method as follows: hanging, knives or cutting blades, firearms, poisoning, jumping from height, submersion, asphyxia by gases and burns. The principal method of suicide was hanging with 1105 attributes, followed by poisoning with 195 attributes and firearms with $n = 42$. For the attribute of gender the nomenclature for male was M, and for female was

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