Classification of Parent Attitudes about Childhood Vaccines using Machine Learning Techniques

L. del Río, A. Maurandi-López, J. A. Palazón , A. González-Vidal, and M.D. Pérez-Cárceles

Amsterdam, September 7th, 2016

UNIVERSIDAD DE MURCIA

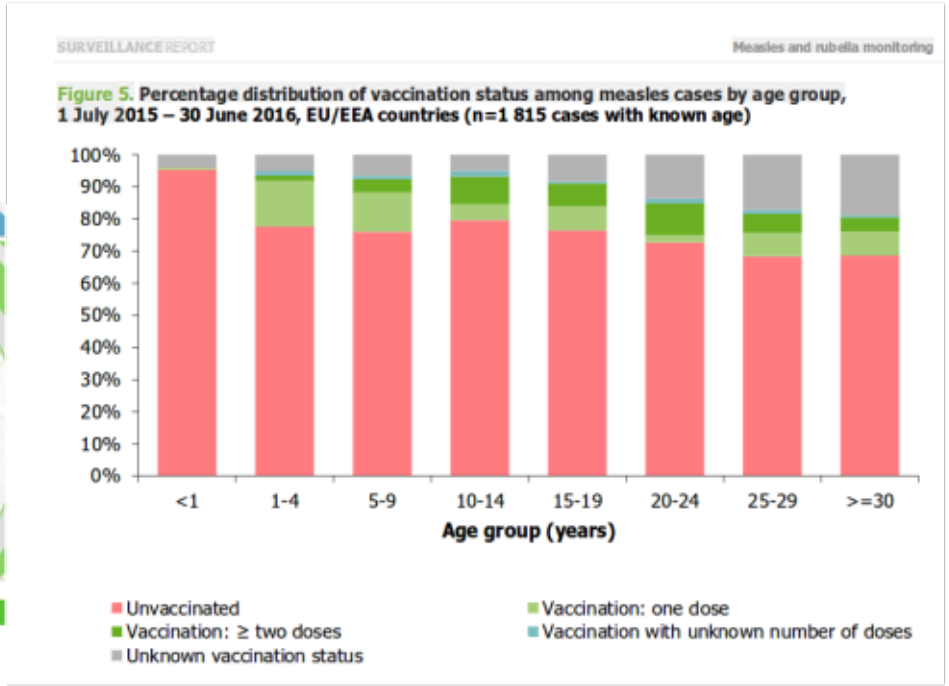
ELSEVIER

10th Vaccine Congress
4–7 September 2016 • Amsterdam, the Netherlands

Introduction

Justification of the study

ECDC practical guide (2016).
http://ecdc.europa.eu



ECDC Measles and rubella monitoring (July 2016)
http://ecdc.europa.eu

R. De Niro advertising
an antivaccine documentary (2016)


LA VANGUARDIA

Muere el niño de Olot afectado de difteria

El pequeño de seis años tenía afectadas las funciones respiratorias, cardíacas y renales por la toxina

In Spain: case of pertussis with result of death (2015)

Objetives

Idea

- Parental attitudes are influenced by multitude of factors, different by country and social context[1]
- Need for a new approach of data analysis
  - multivariate nature of data
  - multiple interactions between factors

[1] Larson et al, 2015; Opel et al, 2011

Main goals

1. Identify *factors* and *relationships between them*, influencing decision of parents to vaccinate their children
2. Set different parental profiles according to their attitude to the pediatric vaccination
3. Find indicators with the highest discriminatory power among the parental profiles

useful in designing instruments for diagnosis of hesitancy

Materials and Methods

Sampling

- 1119 surveys collected (on-line and paper format)
- After validation process, 1030 surveys selected.

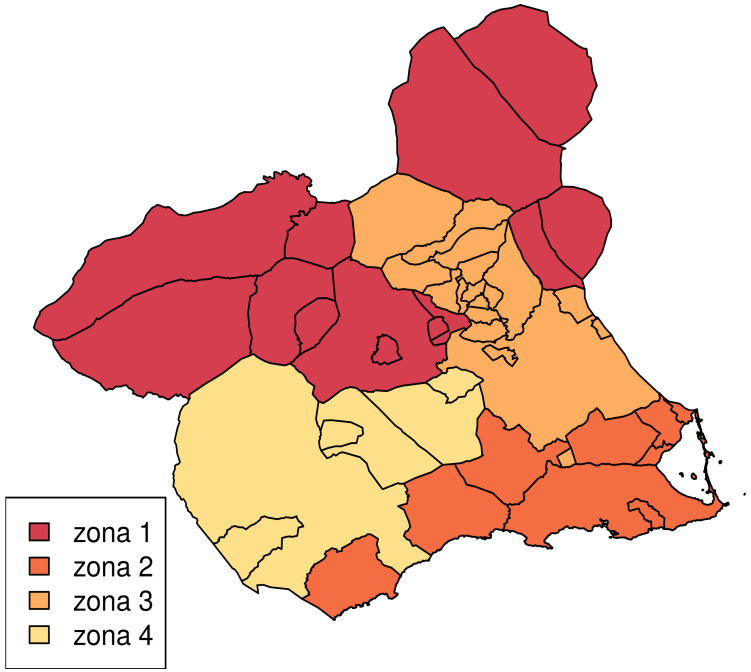


Figura 1: Map of Murcia Region, (SE of Spain), with the sampling zones.

Survey

1. *Sociodemografic* (*items* 1-8)[2]
2. *General knowledge about vacines* (*items* 9-17)
3. *Attitude towards vaccination* (*items* 18-26)
4. *Questions for healthworkers* (*items* 26-29)

- Interrater validation process
- Compliance with ethical and legal standards for human research

[2] *Bernal et al. (2001), Borrás et al. (2009), Coniglio et al. (2011)*

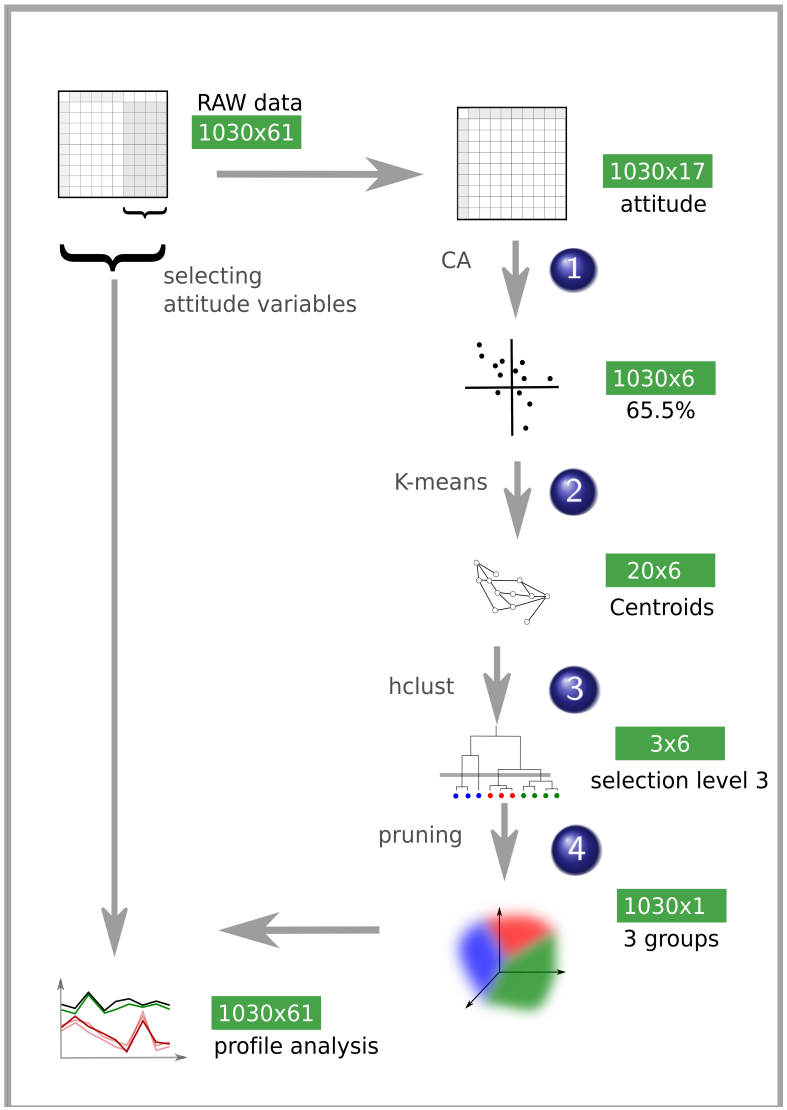
Reproducible research

- `R` version 3.2.2
- LaTeX
- `Markdown`
- `RStudio` version 0.99.878

Statistical analysis

1. Cleaning data
2. Descriptive analysis
   - Construction of agregate variables
   - Statistical contrasts
3. Data classification by Machine Learning techniques
4. Analysis of the groups obtained

Data classification by Machine Learning techniques



1. Correspondence analysis
2. Clustering by K-means
3. Hierarchical clustering
4. Dendrogram pruning

Results and Conclusions

Sociodemographic variables

Tabla 1: Who answers the survey.

Answers	**Percentages**
Mother	80.89 %(834)
Father	16.78 %(173)
Others	2.33 %(24)

Tabla 2: Age in years of parents.

Parent	**Mean**	**SD**	**Median**	**n**
Mother	42.36	5.70	43.00	1003
Father	44.45	5.97	45.00	959

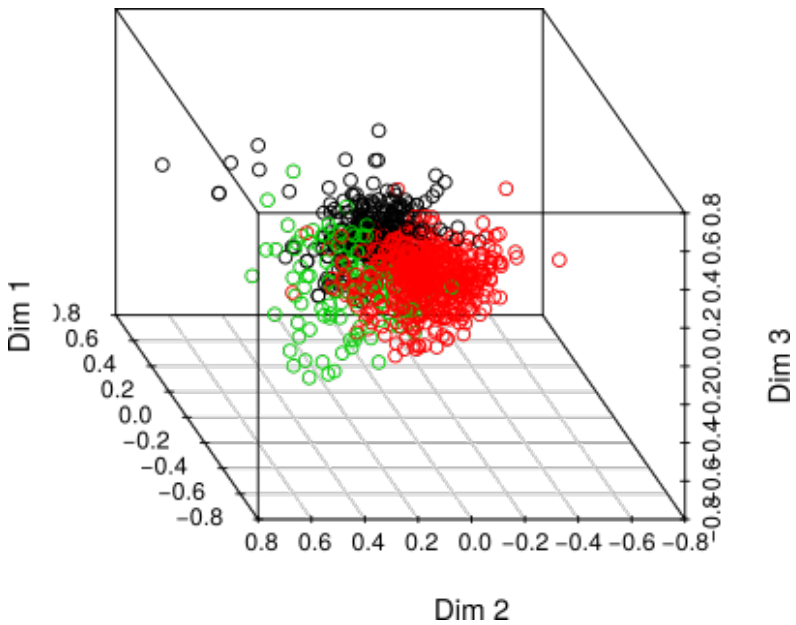
Vaccines uptake

Is your child vaccinated (or do you plan to vaccinate) with the following vaccines?

Vaccine	No	Yes	NR/DK
Hepatitis B	3.78 %(39)	85.94 %(886)	10.28 %(106)
Diphtheria, Tetanus, Pertussis	2.52 %(26)	91.37 %(942)	6.11 %(63)
Poliomyelitis	3.3 %(34)	83.12 %(857)	13.58 %(140)
Haemophilus influenzae	4.27 %(44)	81.67 %(842)	14.06 %(145)
Meningococo C	4.07 %(42)	84.77 %(874)	11.15 %(115)
MMR	2.04 %(21)	91.37 %(942)	6.6 %(68)
HPV	19.01 %(196)	**59.65 %**(615)	21.34 %(220)

Vaccine	No	Yes	No, but I would	NR/DK
Rotavirus	24.73 %(255)	30.26 %(312)	25.32 %(261)	19.69 %(203)
Pneumococcus	13.48 %(139)	56.26 %(580)	17.94 %(185)	12.32 %(127)

Cluster Analysis



Cluster	Size	Color
1	297	●
2	601	●
3	126	●

Defining clusters

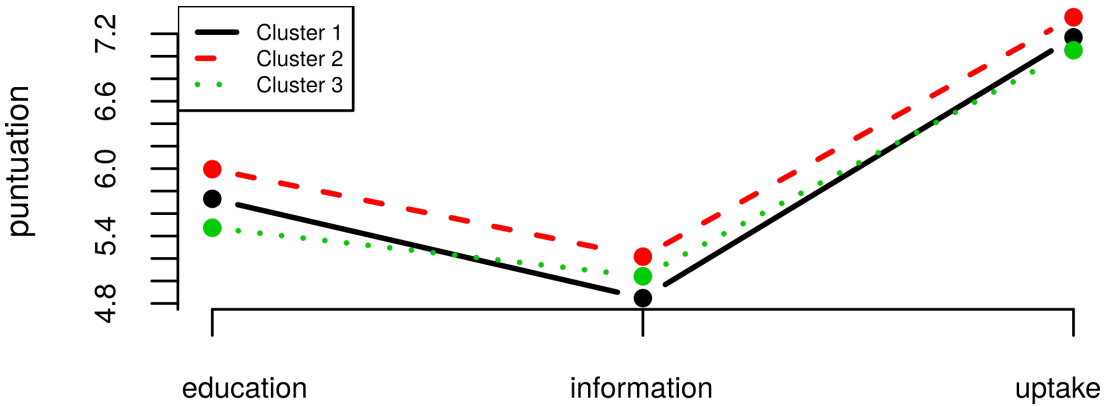
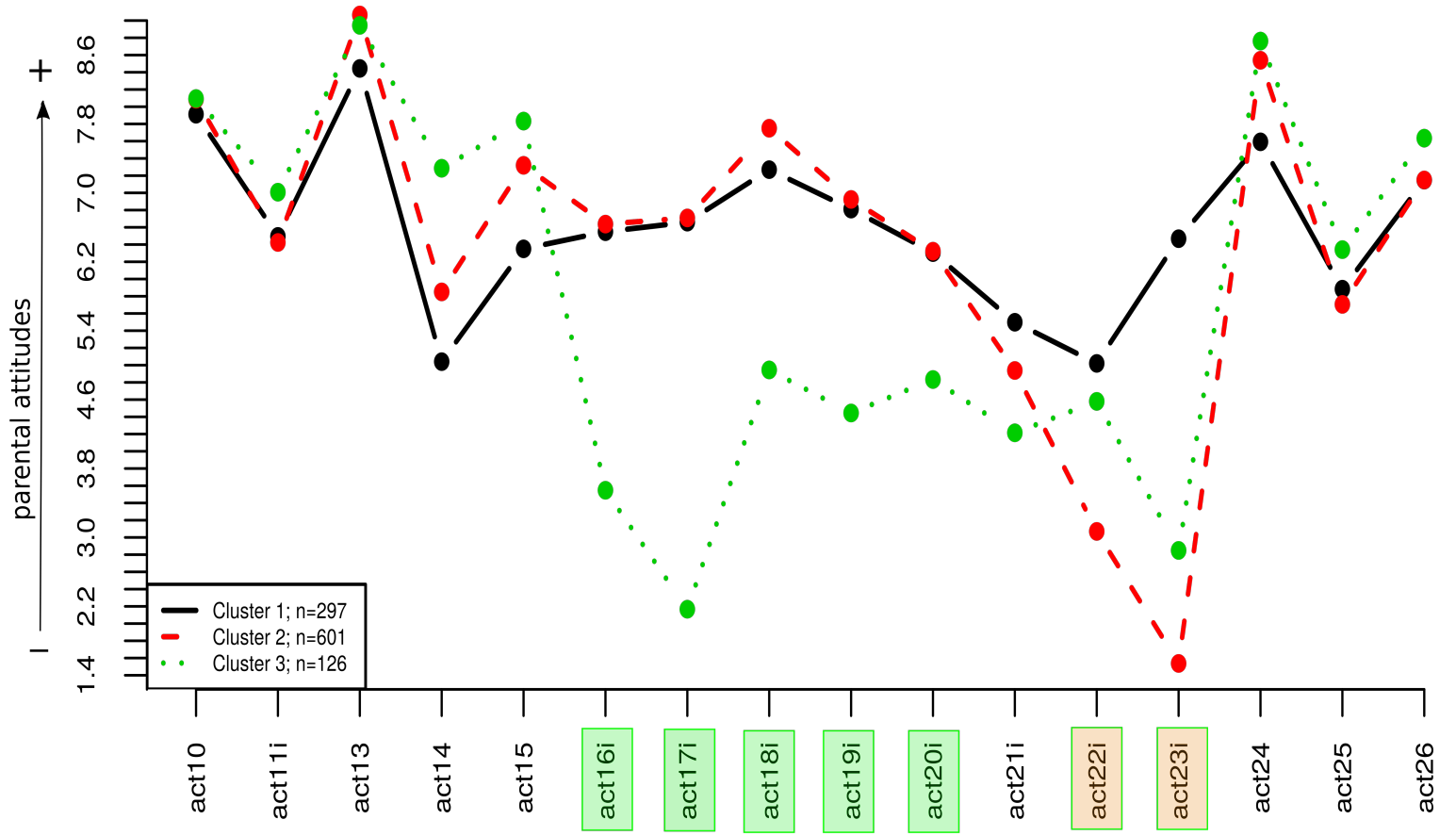


Figura 2: Mean profiles against `education level`, `information level` y `vaccine uptake`

	1 (n=279)	**2 (n=557)**	**3 (n=112)**
Education[1]	$5.73(1.57)^{ab}$	$5.99(1.6)^{a}$	$5.47(1.62)^{b}$
Information [2]	$4.85(1.79)^{a}$	$5.22(1.64)^{b}$	$5.04(1.7)^{ab}$
Uptake	7.17(2.35)	7.35(1.97)	7.05(2.14)

1: $\chi^2(2) = 12.589$,$p<0.05$, 2: $\chi^2(2) = 11.808$,$p<0.05$

Clusters *vs* Variables of attitude

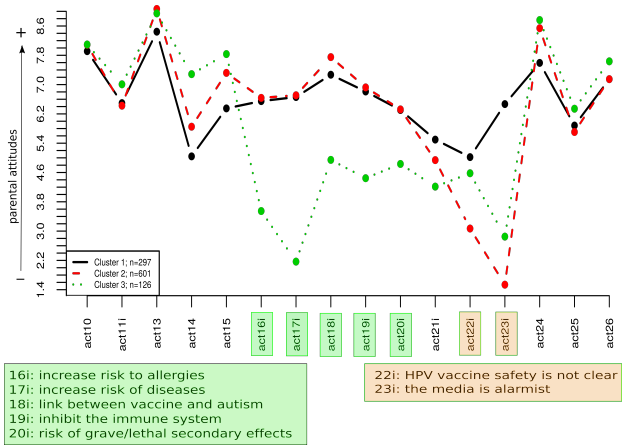


16i: increase risk to allergies
17i: increase risk of diseases
18i: link between vaccine and autism
19i: inhibit the immune system
20i: risk of grave/lethal secondary effects

22i: HPV vaccine safety is not clear
23i: the media is alarmist

Parental profiles

- The **Group 1** (n=297) Lowest level of information about vaccines, positive attitudes toward vaccination
- The **Group 2** (n=601) Highest information, positive attitudes, skeptical with the media
- The **Group 3** (n=126) Lowest level of education, distrust in the safety of vaccines



Conclusions

1. Our results confirm the presence of hesitant attitudes toward paedriatic vaccines in Murcia, that can be affecting the uptake of some vaccines such as papilomavirus.
2. This work contributes not only to the diagnosis of hesitant parental profiles, but also provides a set of multivariate statistical analyses that can be of great help in analysing data sets where multiple interactions take place.

The team

Thank you for your attention

Classification of Parent Attitudes about Childhood Vaccines using Machine Learning Techniques

L. del Río, A. Maurandi-López, J. A. Palazón , A. González-Vidal, and M.D. Pérez-Cárceles

Amsterdam, September 7th, 2016

UNIVERSIDAD DE MURCIA

ELSEVIER 10th Vaccine Congress
4–7 September 2016 • Amsterdam, the Netherlands