70 - ARTIFICIAL NEURAL NETWORKS UTILIZATION FOR THE STUDY OF ACUTE MYOCARDIAL INFARCTION PROPENSITY

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INTRODUCTION

With advances in technology, there is remarkable transformation of society, with little or no opportunity for involvement in leisure activities, physical exercise and balanced diet (RAMOA et.al., 2014). This lifestyle has contributed to the development of risk factors that may lead to the manifestation of heart disease (MANFROI et.al., 2002).

Diseases of the cardiovascular system are among the leading causes of death worldwide (MANFROI et.al., 2002). Acute myocardial infarction (AMI), the most common disease of this system have occurred in the elderly and in young people, even in the first three decades of life. From this, many studies seek to better know and understand these risk factors and their association to such a manifestation (PAGGANI, 2003).

Risk factors include any measurable trait or characteristic that can predict the likelihood of an individual to manifest or not a particular illness (MORIGUCHI, 2002). In heart disease, the risk factors that more evidence and identify men and women with higher or lower risk for development are, total cholesterol, triglycerides, tobacco, diabetes mellitus, stress, sedentary lifestyle, obesity, age, sex, hypertension, body weight, height, heredity and alcohol consumption (MORIGUCHI, 2002; RODRIGUES, 2006).

However, it is difficult to quantitatively determine the importance of a single risk factor for possible heart problems, as many of these factors are inter relationated (CANESTRARO et.al., 2006; HIROSE et.al. 2011).

For research of this scope, artificial intelligence has been outstanding, developing the creation of methods for solving complex problems could not be solved by traditional programming methods or simply the corresponding clinical history, due to the complexity of the variables involved in these cases (LETTNIN et.al., 2002; SANTOS et.al., 2003).

Biological beings have been much inspiration for the creation of more efficient and intelligent computer models (DORILEO et.al, 2006; MARCOLINO et.al. 2007). Based on neuronal structures of the brain have emerged, the Artificial Neural Networks (ANN) which are computational methods that present a model inspired by the neural structure of intelligent organisms and acquire knowledge by way of example, these determined by a set of known parameters, adopted the network, so that, in a finite number of iterations of the algorithm, there is convergence to the generalization of a particular problem (KARRER et.al., 2005; HAYKIN, 1999).

This study aims to implement a tool for identifying likely to AMI using ANN as a means of prevention in individuals aged above 25 years.

METHODOLOGY

a) Evaluation Instrument Preparation:

They have been researched and used parameters already grounded in the scientific literature on the risk factors for AMI demonstrate and elaborate an instrument composed of objective questions that lead the subject to a single answer.

For physical exercise was considered a suitable minimum frequency of three times a week and lasting at least 30 minutes of physical activity for active individuals and sedentary lifestyle for those who perform unless this frequency and described time (HOWLEY & FRANKS, 2000; III General Order AMI, 2004).

Pressure values in 120x80 mmHg was considered optimal blood pressure (IV BRAZILIAN DIRECTIVE HYPERTENSION, 2004) and pressure value greater than 140x90 mmHg was considered hypertension. Thus, the analysis of the respondent's reply was made, or may not be hypertensive.

To the risk factor Obesity was calculated Body Mass Index (BMI) through the weight of values, and Height of volunteers. BMI is recognized as an international standard for evaluating the degree of obesity; is calculated by dividing weight (in kg) by height squared (in meters) (http://www.who.int/hpr/gs.facts.shtml).

The reference values used for the total cholesterol, LDL-Cholesterol and HDL-Cholesterol (men and women aged> 20 years) and values for triglycerides were determined to be up to 200 mg/dl, normal individual and, above 200 mg/dl, individual with dyslipidemia (III GUIDELINES DYSLIPIDEMIA BRAZILIAN, 2001).

For smoking and alcohol consumption parameters used were from the individual's response to be or not users of these substances. The response options are not to use, using possibly be and have been a smoker or drinker (III TREATMENT GUIDELINES AMI, 2004).

For hereditary risk factor were considered the episodes reported by AMI occurrence of the interviewed in the next generations of the same. Response options for this question were yes or no for the episode of AMI in the family (III GUIDELINES AMI, 2004).

Diabetes mellitus is defined as finding glucose> 126 mg% fasting in two separate steps, or> 200 mg% 2 hours after ingestion of 75g of glucose (GUIDELINES OF BRAZILIAN SOCIETY OF DIABETES, 2007). To this factor analysis was performed from the options of being or not being diabetic.

Age, resting heart rate and sex of the individual were also considered. Finally, the AMI likely option was placed to identify individuals who have already had or not such an episode.

For stress risk factor it used the Beck Scale which consists of 21 items, with scores ranging from 0 to 3 (absent, mild, moderate and severe) (MENDES et.al., 2003). Values less than or equal to 8 points determine that the individual does not have characteristic symptoms and for values above 8, identify stress and anxiety (MARCOLINO et.al., 2007).

Below, Table 1 represents the risk factors, its possible response options and certain value to quantize each of the options of the evaluation instrument.

AMI Risk Factors	Objective responses
Age	(numeric value)
Sex	0 - Female 1 - Male
weight (body mass)	(numeric value)
stature	(numeric value)
total cholesterol	0 - below 200 mg / dL 1 - above 200 mg / dL
smoking	0 - smoke 1 - possibly 2 - smokers 3 - former smoker
diabetes mellitus	0 – no 1 – yes
Sedentary lifestyle	0 – no 1 – yes
hypertension	0 – no 1 – yes
triglycerides	0 - below 200 mg / dL 1 - above 200 mg / dL
Resting Heart Rate	(valor numérico)
alcoholism	0 - do not use 1- possibly 2 - alcoholic 3 - x-alcoholic
Stress / anxiety using the Beck Scale	0 - for data = 8 1 - for data = 8
heredity	0 – no 1 – yes
Propensity to AMI	0 – no 1 – yes

b) Data Collection:

In this Cross study, interviews were divided into two groups of volunteers, of both sexes, subjects admitted to the Surgical Unit B, Hospital Santa Clara and individuals working in the Administrative Center of Santa Casa in Porto Alegre. Thus, the samples were attended by two distinct populations, formed by individuals with no episode of AMI and individuals with this disorder episode. The selection of the sample was non-probabilistic intentionally, so that only persons aged less than 25 years old were interviewed. All subjects were invited to participate in the study by signing the consent form approved by the Ethics Committee at Instituto Porto Alegrense - IPA (Protocol 291/2007) and the Irmandade Santa Casa of Misericordia Hospital (Protocol 1780/08). The amount of sample was determined by statistical criteria, PEPI program (Programs for Epidemiologists) version 4.0. To obtain a 95% confidence level, a ratio of propensity to AMI of 50% in a population estimated in 1220 individuals (220 employees and 1,000 patients in six months) with a margin of error of 5%, it was estimated a minimum total of 296 individuals to be interviewed. To make the learning of MultiLayer Perceptron network (MLP) samples were divided into two groups: 50% of individuals with no reported case of AMI (n = 148) and 50% of patients who have had an episode of this condition (n=148). An application software has been specially developed in Visual C++ language to interface and store in a database the collected parameters.

c) Network Topology:

For the network configuration process has been used computational tool MatLab version 6.5 with Artificial Neural Networks packages of MLP. It was modeled a data file containing 14 parameters related to risk factors for AMI, and also one parameter that identifies the event or not of heart attack among the 296 subjects studied, aligning 15 answers. The algorithm used for learning network was the Backpropagation with a sigmodal activation function, increasing monotonic and has asymptotic properties and softness. The supervised learning occurs by error correction, and the response of each unit (node) propagated as a new entry for the units in the next layer until the output layer, which is obtained response network (KARRER et.al., 2005). The error was calculated for each node of the output layer to the input layer from changes in synaptic weights (HAYKIN, 1999). The output was compared to the desired value and computed on a global network error, calculated as the difference between the actual output generated and the desired output. The level of convergence during the network training process was adopted from a default value of the computational tool Matlab (typically 0.1) 100 iteration times for their learning.

d) Training and Network Validation:

As adopted in academia and for reliability in grades obtained, the learning network was divided into two phases: training and validation. For this, during network training phase, 80% of the data were used (118 employees and 118 patients) collected in interviews, creating then an array of weights for the neurons. For the validation was performed from the network already trained, where 20% of the data (30 employees and 30 patients) remaining for the network to predict the status of each individual were used. 20% of these data, knowing the correct output for each individual and the predicted response by the network, it was possible to measure its performance.

Finally, it was considered a hit learning performance above 98%.

RESULTS AND DISCUSSION

For a better analysis of the results it was considered the sensitivity presented by the ANN. Sensitivity tells how the MLP model correctly classifies individuals as their propensity or not AMI. For this, some tests were performed changing the network configuration, specifically, as its intermediate layers in order to find the topology that showed more sensitive to the classification

The weights of the connections between the neurons of ANN were randomly initialized by Matlab software. Thus, to measure the performance was analyzed the average of the results obtained in 10 training and validations on each network topology. Figure 1 shows the graph referring to the curve for the 10 training courses conducted with 236 subjects is shown. In it noted that this amount of data was sufficient for the network to converge, requiring 100 times of iteration with a 1.702x10-12 performance. It is noteworthy that, although this value is significantly small, the expected result (Goal) to convergence has been standardized to zero (0).

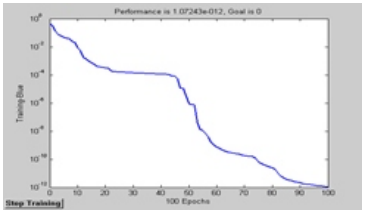

Figure 1. curve for one of the 10 training sessions with 236 individuals (the authors).

The best results were achieved with rating a network topology with two (2) intermediate layers: one with 9 neurons and one with 3 neurons. Figure 2 shows the results for the prediction performed during network validation step for the 60 individuals interviewed. The green dots represent the correct values (collected) as to the propensity, while the red curve represents the determined values (planned) over the network. It is noteworthy that these results refer to 20% of the interviews, which the network "unaware" the answer regarding the propensity to AMI.

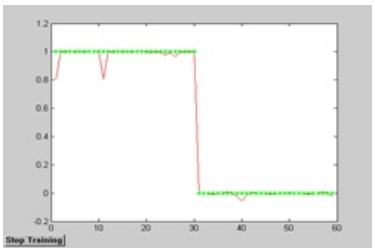

Figure 2. Prediction of the network validation step 60 for individuals (the authors).

A more detailed analysis on the classification of sensitivity can be performed considering the errors in prediction. To this end, during this validation step we calculated the net output relative error considering the response already achieved by each individual. Figure 3 shows the error in the prediction curve (minus the known value obtained) for each validation point. By analyzing this graph, it is observed that the error was greater than 0.2, which can be considered negligible considering the parameters used.

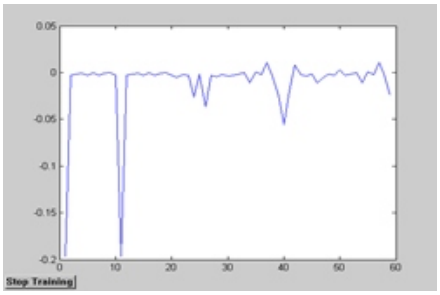

Figure 3. Error curve in predicting for each validation point (the authors).

According to the results obtained in this validation stage, it was found further that the mean error for that model continued to 0.01443 values. Ie around 1.44% of sensitivity in the diagnosis can be distorted in the standings. It is noteworthy that, despite that error regarding the sensitivity, the output rating has been easily identified on the chart, and the final hit rate on the classification presented values always above 98%, as stated above.

However, the results of this study show that an ANN trained and validated MLP can be used to aid in the recognition of the interrelationship of risk factors and can be used in the prevention, support the diagnosis and identification of AMI to a new set of individuals.

CONCLUSION

The Artificial Neural Networks proved to be a great value tool for the recognition and support in studies related to AMI. In the medical field, where it intends to use neural networks as a tool for analysis, this methodology is attractive and was efficient. The neural model proposed here can be conducted in an innovative way as a clinical tool.

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ARTIFICIAL NEURAL NETWORKS UTILIZATION FOR THE STUDY OF ACUTE MYOCARDIAL INFARCTION PROPENSITY.

ABSTRACT

Introduction: The advances in technology have allowed the modern society a relative comfort life. This lifestyle has contributed to the appearence of many factors that can lead to body dysfunctions, bringing serious health complications, especially including Acute Myocardial Infarction (AMI). Studies on Artificial Intelligence has been emphasized (stressed) in the development of methods and solutions to complex problems that could not be solved by traditional programming or by simple clinical history taking. Methodology: An assessment tool on the risk factors for AMI was developed and 296 questionnaires were applied to individuals of both sexes, pertaining to one of two groups: subjects hospitalized in Surgical Unit B, Hospital Santa Clara and subjects who work in the Administrative Center of the Irmandade Santa Casa of Porto Alegre. These collected data were stored in a software applicative and used later to carry out the Artificial Neural Networks (ANN) with 14 neurons in the entry and 1 neuron in the output layer. Results: The results of this study suggests that the ANN MultiLayer Perceptron trained and validated can be used to aid the recognition of the inter inter-relationship of risk factors, which may be used in prevention, diagnosis and support to the identification of AMI in a new set of individuals. Conclusions: The ANN have proved a valuable tool for the recognition and support in studies related to AMI.

KEYWORDS: Artificial Neural Networks, Acute Myocardial Infarction, Risk Factors.

RÉSEAUX DE NEURONES USAGE ARTIFICIEL PROPENSION POUR ÉTUDIER LA CRISE CARDIAQUE.

RÉSUMÉ

Introduction: Les progrès technologiques ont permis à la société moderne, une vie de confort relatif. Ce mode de vie a contribué à l'émergence d'un ensemble de facteurs qui peuvent conduire à des dysfonctionnements corporels, entraînant des complications de santé graves, au premier rang desquels l'infarctus aigu du myocarde. Studies in Intelligence Artificielle ont été mis en évidence pour la création de méthodes et résolution de problèmes complexes qui ne pourraient pas être résolus par des méthodes traditionnelles de programmation ou tout simplement par l'histoire clinique. Méthodes: Pour cela, nous avons conçu un instrument d'évaluation des facteurs de risque pour l'infarctus aigu du myocarde et appliqué 296 questionnaires chez les individus des deux sexes, divisés en deux groupes: les sujets admis à l'Surgical Unit B, Hôpital Santa Clara et sujets Ils travaillent dans la Confrérie de la Casa de Misericordia Hospital de Santa Centre administratif. Les données recueillies ont été stockées dans un logiciel d'application et après, utilisé pour mettre en œuvre l'Réseaux de neurones artificiels avec 14 neurones dans la couche d'entrée et une neurone dans la couche de sortie. Résultats: Les résultats de l'étude soulignent que le Perceptron multicouches Réseaux de neurones artificiels formé et validée peut être utilisé pour aider à la reconnaissance de l'interdépendance des facteurs de risque et peut être utilisé pour appuyer le diagnostic et Infarctus aigu du myocarde sur un nouvel ensemble d'individus. Conclusion: Infarctus aigu du myocarde révélé être un outil précieux pour la reconnaissance et le soutien dans les études liées à Infarctus aigu du myocarde.

MOTS-CLÉS: Réseaux de neurones artificiels; Infarctus aigu du myocarde; Les facteurs de risque.

USO REDES NEURONALES ARTIFICIALES PARA ESTUDIAR LA PROPENSIÓN DEL ATAQUE CARDÍACO.

RESUMEN

Introducción: Los avances en la tecnología han permitido que la sociedad moderna una vida de relativa comodidad. Este estilo de vida ha contribuido a la aparición de un conjunto de factores que pueden conducir a disfunciones corporales, causando serias complicaciones de salud, sobre todo entre ellos el ataque cardíaco. Estudios en Inteligencia Artificial se han destacado por la creación de métodos y resolución de problemas complejos que no podían ser resueltos por métodos tradicionales de programación o simplemente por la historia clínica. Métodos: Para ello, hemos diseñado un instrumento de evaluación de los factores de riesgo de ataque cardíaco y Aplicada 296 cuestionarios en los individuos de ambos sexos, divididas en dos grupos: los sujetos ingresados en la Unidad Quirúrgica B, Hospital Santa Clara y temas Trabajan en la Hermandad de la Casa del Hospital Administrativo Centro Santa de Misericordia. Los datos recogidos se almacenan en un software de aplicación y después de, que se utiliza para implementar el Rede Neuronal Artificial con 14 neuronas en la capa de entrada y 1 neurona en la capa de salida. Resultados: Los resultados del estudio señalan que el Perceptrón multicapa Rede Neuronal entrenado y validado se puede utilizar para ayudar en el reconocimiento de la interrelación de los factores de riesgo y se puede utilizar para apoyar el diagnóstico y el ataque cardíaco de identificación en un nuevo conjunto de individuos. Conclusión: Rede Neuronal Artificial demostrado ser una herramienta valiosa para el reconocimiento y el apoyo en los estudios relacionados con el ataque cardíaco

PALABRAS CLAVE: Redes Neuronales Artificiales; Ataque cardíaco; Los factores de riesgo.

UTILIZAÇÃO DE REDES NEURAIS ARTIFICIAIS PARA ESTUDO DA PROPENSÃO AO INFARTO AGUDO DO MIOCÁRDIO.

RESUMO

Introdução: Os avanços na tecnologia têm permitido à sociedade moderna uma vida de relativo conforto. Este estilo de vida tem contribuído para o aparecimento de um conjunto de fatores que podem culminar em disfunções corporais, trazendo complicações graves para a saúde, destacando-se entre elas o Infarto Agudo do Miocárdio (IAM). Estudos em Inteligência Artificial vêm se destacando para a criação de métodos e soluções de problemas complexos que não poderiam ser resolvidos pelos métodos tradicionais de programação ou simplesmente pela anamnese clínica. Métodos: Para isto, foi elaborado um instrumento de avaliação sobre os fatores de risco ao IAM e aplicados 296 questionários em indivíduos de ambos os sexos, divididos em dois grupos: sujeitos internados na Unidade Cirúrgica B do Hospital Santa Clara e sujeitos que trabalham no Centro Administrativo da Irmandade Santa Casa de Misericórdia de Porto Alegre. Os dados coletados foram armazenados em um aplicativo em Software e, após, utilizados para implementar a RNA com 14 neurônios na camada de entrada e 1 neurônio na camada de saída. Resultados: O resultado deste estudo aponta que a RNA MultiLayer Perceptron treinada e validada pode ser utilizada no auxílio ao reconhecimento da inter-relação dos fatores de risco, podendo ser utilizada no amparo ao diagnóstico e na identificação do IAM em um novo conjunto de indivíduos. Conclusão: As RNA mostraram-se uma ferramenta de grande valia para o reconhecimento e suporte em estudos relacionados ao IAM.

PALAVRAS-CHAVE: Redes Neurais Artificiais; Infarto agudo do Miocárdio; Fatores de risco.