Journal of Computational and Applied Mathematics 312 (2017) 209–215

Contents lists available at ScienceDirect

Journal of Computational and Applied Mathematics

journal homepage: www.elsevier.com/locate/cam

Perception about pediatric hypertension

M. Filomena Teodoro [a,b,*], Carla Simão [c,d]

[a] CEMAT, Instituto Superior Técnico, Av. Rovisco Pais, 1, 1048-001 Lisboa, Portugal

[b] CINAV, Escola Naval, Base Naval de Lisboa, Alfeite, 1910-001 Almada, Portugal

[c] Faculdade de Medicina, Univ. Lisboa, Av. Professor Egas Moniz, 1600-190 Lisboa, Portugal

[d] Departamento Pediatria do Hospital de Santa Maria, Centro Hospitalar Lisboa Norte, Av. Professor Egas Moniz, 1600-190 Lisboa, Portugal

ARTICLE INFO

Article history:
Received 31 August 2015
Received in revised form 22 November 2015

MSC:
60 08
62 07
62F03
62G07
62J12
62P10
92C50

Keywords:
Caregiver
Children
Generalized linear model
Hypertension
Knowledge
Logistic model

ABSTRACT

Pediatric hypertension is prevalent and it may appear silently in childhood where the diagnosis is based on regular blood pressure measurements, which vary with age, sex, and height. It can progress to adulthood and be associated with potentially severe organ damage, so it is important to be aware of its existence and apply an early intervention. To evaluate the population's knowledge of the disease, we provided a questionnaire to the caregivers of pediatric patients at the Hospital de Santa Maria and the results were statistically analyzed in order to infer possible associations between sociodemographic variables (age, sex, race, residence, graduation level, and occupation) and theoretical knowledge of the disease. There were significant statistical associations between age, graduation level, and occupation with the knowledge of the possible silent emergence of the disease in childhood, the existence of risk factors, and the age from which the blood pressure should be checked. In this preliminary study, we used an experimental questionnaire. We employed generalized linear models to obtain statistical models. In future research, we will use more elaborate techniques, such as multivariate analysis (factorial analysis, correspondence analysis), as well as other suitable methods for analyzing the data obtained.

1. Introduction

High arterial blood pressure (BP) is a condition that is traditionally considered a disease of adults, but it may emerge in pediatric subjects and silently in most cases. The diagnostic criteria for pediatric hypertension (HT) mainly reference the normal BP distribution in healthy children [1] and they are based on the concept that the pediatric BP increases with age and with body mass [2]. Thus, considering that there is a strong correlation between body mass index and BP [2], HT has become highly prevalent among children and teens [3] due to parallel growth in the epidemic of childhood obesity [4], which suggests that obesity is a major risk factor for the development of pediatric HT [3,5]. Despite the wide variety of estimated HT incidence rates, a recent study determined high–normal BP prevalence values in 16% of cases and HT in 3.2% [6], which are consistent with other reports that 25% of all pediatric patients have BP levels that meet the criteria for the diagnosis of pediatric HT [7]. However, in the same study by Hansen et al. in [7], they also showed that despite the high estimated prevalence, this disease remains under-diagnosed.

* Corresponding author at: CEMAT, Instituto Superior Técnico, Av. Rovisco Pais, 1, 1048-001 Lisboa, Portugal.
E-mail addresses: maria.alves.teodoro@marinha.pt (M.F. Teodoro), carla.mail@netcabo.pt (C. Simão).

http://dx.doi.org/10.1016/j.cam.2016.03.016
0377-0427/

The present study was designed to assess whether caregivers (parents or their legal representatives) in the Portuguese population are aware of the existence of this pathology and the importance of assessing BP in this age group, as well as determining whether the results are influenced positively or negatively by characteristic sociodemographic parameters. In addition, we aimed to determine whether the regular measurement indication for BP is usually fulfilled according to current recommendations.

The questionnaire data were analyzed in three steps. Initially, we used descriptive statistics to summarize all of the information. In the next stage, we verified the suitability of the questionnaire. Finally, we employed generalized linear models (GLM) to obtain statistical models which relate the questionnaire answers and the sociodemographic information.

The remainder of this paper is organized as follows. In the next section, we discuss the questionnaire in detail and introduce GLM as a statistical method. Section 3 deals with the data. Questionnaires were given to 128 random individuals and 107 were completed correctly. The estimated models and the estimates of interesting likelihoods for some individual characteristics are presented. In the final two sections, we discuss the results and give some conclusions.

2. Preliminaries

2.1. Questionnaire

A questionnaire is an instrument that can be very informative when designed correctly. Thus, an experimental questionnaire was provided to the caregivers of children aged between three and 18 years to identify whether the caregivers of children and young people had any knowledge of high BP in children.

The questionnaire was designed as a "minimal" scheme to be completed within a short period of time. The information requested by questionnaire is described as follows.

- Sociodemographic characteristics such as age, sex, race, residence area, level of education, and profession.
- Five dichotomic questions to easily answer Yes/No in a short period of time:
  1. Can HT arise in pediatric subjects?
  2. Is HT a silent disease in the majority of cases?
  3. Should BP measurements be collected during routine health surveillance visits (routine visits) from three years of age?
  4. Are risk factors such as obesity, lack of physical activity, or overeating associated with HT?
  5. Please respond if you have children. Is your child's BP usually measured during health surveillance visits?

2.2. GLM approach

In 1972, [8] first described the use of GLM as a powerful method in statistics by standardizing the theoretical and applied aspects of the structure of linear regression up to that time. Due to the large number of available models as well as the simple and rapid computational analysis using this method, GLM play important roles in statistical analysis. The aim of GLM is to establish a functional relationship between the variable for prediction (dependent variable) and a set of other exogenous variables (explanatory variables or covariates). This relationship can then be used to predict the dependent variable. The dependent variables and the explanatory variables can be of any type, i.e., continuous, discrete, dichotomous, quantitative, qualitative, stochastic, and non-stochastic. The response variable can also be a proportion, positive, and have a non-normal random component. In 1935, Bliss proposed the probit model for proportions, while in 1944, Berkson developed logistic regression. Log-linear models for contingency tables were introduced by Birch in 1963. In 1972, Nelder and Wedderburn proved that all of these models are particular cases of a general family: the GLM. In GLM, the random component belongs to an exponential family and a transformation of the expected value of the response variable is related to the explanatory variables. The simplest models where the explanatory variables are nonrandom and the disturbances are Gaussian white noise can be estimated by ordinary least squares, but they can be extended to more general models where the disturbances are autocorrelated, heteroscedastic, not Gaussian, etc., or when some of the explanatory variables are stochastic. Thus, linear regression models can be estimated by generalized least squares.

In the classical linear model, a vector X with p covariates $X = (X_1, X_2, \ldots, X_p)$ can explain the variability of the variable of interest Y (response variable), where $Y = Z\beta + \epsilon_i$. Z is a specification matrix with size $n \times p$ (usually $Z = X$, considering an unitary vector in first column), β is a parameter vector, and ϵ is a vector of random errors ϵ_i, which are independent and identically distributed as a reduced Gaussian.

The data are in the form $(y_i, x_i),\ i = 1, \ldots, n$ because the observations (Y, X) are made n times. The response variable Y has an expected value of $E[Y|Z] = \mu$.

In GLM, the model is an extension of the classical model, but the response variable does not need to be Gaussian and it follows an exponential family distribution[1] [9].

[1] A random variable Y belongs to an exponentially distributed family if its probability density function (or probability mass function) can be represented as

$$f(y|\theta, \phi) = e^{\frac{y\theta - b(\theta)}{a(\theta)}} + c(y, \phi), \tag{1}$$